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Self-Defense Against Robots and Drones

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Robots can pose—or can appear to pose—a threat to life, property, and privacy. May a landowner legally shoot down a trespassing drone? Can she hold a trespassing autonomous car as security against damage done or further torts? Is the fear that a drone may be operated by a paparazzo or Peeping Tom sufficient grounds to disable or interfere with it? How hard may you shove if the office robot rolls over your foot? This Article addresses all those issues and one more: what rules and standards we could put into place to make the resolution of those questions easier and fairer to all concerned. The default common-law legal rules governing each of these perceived threats are somewhat different, although reasonableness always plays an important role in defining legal rights and options. In certain cases—drone overflights, autonomous cars—national, state, and even local regulations may trump the common law. Because it is in most cases obvious that humans can use force to protect themselves against actual physical attack, this Article concentrates on the more interesting cases of (1) robot (and especially drone) trespass and (2) responses to perceived threats other than physical attack by robots—notably the risk that the robot (or drone) may be spying—perceptions which may not always be justified, but which sometimes may nonetheless be considered reasonable in law.

We argue that the scope of permissible self-help in defending one's privacy should be quite broad. There is exigency because resort to legally administered remedies would be impracticable; and worse, the harm caused by a drone that escapes with intrusive recordings can be substantial and difficult to remedy after the fact. Further, it is common for new technology to be seen as risky and dangerous until proven otherwise. At least initially, violent self-help will seem, and often may be, reasonable even when the privacy threat is not great—or even extant. We therefore suggest measures to reduce uncertainties about robots, including forbidding weaponized robots, requiring lights and other markings that would announce a robot's capabilities, and mandating RFID chips and serial numbers that would uniquely identify the robot's owner.

We conclude by examining what our survey of a person's right to defend against robots might tell us about the current state of robot rights against people.

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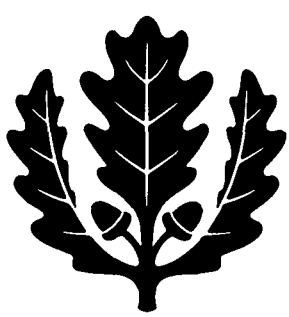

Self-Defense Against Robots and Drones

A. MICHAEL FROOMKIN* & P. ZAK COLANGELO**

I. INTRODUCTION

Deployment of robots in the air, the home, the office, and the street inevitably means that their interactions with both property and living things will become more common and more complex. This Article examines when, under U.S. law, humans may use force against robots to protect themselves, their property, and their privacy.

In the real world, where Asimov's Laws of Robotics[1] do not exist, robots can pose—or can appear to pose—a threat to life, property, and privacy. May a landowner legally shoot down a trespassing drone? Can she hold a trespassing autonomous car as security against damage done or further torts? Is the fear that a drone may be operated by a paparazzo or a Peeping Tom sufficient grounds to disable or interfere with it? How hard may you shove if the office robot rolls over your foot? This Article addresses all those issues and one more: what rules and standards we could put into place to make the resolution of those questions easier and fairer to all concerned.

The default common-law legal rules governing each of these perceived threats are somewhat different, although reasonableness always plays an important role in defining legal rights and options. In certain cases—drone overflights, autonomous cars—national, state, and even local criminal law or regulations may trump the common law. Because in most cases it is obvious that humans can use force to protect themselves against actual physical attack, this Article concentrates on the more interesting cases of (1) robot (and especially drone) trespass and (2) responses to perceived

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[1] Isaac Asimov introduced the three laws ("1—A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2—A robot must obey the orders given it by human beings except where such orders would conflict with the First Law. 3—A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.") in *Runaround*, a short story originally published in the March 1942 issue of Astounding Science Fiction and subsequently included in ISAAC ASIMOV, I ROBOT (1950).

threats other than physical attack by robots—perceptions which may not always be justified in fact, but which sometimes may nonetheless be considered reasonable in law.

Part II discusses common-law self-help doctrine, which states that conduct otherwise tortious is privileged where it cures, prevents, or mitigates a more serious tort that is, or reasonably seems to be, about to occur. In the protection-of-person context, the issue is simple because we value life more than property. One may destroy even expensive property in the reasonable belief that the destruction is necessary to save one's own life or that of another. The same general rule applies to non-life-threatening personal injury, subject to a reasonableness test as to the relative damages. On the other hand, one may not knowingly destroy expensive property to protect inexpensive property. The test is one of reasonableness and proportionality: the chattel that poses the threat may be harmed only if its destruction is reasonably believed to be necessary and the cost of that destruction is reasonable in light of the threat posed.

Privacy intrusions complicate the calculus. Intrusion on seclusion is a recognized, if somewhat exotic, tort, but its rarity in the courts means that the scope of permissible self-help against privacy-invading chattels—like the camera planted by the landlord in the tenant's bedroom—is poorly charted legal territory. When a privacy intrusion also involves a trespass, the trespass rule likely defines the scope of permissible self-help. But some robot-enhanced privacy intrusions will not involve trespass, and these are the hardest cases.

In Part II.D, we argue that the scope of permissible self-help in defending one's privacy should be quite broad even in the absence of a trespass. There is exigency because resort to legally administered remedies would be impracticable; and worse, the harm caused by a drone that escapes with intrusive recordings can be substantial and difficult to remedy after the fact. Further, it is common for new technology to be seen as risky and dangerous, and until proven otherwise, drones are no exception. At least initially, violent self-help will seem, and often may be, reasonable even when the privacy threat is not great—or even extant. One Colorado town has already proposed to offer drone-hunting licenses and a bounty for those shot down.[2]

A limiting principle, however, is that the intrusion-on-seclusion tort requires that the intrusion be highly offensive to a reasonable person. And self-help is limited to what a reasonable person would think necessary. The calculus, then, must balance the value of the interest being protected against the value of the chattel committing the intrusion and the risk of harm to third parties. Third-party rights could make it unreasonable to

[2] *See infra* note 122 and accompanying text.

shoot at or disable a drone, as the projectile or the falling drone could injure bystanders or their property.

That calculation may ask too much. Unlike defending life or property against a chattel, defending privacy against a chattel requires a cost-benefit analysis that may be impossible to make in the abstract or the particular. A person cannot reasonably be expected to know much about an intruding drone's capabilities or intentions; hence, threat assessment, much less balancing, is nearly impossible. Does that uncertainty justify the use of purely precautionary self-help? In addition, the calculation demands a value judgment about privacy and invites inquiry into what sorts of self-help should be permitted, rather than just whether the robot looks more expensive than the property to be defended.

Further complicating matters, state common law can be preempted by federal and state legislation and regulation. Part III therefore outlines relevant state and federal law and explains how it influences parts of tort law. The Federal Aviation Administration (FAA) regulates how low fixed-wing aircraft and helicopters may lawfully fly, and similar rules for drones are likely. These rules help define a trespass. But while height rules are likely, federal action in the privacy arena is not. State legislation and common-law rules will thus continue to play a fundamental role in shaping individuals' privacy rights. Several states have passed legislation regulating private and public drone use, often evincing a concern for privacy rights.

Part IV contains our recommendations to solve, or at least ameliorate, seven issues we identify during our survey of current law in Parts II and III. The seven issues can be summarized as follows:

1. Because both self-defense and defense of another person are privileged when a mere chattel reasonably appears to present a physical threat,[3] some people may be too willing to destroy robots when they feel threatened by them, and the law will tend to permit this.

2. Because it will be difficult for the average person to know the capabilities of an unfamiliar robot—something essential to making good judgments of how dangerous the robot might be—some people will overprotect their property against damage from robots. What is more, so long as this uncertainty about robot danger (whether as a class, or in specific cases of ambiguously dangerous robots) is widespread, tort law will tend to treat this overprotective behavior as "reasonable" and thus privileged.[4]

3. Relatedly, the great difficulties in assessing the privacy consequences of a robotic intrusion will also lead people to err—

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[3] *See infra* Part II.A.

[4] *See infra* Part II.C.2.

reasonably—on the side of caution and thus self-help. To the extent that tort law recognizes a right of self-help against privacy intrusions,[5] the law will tend to privilege that conduct also.[6]

4. These considerations will apply even more strongly to aerial robots (drones): people will have significant practical difficulties in identifying and assessing the position, actions, and capabilities of aerial robots. The resulting uncertainty will make some property owners too willing to take offensive action in perceived self-defense. Tort law is likely to be solicitous of the property owner's need to make quick decisions under uncertainty. That solicitude will not, however, extend to actions that present an unreasonable risk of danger to third parties, such as shooting into the air in populated areas.[7]

5. There is uncertainty as to the vertical boundary of property,[8] something people will need to know in order to determine when an aerial robot is committing a legal trespass.

6. The law is unclear as to the extent of the privilege for self-help in the face of privacy torts like intrusion on seclusion.[9]

7. Under tort law principles, a person's privilege to defend her property by harming a robot reasonably perceived as dangerous will turn on the value of the robot as much as on the value of the property being threatened. A person can be expected to know the value of the property she is protecting, but the law will recognize that it will be difficult for the canonical reasonable person to make an estimate of a robot's value in a timely manner during an emergency.[10] If courts attempt to rely on the reasonably perceived value of the robot, then that creates incentives for robot designers to make their robots look more expensive than they actually are. Encouraging gilding of robots in order to make them resistant to self-defense predicated on tort claims of property damage seems undesirable.[11]

Our proposed solutions to these problems begin with the observation that most of them spring from some kind of uncertainty about, or relating to, robots. We therefore suggest measures to reduce those uncertainties, including forbidding weaponized robots, requiring lights and other markings that would announce a robot's capabilities, creating a legal

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[5] *See infra* Part II.D.

[6] *See infra* Part II.D.1–2.

[7] *See infra* notes 80–81 and accompanying text.

[8] *See infra* Part II.C.2.a.

[9] *See infra* Part II.D.

[10] *See infra* Part II.B.

[11] Our proposals in Part IV address each of the first six issues above directly, but they do not directly confront this seventh issue. However, by reducing the number of cases in which people erroneously become convinced that they need to defend themselves against a robot, our proposals at least address this issue indirectly in that it will matter less frequently.

presumption that trespassing drones are dangerous to privacy if they do not bear visible indicia of harmlessness, requiring drone operators to file flight plans—either before or after the fact—if they overfly private property or even public property in urban areas, and mandating serial numbers that would uniquely identify the robot's owner.

Part V concludes with a brief examination of what if anything our survey of a person's right to defend against robots might tell us about the current state of robot rights against people.

II. SELF-HELP AGAINST ROBOTS

Robots pose a threat of physical harm to life and limb. Google's autonomous car may run over your foot as you cross the street; Amazon's drone may drop a package on your head. Robots also pose a physical threat to property: the car or the package may hit your car instead of you. Robots may trespass, violating your right to exclusive possession. Drones, like manned aircraft, will crash, and should Google Maps provide misinformation, their autonomous car may make a right turn onto your front lawn. Finally, robots pose a threat to privacy. They may spy by recording or intercepting information in situations where it would be difficult for a human to do so.

Driverless cars present special problems, in part because they must interact with an extensive body of primarily state law regulating on-road operations, and both state and federal law relating to safety. Cars are generally bigger than drones, can move faster than most drones, and tend to operate in closer proximity to people and their property. Thus, driverless cars, like ordinary cars,[12] raise a great risk of physical harm. Privacy concerns, on the other hand, are less severe with driverless cars than with drones: drones can reach and remain in spaces that most cars cannot. Trespass is probably an equally significant problem for both driverless cars and drones.

The law must respond as technology enables new ways for individuals and their mechanical agents to commit harms. Robots present questions that in many cases will be answered by appeal to classic legal rules. But robots sometimes may also require new rules or new understandings. One might sometimes avoid the need for self-defense by reasoning with a human who appears poised to commit a tort,[13] but that strategy may not

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[12] In 2012, there were 5,615,000 police-reported car crashes, 33,561 fatalities, and 2,362,000 people injured. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., U.S. DEP'T OF TRANSP., QUICK FACTS 2012, at 1 (2014), http://www-nrd.nhtsa.dot.gov/Pubs/812006.pdf [http://perma.cc/X6C2-CCSP].

[13] W. PAGE KEETON ET AL., PROSSER AND KEETON ON THE LAW OF TORTS 132 (5th ed. 1984) ("Ordinarily, the use of any force at all will be unreasonable unless the intruder has first been asked to desist. Blows are not justified where it is not clear that words alone would not be enough."). This is not the case in the robot context. Unless the robot is remotely operated by a human, or has sophisticated

work with a robot lacking cognition. Force will sometimes be the best option in dealing with an out-of-control robot; even when force is not obviously the best choice, people will sometimes resort to it nonetheless. The law must be prepared to address these inevitable scenarios.

The law calls this use of defensive force "self-help." "Tort self-help is any extrajudicial act that cures, prevents, or minimizes a tort."[14] Traditionally, we distinguish between two types of self-help: simple self-help, in which the self-helper's actions in any event would be legal, and the special case where the self-helper's actions are justified only because of the danger created by the tortfeasor. In the simple case, the self-helper's conduct requires no special legal privilege. Examples of this legally straightforward type of self-help include staying inside at night to prevent robbery and erecting a fence to prevent trespass. Other types of conduct that would normally be tortious or otherwise sanctionable become legal when justified by special circumstances such as the risk imposed by the tortfeasor's act or omission. Deemed "coercive self-help" by Richard Epstein,[15] these actions are permissible only because of a legal privilege.[16]

We focus on self-help against the torts that mobile robots seem most likely to commit initially, namely assault, battery, trespass, and invasions of privacy. In the long run, as robots become more sophisticated and autonomous, we may see robots committing conversion, libel,[17] malpractice,[18] or even fraud; but we leave those for another day. In order to determine the extent to which people have a common-law right to defend themselves against robots, we must begin by looking at a person's right of self-defense against torts by other people, and then at a person's unilateral right to harm another person's chattels when those chattels threaten people or property. There is no category of "robot torts" because machines are not considered to be the legal authors of their actions, just as computers are not

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artificial intelligence, negotiation will not work, so the privilege of self-help should be correspondingly broader than elsewhere.

[14] Douglas Ivor Brandon et al., *Self-Help: Extrajudicial Rights, Privileges and Remedies in Contemporary American Society*, 37 VAND. L. REV. 845, 852 (1984).

[15] Richard A. Epstein, *The Theory and Practice of Self-Help*, 1 J.L. ECON. & POL'Y 1, 3 (2005).

[16] A legal privilege is "conduct which, under ordinary circumstances, would subject the actor to liability, [but] under particular circumstances does not subject him to such liability." RESTATEMENT (SECOND) OF TORTS § 10 (1965).

[17] *See, e.g.*, Andrew Beaujon, *L.A. Times Reporter Talks About His Story-Writing 'Quakebot,'* POYNTER (Mar. 17, 2014), http://www.poynter.org/news/mediawire/243744/l-a-times-reporter-talks-about-his-story-writing-quakebot/ [http://perma.cc/GZ7C-Z4BF] (discussing an algorithm's being used to create news stories).

[18] *See, e.g.*, John Timmer, *IBM to Set Watson Loose on Cancer Genome Data,* ARS TECHNICA (Mar. 19, 2014), http://arstechnica.com/science/2014/03/ibm-to-set-watson-loose-on-cancer-genome-data/ [http://perma.cc/WL4Z-F47D] (discussing a computer's being used to recommend medical treatments).

held liable for their own acts or omissions.[19] Nevertheless, throughout this Article we adopt that shorthand on the understanding that the law will look behind the robot to find a person to hold liable for the robot's actions.[20]

Usually a person who has been wronged is expected to go to the law for redress. Indeed, it is common to claim that one of the hallmarks of modern civilization is that personal revenge and vendettas have been displaced by due process and state-controlled remedies.[21] In contrast, self-help is personal and extrajudicial. Nevertheless, two factors[22] justify carving out a self-help privilege. First, the law recognizes that the judicial remedies available may sometimes be inadequate, or self-help remedies superior.[23] Second, the law recognizes that in certain circumstances the use of self-help will only minimally impair society's interest in law and order.[24] The law is willing to permit extrajudicial remedies of an actor's own making where a judicial remedy is inconvenient or unavailable, and where self-help does not strongly threaten a breach of the peace.

Common-law self-help doctrine generally boils down to a reasonableness standard. In general, threats to persons may be met with

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[19] For an early and accurate prediction that "for the foreseeable future" computers would not be held liable for their acts and omissions, see John F. Banzhaf III, *When a Computer Needs a Lawyer*, 71 DICK. L. REV. 240, 240 (1967). For a more modern account, see Neil M. Richards & William D. Smart, *How Should the Law Think About Robots?*, *in* ROBOT LAW (M. Ryan Calo, A. Michael Froomkin & Ian Kerr eds., forthcoming 2016). For a general discussion of how tort law might one day account for autonomous robots, see Curtis E.A. Karnow, *The Application of Traditional Tort Theory to Embodied Machine Intelligence*, *in* ROBOT LAW, *supra*.

[20] There will undoubtedly be interesting issues as to which of the various parties involved in the design, construction, programming, and operation of a robot should be held responsible for harm it causes. Those questions, however, are beyond the scope of this Article.

[21] *See* Brandon et al., *supra* note 14, at 853 ("The earliest tort remedies were exclusively self-help. Early medieval plaintiffs, without courts on which to depend or with only a few courts of limited jurisdiction to which they could turn, often had to seek redress directly from the tortfeasor or his family, usually by force of arms. This ad hoc system often led to breaches of the peace and, not uncommonly, bloodshed. Exclusive reliance on self-help also gave the strongest members of society a disproportionate ability to recover and led to an inequitable distribution of remedial fruits. These concerns and the desire to centralize economic and judicial power caused medieval rulers to establish a system of courts that generally discouraged self-help, especially in the tort field. One commentator has described the 'first business of the law, and more especially of the law of crime and tort' of fifteenth century courts as the suppression of self-help." (footnotes omitted)).

[22] Other minor factors also come into play. For example, traditional ideas of the reasonableness of instinctive human reactions also contribute to the permissive nature of the self-help privilege. *See* Epstein, *supra* note 15, at 29 ("To ask an innocent party . . . to refrain from the use of force when threatened with serious bodily harm or the substantial loss of property is to demand too much, and to increase the chances of such aggression.").

[23] Brandon et al., *supra* note 14, at 853. Richard Epstein notes as an example that no one is forced to pay for goods that have not been delivered. Epstein, *supra* note 15, at 26 ("It would be grotesque to foreclose that option and to force the innocent party to sue in contract for expectation damages. The innocent party gets the options.").

[24] *See* Brandon et al., *supra* note 14, at 853.

proportionate counter-violence.[25] But threats to property, especially meager threats like technical trespass, cannot in the main justify harms to persons.[26] A property owner may defend his property only with such steps as society views as reasonably necessary.[27] In the classic common-law cases, this meant that potentially lethal self-help was rarely allowed just to protect against threats to property.[28] That standard has been modified by statute.[29] Thus, the key issue in mapping the scope of permissible self-help against robots will be defining the harm posed by a tortfeasing robot: the threat of limited harms justifies only limited self-help remedies, while great harms may justify unique and severe self-help remedies.[30]

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[25] *See, e.g.*, RESTATEMENT (SECOND) OF TORTS § 63(1) (1965) ("An actor is privileged to use reasonable force, not intended or likely to cause death or serious bodily harm, to defend himself against unprivileged harmful or offensive contact or other bodily harm which he reasonably believes that another is about to inflict intentionally upon him.").

[26] *See, e.g.*, Anderson v. Smith, 7 Ill. App. 354, 358 (1880) (noting that the law places "such a transcendent value upon human life that it conclusively presumes that it is not reasonable to take the life of a human being when the threatened injury, if consummated, would be but a mere trespass or misdemeanor"). *See generally* KEETON ET AL., *supra* note 13, at 133–34 ("Even the tradition that a man's house is his castle, and that one may kill in defense of his dwelling, has given way in most jurisdictions to the view that such force is not justified unless the intrusion threatens the personal safety of the occupants." (footnotes omitted)); Richard A. Posner, *Killing or Wounding to Protect a Property Interest*, 14 J.L. & ECON. 201 (1971).

[27] *See* RESTATEMENT (SECOND) OF TORTS § 260(1) (1965) ("[O]ne is privileged to commit an act which would otherwise be a trespass to a chattel or a conversion if the act is, or is reasonably believed to be, necessary to protect the actor's land or chattels or his possession of them, and the harm inflicted is not unreasonable as compared with the harm threatened."); *id.* § 263 ("One is privileged to commit an act which would otherwise be a trespass to the chattel of another or a conversion of it, if it is or is reasonably believed to be reasonable and necessary to protect the person or property of the actor . . . .").

[28] *See, e.g.*, Bird v. Holbrook, (1828) 130 Eng. Rep. 911 (C.P.) (imposing liability on an owner who, in order to protect his garden, left a spring gun to injure a trespasser); *see also* RESTATEMENT (FIRST) OF TORTS § 79 (1934) (recognizing privilege to use deadly force in defense of property only where necessary to protect the occupant from death or serious bodily harm). *But see* Scheuerman v. Scharfenberg, 50 So. 335, 342 (Ala. 1909) (recognizing privilege to use potentially deadly force in defense of business premises). The privilege to use non-deadly force, such as barbed wire, to protect property is generally more permissible. *See* RESTATEMENT (FIRST) OF TORTS § 84 (1934). One of the comments to that section states that the privilege is not destroyed by the use of a device "which is likely to do more harm than the possessor of land would be privileged to inflict if he were present at the time of the particular intrusion." *Id.* cmt. e.

[29] *See, e.g.*, CAL. PENAL CODE § 197 (West, Westlaw through Ch. 580 of 2015 Reg. Sess.) ("Homicide is also justifiable when . . . committed in defense of habitation, property, or person, against one who manifestly intends or endeavors, by violence or surprise, to commit a felony, or against one who manifestly intends and endeavors, in a violent, riotous or tumultuous manner, to enter the habitation of another for the purpose of offering violence to any person therein . . . ."); FLA. STAT. ANN. § 782.02 (West, Westlaw through 2015 1st Reg. Sess.) ("The use of deadly force is justifiable when a person is resisting any attempt to murder such person or to commit any felony upon him or her or upon or in any dwelling house in which such person shall be.").

[30] *Cf., e.g.*, Hummel v. State, 99 P.2d 913, 916 (Okla. Crim. App. 1940) (recognizing privilege to castrate "mongrel bull" where it threatened to impregnate thoroughbred cattle).

A. *Robot Threats to Humans*

We see both classic justifications for self-help in the paradigmatic example of the self-help privilege. The use of violence to protect one's bodily integrity is privileged, i.e., permitted, because judicial remedies are not available during a melee and because society's interest in maintaining order is not appreciably harmed. Judicial remedies are inadequate when someone is beating you on the head because ordinarily a victim of a physical battery does not have the luxury of time to go to court to seek an injunction against it. Moreover, while privileging the application of force in self-defense does risk breaching the peace, the damage has in some sense already been done because the initial attacker breached the peace; allowing the invocation of a self-defense privilege will not in most cases make matters notably worse.

As a general matter, humans may only use reasonable force against others to protect themselves from physical harm, including both assault and battery.[31] When humans are endangered by property, the quantum of force permitted against that property is more expansive than when a person is threatening the harm,[32] but it still is not unlimited.[33] One may destroy even expensive property in the reasonable belief that the destruction is necessary to save one's own life or that of another.[34] The same general rule applies to defense against non-life-threatening personal injury (battery) and the reasonable apprehension of physical injury (assault), subject to a reasonableness test as to the relative damages.[35]

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[31] RESTATEMENT (SECOND) OF TORTS §§ 63–66 (1965); RESTATEMENT (FIRST) OF TORTS §§ 63–66 (1934).

[32] *See, e.g.*, Commonwealth v. Baker, 74 Pa. D & C.2d 595, 600 (Com. Pl. 1975) ("The person under attack will not be held to the same standard of judgment in shooting a dog as he would be in shooting a human, even in self-defense.").

[33] Thus, an individual is not privileged to destroy a Rembrandt in order to prevent a mere bump on the toe. This follows from the general reasonableness standard: the threat (bump on the toe) must be of the sort that requires immediate action. And the action (destruction) must be reasonable in light of both the harm it will cause (value of Rembrandt) and the harm it will prevent (bump on toe). Where a reasonable person would take the bump on the toe rather than destroy the property, the law will not allow the unreasonable behavior; consequently, the person attached to the toe must pay for the Rembrandt if she harms it. *See* KEETON ET AL., *supra* note 13, at 136 ("The conduct of the defendant in preventing the harm would be unreasonable if a reasonable person would not so act because the magnitude of the harm that would likely result from the action outweighed the benefits of the action.").

[34] RESTATEMENT (FIRST) OF TORTS § 261 (1934) ("One is privileged to use or otherwise intentionally intermeddle with a chattel in the possession of another for the purpose of defending himself or a third person . . . .").

[35] RESTATEMENT (SECOND) OF TORTS § 63 (1965) ("An actor is privileged to use reasonable force, not intended or likely to cause death or serious bodily harm, to defend himself against unprivileged harmful or offensive contact or other bodily harm which he reasonably believes that another is about to inflict intentionally upon him."); *id.* § 261 ("One is privileged to commit an act which would otherwise be a trespass to or a conversion of a chattel in the possession of another, for the purpose of defending himself or a third person against the other, under the same conditions which would afford a privilege to inflict a harmful or offensive contact upon the other for the same purpose.").

At present under the law of all U.S. jurisdictions, all robots, no matter how clever or autonomous,[36] are property.[37] Thus, under these standard tort principles, in any case in which a robot reasonably appears to threaten human life or even threatens to commit serious bodily injury, not only the potential victim, but also third parties, will be justified in destroying the offending robot. At the same time, the overarching reasonableness standard means that people will not be justified in destroying a robot that appears to be threatening a person if the self-helper knew or should have known that the apparent victim was not in fact in danger, or if the self-helper knew or should have known of a feasible and less destructive means of preventing the human injury. But even here the law makes allowances for the pressure imposed by the need for split-second judgments, and thus does not require perfect decisionmaking from potential victims or rescuers in emergencies.[38]

In light of the newness of robotic technology, an alternate legal theory for drone-operator liability, and perhaps for robot-operator liability more generally, would be a strict-liability regime on the grounds that robot use in public is an ultrahazardous activity. Ultrahazardous activities—like using dynamite in construction or keeping wild animals as pets—are subject to strict liability[39] to ensure that such activities are undertaken with all appropriate precautions. The very dangerousness of an ultrahazardous activity means that self-defense against its harmful consequences will usually be privileged.[40] For example, when airplanes were new and experimental, their use was considered an ultrahazardous activity and was subject to a strict-liability regime.[41] The rationale was that airplanes were

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[36] *See* Richards & Smart, *supra* note 19.

[37] Justice Oliver Wendell Holmes suggested that "property" is anything for which there exists a market, i.e., anything *treated* as property over an extended period of time. Oliver Wendell Holmes, *The Path of the Law*, 10 HARV. L. REV. 457, 476–77 (1897).

[38] *See, e.g.*, Anderson v. Smith, 7 Ill. App. 354, 360–61 (1880) ("We use the words *apparent danger* because we do not consider that *real* danger is indispensable in defense of property, any more than it is in defense of person. In either case a party must judge of and act from the appearances."); *see also* KEETON ET AL., *supra* note 13, at 125 ("The privilege to act in self-defense arises, not only where there is real danger, but also where there is a reasonable belief that it exists.").

[39] Strict liability imposes liability even absent negligence or intent to harm. In that way it imposes an absolute duty to not cause harm.

[40] This again follows from the general reasonableness standard because the harm threatened by ultrahazardous activities is so severe.

[41] *See* RESTATEMENT (FIRST) OF TORTS § 520 cmt. g (1938) ("[A]viation has not as yet become either a common or an essential means of transportation. This, coupled with the fact that as yet aeroplanes have not been so perfected as to make them subject to a certainty of control approximating that of which automobiles are capable, and with the serious character of harm which an aeroplane out of control is likely to do to persons, structures or chattels on the land over which it flies make it proper to regard aviation as an ultrahazardous activity. Furthermore, a perfect plane perfectly flown may crash in unfavorable weather conditions."); P.F. Doherty, *Torts in Aeronautical Navigation*, 19 TEMP. L.Q. 496, 496 (1946) (noting that at the end of 1945, eighteen states had laws "provid[ing] that the owner and/or operator of every aircraft which is operated over land or water of the state is absolutely liable for

(1) dangerous and (2) uncommon.[42] In that way, airplanes were distinct from automobiles, which while perhaps more deadly were significantly more common. Unarmed robots, including drones, are probably not as dangerous as manned aircraft were in the early twentieth century, and whether drones are as dangerous as a wild animal kept as a pet will probably depend on the characteristics of the individual robot. Thus it is not clear that the operation of the ordinary robot—or even the ordinary drone that is capable of falling out of the sky—will qualify as an ultrahazardous activity. Robots are still somewhat uncommon—although the impetus for this Article is the prediction that robots will soon become common. Therefore, although it is possible that courts might treat the operation of robots with the capability to hurt people as an ultrahazardous activity for an introductory period, we would not expect that period to last long, at least with regard to robots that do not carry anti-personnel weapons. Remotely controlled drones outfitted with guns or Tasers might well be considered ultrahazardous, especially if there is any risk that they might be hacked, hijacked, or malfunction. Semi-autonomous weaponized robots could easily qualify as ultrahazardous, and fully autonomous armed robots would be considered even more dangerous.

Autonomous cars could be considered ultrahazardous.[43] But some of the very aspects that make driverless cars, and cars in general, dangerous, may reduce a victim's ability to use self-help. Cars are big and heavy. That means it would be harder to use self-help against a driverless car than against a drone, and much more difficult to do so safely under the circumstances. If the car is moving at significant speed, any attempt to disable it risks harm to other cars, property, or bystanders, not to mention

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injury to persons or property on the land or water beneath . . . whether such owner was negligent or not"); Timothy M. Ravich, *The Integration of Unmanned Aerial Vehicles into the National Airspace*, 85 N.D. L. REV. 597, 603 (2009) ("[A]n early view of aviation—whether by balloon or by something else—[was] an ultrahazardous activity."); *see also* RESTATEMENT (SECOND) OF TORTS § 520A (1977) ("If physical harm to land or to persons or chattels on the ground is caused by the ascent, descent or flight of aircraft, or by the dropping or falling of an object from the aircraft, (a) the operator of the aircraft is subject to liability for the harm, even though he has exercised the utmost care to prevent it, and (b) the owner of the aircraft is subject to similar liability if he has authorized or permitted the operation.").

[42] *See* RESTATEMENT (SECOND) OF TORTS § 520 (1977) ("In determining whether an activity is abnormally dangerous, the following factors are to be considered: (a) existence of a high degree of risk of some harm to the person, land or chattels of others; (b) likelihood that the harm that results from it will be great; (c) inability to eliminate the risk by the exercise of reasonable care; (d) extent to which the activity is not a matter of common usage; (e) inappropriateness of the activity to the place where it is carried on; and (f) extent to which its value to the community is outweighed by its dangerous attributes."); RESTATEMENT (FIRST) OF TORTS § 520 (1938) ("An activity is ultrahazardous if it (a) necessarily involves a risk of serious harm to the person, land or chattels of others which cannot be eliminated by the exercise of the utmost care, and (b) is not a matter of common usage.").

[43] *See, e.g.*, F. Patrick Hubbard, *"Sophisticated Robots": Balancing Liability, Regulation, and Innovation*, 66 FLA. L. REV. 1803, 1834, 1862–63 (2014).

harm to any occupants of the vehicle.[44] The physical danger from effective self-help against a moving driverless car can be great, but so too can the physical harm that that car may cause. As a result, the balancing of probable harms required by tort law's reasonableness standard will in most cases have weights on both sides.

Self-help against driverless cars is also less likely than against drones because the public fears drones much more than driverless cars—almost half of those surveyed by the Pew Research Center stated that they would ride in a driverless car if given the opportunity.[45] The lack of fear of driverless cars may stem from a general familiarity with automobiles. Whatever its source, the public's lack of concern suggests that people are less likely to feel compelled to engage in self-help against a driverless car, at least until its physical threat is very obvious.

B. *Robot Threats to Property*

In contrast to when a person is threatened, in which case even expensive property can be destroyed to save life and limb, one may not in general destroy expensive property to protect inexpensive property.[46] The test is one of reasonableness layered over cost-benefit: the chattel that poses the threat may be interfered with only if the expected cost of that interference is "reasonably believed to be[] necessary to protect the actor's land or chattels or his possession of them, and the harm inflicted is not unreasonable as compared with the harm threatened."[47]

In most cases it would be unreasonable for a person to knowingly destroy expensive property to protect inexpensive property. It follows that a person's right to self-help will be greater against an inexpensive-looking robot threatening property damage than against an expensive-looking robot threatening the same damage.[48] The difficulty, however, is that this distinction depends on the property-owner having some sense of what the relative value of the robot is. The courts long ago decided that

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[44] Drones, being unmanned by definition, have no occupants.

[45] AARON SMITH, PEW RESEARCH CTR., U.S. VIEWS OF TECHNOLOGY AND THE FUTURE: SCIENCE IN THE NEXT 50 YEARS, at 4 (2014), http://www.pewinternet.org/files/2014/04/US-Views-of-Technology-and-the-Future.pdf [http://perma.cc/DX29-A4CX].

[46] *See* RESTATEMENT (SECOND) OF TORTS § 260 (1965) ("[O]ne is privileged to commit an act which would otherwise be a trespass to a chattel or a conversion if the act is, or is reasonably believed to be, necessary to protect the actor's land or chattels or his possession of them, *and the harm inflicted is not unreasonable as compared with the harm threatened.*" (emphasis added)).

[47] *Id.*; *see also, e.g.*, Nesbett v. Wilbur, 58 N.E. 586, 586 (Mass. 1900) (holding that whether a self-helper is justified in defending her property depends "upon a number of variable facts[]—the imminence and nature of the danger threatened, the kind of property in peril, from whom or what the danger proceeds, the relative importance of the harm threatened, and that which is done in defense").

[48] *Cf.* KEETON ET AL., *supra* note 13, at 136 ("The conduct of the defendant in preventing the harm would be unreasonable if a reasonable person would not so act because the magnitude of the harm that would likely result from the action outweighed the benefits of the action.").

decisionmaking under stress need not be perfect. As one court put it, if a chicken-owner was privileged to shoot a hungry trespassing dog only if the value of the property he protects is in fact greater than the value of the dog, then "a keeper of poultry might lose his entire flock of chickens while endeavoring to ascertain whether the attacking dog [is] worth more than the chickens, and thus be deprived of the right, which the law has given him from the earliest times, to defend his property against the unlawful acts of man or beast."[49]

That expensive robots enjoy more protection than inexpensive ones may create perverse incentives for drone owners and operators: apparently one can increase the protection enjoyed by one's robot by making it look more expensive than it actually is.

C. *Robot Trespass*

We turn now to the more complicated cases of robot (and especially drone) trespass.

1. *Trespass in General*

A trespass is an intentional entry onto an owner's land or property without her permission.[50] While trespass is technically an intentional tort, because it requires the element of intent to do the act that constituted the trespass, it operates, for all practical purposes, as a strict-liability tort. This means that defendants are liable even in the absence of any negligence on their part.[51] Thus, trespass is actionable even when unknowing. To commit a trespass, one need only intend to enter the land. The trespasser, however, may be liable even absent knowledge that the property is owned by another. Furthermore, unlike most other torts where plaintiffs must have and prove actual damages in order to have a viable claim, the trespass plaintiff does not need to prove actual damages to the property. As a formal matter, although not so much in practice, the simple violation of the technical legal right to exclusive possession is harm enough in and of itself to establish liability.[52]

Unlike in cases of actual physical harm—where damage includes a

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[49] Johnston v. Wilson, 123 S.E. 222, 224 (Ga. Ct. App. 1924).

[50] RESTATEMENT (THIRD) OF TORTS: PHYS. & EMOT. HARM § 50 (2012); RESTATEMENT (SECOND) OF TORTS § 158 (1965).

[51] RESTATEMENT (THIRD) OF TORTS: PHYS. & EMOT. HARM § 50 (2012); RESTATEMENT (SECOND) OF TORTS § 158 (1965).

[52] Trespass protects the right of exclusive possession, not merely the tangible property itself. RESTATEMENT (THIRD) OF TORTS: PHYS. & EMOT. HARM § 50 (2012) ("A trespasser is a person who enters or remains on land in the possession of another without the possessor's consent or other legal privilege."); RESTATEMENT (SECOND) OF TORTS § 158 (1965) ("One [may be] subject to liability to another for trespass, irrespective of whether he thereby causes harm to any legally protected interest of the other . . . .").

physical element that is calculable, monetizable, and thus susceptible to cost-benefit analysis—the less-tangible harm to technical legal rights in cases of technical trespass does not lend itself to straightforward cost-benefit balancing. The simplest case is when the trespass has caused only nominal damages—for instance, grass that has been trodden down. If the damage is small, it follows that the self-help reprisal must be small too, or else it exceeds the privilege.[53]

Tort law recognizes as actionable trespasses by chattels when an individual causes a chattel to enter or remain on land in the possession of another without permission.[54] So when unwanted inanimate chattels such as cars[55] or construction equipment[56] come to rest on a landowner's property, the general rule is that the landowner is entitled to remove the trespassing chattels, but may take only such steps as are reasonably necessary to effect the removal.[57] The privilege to interfere with another's chattel is narrow here because it is triggered by a relatively insignificant harm. Furthermore, if the chattel's intrusion is by invitation or contract—for example, a delivery drone entering the customer's property—the permission to enter makes the chattel effectively an invitee, and not a trespasser.[58]

Special rules in animal cases add an additional wrinkle: if the landowner is willing to give the animals proper care, she does not have to remove them. Instead she may seize them and bill their owner for the nominal damages from the trespass and the costs of caring for the animals (in part because the seizure prevents additional damage to the property or vegetation).[59] Often granted today by "estray"[60] statutes,[61] the right to

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[53] *Cf.* RESTATEMENT (SECOND) OF TORTS § 260 (1965) ("[T]he harm inflicted [must not be] unreasonable as compared with the harm threatened.").

[54] RESTATEMENT (SECOND) OF TORTS § 158 (1965).

[55] *E.g.*, Rossi v. Ventresca Bros. Constr. Co., 405 N.Y.S.2d 375, 376 (Civ. Ct. 1978); Reed v. Esplanade Gardens, Inc., 398 N.Y.S.2d 929, 930 (Civ. Ct. 1977).

[56] *E.g.*, Melbourne Bros. Constr. Co. v. Pioneer Co., 384 S.E.2d 857, 860 (W. Va. 1989); Sears v. Summit, Inc., 616 P.2d 765, 766 (Wyo. 1980).

[57] RESTATEMENT (SECOND) OF TORTS § 260 (1965); *see also* Louisville & N.R. Co. v. Joullian, 76 So. 769, 770 (Miss. 1917) (holding appellant railroad company liable for damages where it destroyed two boats owned by plaintiff that had drifted from his dock during a storm and finding that such behavior was "unnecessary force" since "there was time for the railway company to employ the services of those who knew how to . . . remove the boat from the right of way, or to permit the plaintiff to do the work for himself"); Grier v. Ward, 23 Ga. 145, 148 (1857) (holding that the landowner could remove, without causing unnecessary injury, cotton placed on his property without his authorization, and stating in dicta that the cotton-owner might be able to recover for damage to the cotton).

[58] A very popular sales company like Amazon might make granting of overflight privileges a part of its standard-form contract. How long such a term could be effective as a consequence of a one-time sale is a consumer-law question beyond the scope of this Article. It seems likely, however, that such a term could be valid as part of a continuing relationship like Amazon Prime.

[59] Robert C. Ellickson, *Of Coase and Cattle: Dispute Resolution Among Neighbors in Shasta County*, 38 STAN. L. REV. 623, 665–66 (1986). Ellickson also notes, however, that "even ranchers who

capture and hold as security trespassing animals derives from the ancient legal remedy of *distraint damage feasant* or *distress damage feasant*.[62] Despite this privilege of self-help, the landowner is generally not privileged to wound or kill the trespassing animals.[63] As elsewhere in tort law, all these principles are subject to a reasonableness standard.

2. *Trespass by Robots*

The animal cases pose interesting possibilities for instances of robot trespass. Some scholars equate the moral claims of autonomous robots with those of animals, and others suggest that animal law provides a useful

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know that they are legally entitled to recover feeding costs virtually never seek monetary compensation for boarding estrays." *Id.* at 674.

[60] "The term 'estrays' at common law had the well-defined meaning of animals found wandering at large, whose ownership was unknown." Yraceburn v. Cape, 212 P. 938, 940 (Cal. Dist. Ct. App. 1923). For a modern statutory definition, see CAL. FOOD & AGRIC. CODE § 17001.5 (West, Westlaw through Ch. 132 of 2015 Reg. Sess.) ("For the purpose of this chapter, 'estray' means any impounded or seized bovine animal, horse, mule, sheep, swine, or burro whose owner is unknown or cannot be located.").

[61] *See, e.g.*, CAL. FOOD & AGRIC. CODE § 17041 (West, Westlaw through Ch. 132 of 2015 Reg. Sess.).

[62] *See* Kelly v. Easton, 207 P. 129, 130 (Idaho 1922) ("This right [to seize and detain trespassing animals] existed at common law and was not introduced by statute, but the matter is now regulated by statutory enactments in the several states, providing for the seizure and impounding of cattle taken *damage feasant*, and for their sale." (emphasis added) (citation omitted)). Distress, generally, was defined at common law as,

> [T]he taking, either with legal process, or extra-judicially subject to the performance of some necessary condition precedent, by a private individual or by an officer of the court, of a personal chattel, out of the possession of a wrongdoer or defaulter and into the custody of the law to be impounded as a pledge in order to bring pressure to bear upon the owner of the chattel to redress an injury, to perform a duty, or to satisfy a lawful demand, subject, however, to the right of the owner to have the chattel returned to him [up]on the injury being redressed, the duty performed, or the demand satisfied or [up]on security being given so to do.

F.A. ENEVER, HISTORY OF THE LAW OF DISTRESS FOR RENT AND DAMAGE FEASANT 7–8 (1931). The right of *distress damage feasant* is described by Blackstone as follows:

> A man is answerable for not only his own trespass, but that of his cattle also; for if by his negligent keeping they stray upon the land of another, (and much more if he permits, or drives them on,) and they there tread down his neighbor's herbage, and spoil his corn or his trees, this is a trespass for which the owner must answer in damages. And the law gives the party injured a double remedy in this case; by permitting him to distrain the cattle thus *damage-feasant*, or doing damage, till the owner shall make him satisfaction, or else by leaving him to the common remedy *in foro contentioso*, by action.

3 WILLIAM BLACKSTONE, COMMENTARIES 211 (1768); *see also Kelly*, 207 P. at 130 (quoting Blackstone's description with approval); Hall v. Marshall, 27 P.2d 193, 195 (Or. 1933) (quoting Blackstone's description with approval).

[63] *See* Ellickson, *supra* note 59, at 666 & n.115 (surveying cases to that effect).

model for robot law.[64] Though animals are technically chattels, the animal cases show a greater solicitude for life, non-human though it may be.[65] Were courts to decide that robots are more like animals than inanimate chattels, then the privilege to use violent self-help measures would be narrower. Until that day, however, the law will treat robots as chattels. The self-help rights of persons who are, or believe themselves to be, threatened by robots will be analyzed under the tort rules developed for torts committed by or with chattels.[66]

So long as the law treats a robot as an extension of the person that is legally responsible for its actions, we might say that the natural person or corporation responsible for the robot is directly responsible for what it does, or vicariously liable for the robot's actions. In the vicarious-liability scenario, the responsible party has a non-delegable duty to third parties to ensure that the robot is no more dangerous than it would be if a reasonable natural person were performing the same acts. Thus, for example, the operator[67] of an autonomous car would have the same duty to other drivers, pedestrians, and owners of property adjoining public streets that it would owe if the operator[68] were personally driving the car, and the operator must ensure that its autonomous car discharges that duty. A simpler formulation, which we adopt in what follows, is to say that robots are always agents of their owners acting within the scope of their agency. This approach leaves open the scope of liability of the robot and its operator for the underlying torts, a subject we address below.[69]

In principle, victims of actionable trespass have a privilege of self-help.[70] Self-help ranges from stopping the invader[71] to damaging or even

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[64] *See, e.g.*, Kate Darling, *Extending Legal Protection to Social Robots: The Effects of Anthropomorphism, Empathy, and Violent Behavior Towards Robotic Objects*, *in* ROBOT LAW, *supra* note 19; F. Patrick Hubbard, *"Do Androids Dream?": Personhood and Intelligent Artifacts*, 83 TEMP. L. REV. 405, 417 (2011); Mark Coeckelbergh, *Robot Rights? Towards a Social-Relational Justification of Moral Consideration*, 12 ETHICS & INFO. TECH. 209, 210 (2010).

[65] *See, e.g.*, Bruister v. Haney, 102 So. 2d 806, 808 (Miss. 1958) (upholding punitive-damage award against trespass victim who poisoned trespassing cattle); Strong v. Ga. Ry. & Elec. Co., 45 S.E. 366, 366–68 (Ga. 1903) (per curiam) (Cobb, J. concurring) (eulogizing deceased dog).

[66] The distraint remedy is not limited to the animal context. *See* Sears v. Summit, Inc., 616 P.2d 765, 769–70 (Wyo. 1980) (recognizing the privilege to seize construction equipment that causes damage, but finding it excessive on facts of case because equipment caused little damage).

[67] We leave for another day the question of whether the relevant "operator" is the supplier of the autonomous vehicle or the owner or the person riding inside it, formerly known as the "driver."

[68] If the legally responsible party is the supplier, likely a corporation, one would have to imagine it as if it were a natural person driving the car. For discussion of the possibilities for apportioning liability, see generally Jeffrey K. Gurney, *Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles*, 2013 U. ILL J.L. TECH. & POL'Y 247 (2013); Kevin Funkhouser, Note, *Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for a New Approach*, 2013 UTAH L. REV. 437, 440 (2013); Hubbard, *supra* note 43.

[69] The authors are grateful to Gregory Keating for pointing out the issues discussed in this paragraph.

[70] RESTATEMENT (SECOND) OF TORTS § 260 (1965).

destroying it[72] if there appears to be no other way to stop it. If the robotic invader is an airborne drone, this privilege may extend to shooting it down.[73] In 2013, the Congressional Research Service found "no cases where a landowner was permitted to use force to prevent or remove an aircraft from his property."[74] But that is what one would expect in a world where aircraft are manned—no one should be able to risk a life to protect property.[75] An unmanned drone will not enjoy this blanket legal protection.[76]

In addition to destroying the robotic invader by some means, some sort of distraint remedy,[77] i.e., capture and security, might also be available where the damages done, or reasonably believed to have been done, appear to be at least equal to the value of the trespassing robot. In the case of an airborne drone, even if the infringement of airspace does not alone justify the distraint remedy, the drone may cause property damage after being forced down; that additional harm is also charged to the tortfeasor's account because it is a reasonably foreseeable consequence of the trespass.[78] If the robot appears substantially more valuable than the nominal damage it has done, the victim of the trespass likely cannot hold the robot.[79]

Weighing against the right to shoot down a drone are the risks entailed with shooting or attempting to disable an airborne vehicle. The risks of firing a gun into the air are obvious, as are the risks of causing a drone—

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[71] *E.g.*, Rossi v. Ventresca Bros. Constr. Co., 405 N.Y.S.2d 375, 377 (City Ct. 1978) (stopping trespass by car by towing it).

[72] *E.g.*, Forster v. Juniata Bridge Co., 16 Pa. 393, 399 (1851) (holding that while landowner was not justified in appropriating bridge cast onto his land by storm, he would have been privileged to cast the bridge back into the river).

[73] Shooting down a drone with a projectile is not the only way to disable a drone or engage in self-help against one—one might also use a jammer, or an electromagnetic pulse, or simply cast a net over the drone.

[74] ALISSA M. DOLAN & RICHARD M. THOMPSON II, CONG. RESEARCH SERV., INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES 29 (2013), https://www.fas.org/sgp/crs/natsec/R42940.pdf [https://perma.cc/ZY8Z-9MV7].

[75] *See* sources cited *supra* note 26.

[76] *See* sources cited *supra* note 42 (defining "abnormally dangerous" and "ultrahazardous" activities for the purpose of tort law).

[77] *See supra* note 62 and accompanying text.

[78] The general principle is that once a party commits an initial tort (here, trespass), that party is also liable for all damages proximately caused by that harm—often including any damages suffered by (and even reasonable ones caused by) those responding to the initial trespass. *See* RESTATEMENT (SECOND) OF TORTS § 435A (1965) ("A person who commits a tort against another for the purpose of causing a particular harm to the other is liable for such harm if it results, whether or not it is expectable, except where the harm results from an outside force the risk of which is not increased by the defendant's act."). Here, the initial trespass would have increased the risk of outside harm in the form of reactive self-help.

[79] *See supra* note 46 and accompanying text.

which may be rather large—to fall from the sky.[80] Tort law's ubiquitous reasonableness standard would demand that a self-helper recognize these foreseeable risks and account for them in her cost-benefit analysis before allowing a self-defense privilege.[81] The calculus will thus be very different on an open tract of land, where there is no one else to hurt, than it would be in a crowded community.

Lobbing a projectile in the air in the hopes of shooting down a drone is not the only form of self-help potentially available to landowners. Both passive and targeted jamming may be a technologically effective—if not always legal[82]—counter-measure as well. One could imagine that mansions of the future will have electronic as well as physical walls surrounding their estates, with the electronic wall designed to jam control signals being used to guide overflying drones. While it is tempting to analogize the electronic wall to a physical wall, there are at least four important differences between the two. First, a physical wall is much easier to see, and thus avoid, than an electronic wall.[83] Second, any signal that extends to the property line has a substantial risk of bleeding outside, but jamming robots or drones outside the property will almost always be unjustified because there is no actual trespass, not to mention that jamming will violate FCC rules.[84] Many forms of surveillance from off-site, such as

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[80] *See, e.g.*, J. David Goodman, *Remote-Controlled Model Helicopter Fatally Strikes Its Operator at a Brooklyn Park*, N.Y. TIMES (Sept. 6, 2013), http://www.nytimes.com/2013/09/06/nyregion/remote-controlled-copter-fatally-strikes-pilot-at-park.html?smid=pl-share&_r=1&; Joe Sutton, *2 Injured when Drone Malfunctions, Crashes into Navy Ship*, CNN (Nov. 17, 2013, 10:37 AM), http://www.cnn.com/2013/11/17/us/drone-malfunction-duplicate-2/ [http://perma.cc/DVP4-MK8A].

[81] The implications of this rule can be seen from the following example: Homeowner shoots a drone in a populated area. Homeowner is a good shot and hit the drone and no one is injured when it crashes. Homeowner's action was unreasonable but it ended well. Nevertheless, Homeowner's action was not privileged because there never existed a privilege of self-help, as a reasonable person would not have taken the shot. Any other rule would reward and thus encourage attempts at unreasonable self-help even when it threatened public safety.

[82] Even if justified under some theory of self-help, hacking into a robot or drone, *see, e.g.*, Katia Moskvitch, *Are Drones the Next Target for Hackers?*, BBC (Feb. 6, 2014), http://www.bbc.com/future/story/20140206-can-drones-be-hacked [http://perma.cc/FMS7-8QNV] (discussing the vulnerabilities of drones and possible ways of hacking them, including "[j]amming" and "spoof[ing]" signals), is probably a criminal violation of 18 U.S.C. § 1030 (2012), which imposes punishment on "[w]hoever . . . intentionally accesses a computer without authorization or exceeds authorized access, and thereby obtains . . . information from any protected computer."

[83] Deploying the electronic wall might impose some duty of notice on the landowner.

[84] Federal law prohibits the operation, marketing, or sale of any type of jamming equipment, including devices that interfere with cellular and Personal Communication Services (PCS), Global Positioning Systems (GPS), and wireless networking services (Wi-Fi). *See* 47 C.F.R. § 2.803 (2008) (prohibiting the importation, marketing, sale, or operation of these devices within the United States); *Consumer Alert: Using or Importing Jammers Is Illegal*, FED. COMM. COMMISSION, https://www.fcc.gov/document/consumer-alert-using-or-importing-jammers-illegal [https://perma.cc/B6HA-LUCV] (last visited Oct. 11, 2015).

photography, are also protected by the First Amendment.[85] Third, any jamming signal that reaches to or near the top of the vertical curtilage is highly likely to extend above it into FAA-regulated airspace, thereby violating federal law.[86] Fourth, a signal that blocks transmissions to or from the device's controller will not deter a robot or drone that is proceeding autonomously or acting according to pre-programmed instructions.

Rather than resorting to an electronic wall, property owners might instead opt for hand-held or automated devices that aim at trespassing robots or drones. Targeted jamming could take many forms, some of which will seek only to degrade certain robot or drone functions instead of trying to disable the device, with all the attendant risks that it might damage something. One might, for example, aim a laser at a drone in hopes of blinding any camera it might carry. Pointing lasers at manned aircraft is very dangerous because it can blind the pilot and frequently leads to imprisonment.[87] Pointing a laser at a robot might damage a digital camera's sensors.[88] Even if not a criminal act of property destruction, this damage would be tortious unless justified as self-help—a determination that would turn on many factors, including the camera-carrying device's exact location and what it was, or appeared to be, doing there. Another possibility, albeit an illegal one,[89] is Global Positioning System (GPS) "spoofing," in which false GPS signals are sent in hopes of fooling the intruder as to its position and thus forcing it to erroneously "correct" its heading.[90]

No account of possible drone counter-measures would be complete

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[85] *See* Margot E. Kaminski, *Drone Federalism: Civilian Drones and the Things They Carry*, 4 CALIF. L. REV. CIRCUIT 57, 62–63 (2013) ("A First Amendment right to record is most likely to outweigh privacy concerns in a public space, where one person's privacy collides with other peoples' experience and memory.").

[86] *See* 18 U.S.C. § 32(a)(5) (2012) (imposing criminal penalties on anyone who "interferes with or disables, with intent to endanger the safety of any person or with a reckless disregard for the safety of human life, anyone engaged in the authorized operation of such aircraft or any air navigation facility aiding in the navigation of any such aircraft"); sources cited *supra* note 84 (relating to FCC rules against jamming GPS and other signals).

[87] *See Sentences for Persons Convicted of Laser Offenses*, LASERPOINTERSAFETY.COM, http://www.laserpointersafety.com/sentences/sentences.html [http://perma.cc/A25B-D6PH] (last visited June 27, 2015) (reporting cases of individuals convicted of offenses involving laser pointers).

[88] *See Laser Effects on Cameras and Camcorders*, LASERPOINTERSAFETY.COM, http://www.laser pointersafety.com/styled-6/ilda.html [http://perma.cc/2RXM-BHL3] (last visited June 27, 2015) (detailing the effects of lasers on recording devices, safety concerns, and possible damage as a result of lasers striking lenses).

[89] *See* sources cited *supra* note 84.

[90] *See* David Brancaccio, *Forget GPS Jamming, Drone 'Spoofing' Is All the Rage*, MARKETPLACE TECH (Mar. 11, 2013), http://www.marketplace.org/topics/tech/forget-gps-jamming-drone-spoofing-all-rage [http://perma.cc/8ZTE-KWF8] (describing an experiment that exposed the problem of mimicking a drone's GPS signal to disrupt its flight instructions).

without mentioning the "Rapere," a drone "optimized for one single purpose: finding nearby drones and causing them to crash."[91] As of now, perhaps fortunately, this product is still on the drawing board, and it is unclear if, should it ever become commercialized, the Rapere would be offered to the public or only to those able to demonstrate a legitimate need for its use.[92]

Determining the scope of permissible self-help will always be complicated by the difficulty victims have in trying to ascertain what the invading robot is doing. That difficulty is particularly acute when the robot is airborne, for it will be harder to examine it due to distance, speed, and (at night) lighting conditions. So long as drones are an experimental technology, this uncertainty likely will be found to justify more self-help. As drones become more common, and presuming it becomes routine to see them being operated in a safe manner, the calculus will likely shift. In the short term, however, we may see courts in rural areas finding a privilege to shoot down a trespassing drone because it will rarely, if ever, be clear that a drone's overflight is no more than a purely technical trespass: if nothing else, the drone's very existence in the airspace above persons and property poses a theoretical threat of a crash.[93] As discussed further below, both air and ground robots also might be used to spy. At least until some standards take shape, the victim of a trespass may be entitled to assume the worst, e.g., that the robot is not merely trespassing but is recording. If one is entitled to assume the worst, then in the absence of persuasive notice that the robot is harmless, the victim of robotic trespass frequently will be privileged to employ violent self-help.[94]

Before landowners start reaching for their shotguns, however, they should be aware that current trespass law creates at least three substantial obstacles for landowners seeking legal justification for self-help against overflying drones. The first, and more substantial, difficulty lies in charting the boundaries of private airspace—the space over which a landowner can claim the absolute possessory right that is a prerequisite to a trespass claim; this turns out to be a complex issue involving both state and federal law.

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[91] Evan Ackerman, *Rapere: An Intercept Drone to Seek and Destroy Other Drones*, IEEE SPECTRUM (Jan. 14, 2015), http://spectrum.ieee.org/automaton/robotics/aerial-robots/rapere-intercept-drone [http://perma.cc/4HZN-DMXP].

[92] *Id.*

[93] *See, e.g.*, Goodman, *supra* note 80 (reporting that a remote-controlled helicopter killed a man when it struck him in the head); Sutton, *supra* note 80 (reporting that two sailors were injured by a drone). A somewhat similar case of ever-present risk of greater-than-nominal harm applies in animal cases. Robert C. Ellickson notes that "[b]ecause cattle eat almost incessantly, a trespass victim's vegetation is always at risk." Ellickson, *supra* note 59, at 658. Further, trespass by a non-thoroughbred bull into the vicinity of thoroughbred female cattle, while merely a technical trespass in the absence of actual damages, poses the more serious risk of impregnation and production of offspring of an undesired pedigree. *See id.*

[94] *See supra* text accompanying notes 70–76.

Landowners will need to know how federal and state law interact to shape their air rights and how those air rights affect their privilege of self-help.

A second issue is that in practice some courts are unfriendly to claims of technical trespass and tend to require actual harm before allowing an aerial trespass claim. In these jurisdictions, it may be fair to ask if technical trespass actions exist at all, or whether instead the courts have in practice converted them into nuisance claims, which, unlike trespass claims, require actual harm.[95]

A third issue is that, even where tort law, standing alone, might find that a privilege of self-help exists, there is no privilege to commit a criminal act. Issues of criminal liability are beyond the scope of this Article. News reports of recent armed-citizen versus drone interactions suggest that law enforcement tends to arrest, or at least blame, people who discharge firearms when defending against a drone.[96] On the other hand, it is not clear that this necessarily leads to formal charges; and even where charges are brought, it is not clear that they will succeed.[97]

a. Defining Private Airspace

The starting point for determining what constitutes an aerial trespass is determining the extent of the airspace covered by a landowner's right to exclude others. The ancient rule gave a landowner rights all the way to the moon,[98] but that rule has long been abrogated to allow modern air travel.[99] Yet a landowner still has exclusive rights to some of the airspace over her

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[95] *See infra* Part II.C.2.b (discussing whether the law should require actual harm as an element).

[96] *See, e.g.*, Cyrus Farivar, *Kentucky Man Shoots Down Drone Hovering over His Backyard*, ARS TECHNICA (July 29, 2015), http://arstechnica.com/tech-policy/2015/07/kentucky-man-shoots-down-drone-hovering-over-his-backyard/ [http://perma.cc/7HYQ-VQTR]; Michael Martinez, *Handgun-Firing Drone Appears Legal in Video, but FAA, Police Probe Further*, CNN (July 21, 2015), http://www.cnn.com/2015/07/21/us/gun-drone-connecticut/ [http://perma.cc/XLG5-FU3Z]; Gregory S. McNeal, *Thankfully, Shooting Down a Drone Will Land You in Federal Prison*, FORBES (Dec. 10, 2013), http://www.forbes.com/sites/gregorymcneal/2013/12/10/thankfully-shooting-down-a-drone-will-land-you-in-federal-prison/; Bruce Schneier, *Is It OK to Shoot Down a Drone over Your Backyard?*, CNN (Sept. 9, 2015), http://www.cnn.com/2015/09/09/opinions/schneier-shoot-down-drones/ [http://perma.cc/H7T7-MB5A]; John Seibler, *Is It Legal to Shoot Down a Drone Hovering over Your Property?*, NEWSWEEK (Aug. 15, 2015), http://www.newsweek.com/it-legal-shoot-down-drone-hovering-over-your-property-362878 [http://perma.cc/RP3W-ASBM].

[97] The privilege to defend one's thoroughbred livestock supplied an affirmative defense, at least once, to the criminal charge of malicious mischief. *See* Hummel v. State, 99 P.2d 913, 917 (Okla. Crim. App. 1940) ("The right of summary abatement of nuisances without judicial process or proceeding was an established principle of the common law, and it has not been regarded as being abrogated by the provisions of constitutions for the protection of life, liberty, and property, although the exercise of the right might result in a destruction of property.").

[98] This was the doctrine of *ad coelum* under which a landowner's ownership "extended to the periphery of the universe," up to the heavens and down to the depths. United States v. Causby, 328 U.S. 256, 260–61 (1946).

[99] *See id.* at 261 (stating that "[t]he air is a public highway"); *see also* Ravich, *supra* note 41, at 604–05 (discussing the history of *ad coelum* and its abandonment during the era of mass air transit).

land. It follows that landowners should be able to claim a freedom from drone overflight in at least some portion of their airspace. The questions are how high, and who sets the boundaries.

Although in principle "invasions [of airspace] are in the same category as invasions of the surface,"[100] today's landowners do not have an absolute possessory right to all the airspace above their land, whether their claims are based on the Takings Clause,[101] or on tort and contract principles.[102] Instead, a landowner has the right to only "as much space above the ground as he can occupy or use in connection with the land."[103] That the landowner has not in fact used the airspace is not material; the land must only be reasonably subject to use.[104] Unhelpfully, the Restatement (Second) of Torts states that "[f]light by aircraft in the air space above the land of another is a trespass if, but only if . . . it enters into the *immediate reaches of the air space next to the land.*"[105]

Common-law rules defining a landowner's airspace can be preempted by statute.[106] Congress has declared a "public right of freedom of transit through the navigable airspace" of the United States.[107] "Navigable airspace" is defined as the airspace above the minimum safe-operating altitudes, including airspace needed for safe takeoff and landing.[108] FAA regulations define these minimum safe-operating altitudes for different

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[100] *Causby*, 328 U.S. at 265.

[101] *See id.* at 258, 265 (holding that "frequent and regular flights" of aircraft over residential property violated the Takings Clause, U.S. CONST. amend. V).

[102] *See, e.g.*, Brandes v. Mitterling, 196 P.2d 464, 465 (Ariz. 1948) ("Extensive flying at low altitudes, accompanied by excessive noise and occasioning unreasonable annoyance to the occupants of the land below, and apprehension of danger on their part, has been held to constitute an element of nuisance in that it interferes substantially with the enjoyment of the property by the occupants."); Jones v. Wagner, 624 A.2d 166, 167 (Pa. Super. Ct. 1993) (dealing with trespass by overhanging tree branches); *see also* DOLAN & THOMPSON, *supra* note 74, at 11 (stating that *Causby* standards "are used in property tort claims because there can be no trespass in airspace unless the property owner has some possessory right to the airspace, which was the same question at issue in *Causby*").

[103] *Causby*, 328 U.S. at 264.

[104] *Id.*

[105] RESTATEMENT (SECOND) OF TORTS § 159(2)(a) (1965) (emphasis added).

[106] Note that the U.S. Supreme Court's cases addressing aerial surveillance under the Fourth Amendment do not decide the issue of private air rights because the warrantless observations were all taken from within the FAA-defined national airspace. *See* Florida v. Riley, 488 U.S. 445, 451–52 (1989) (sanctioning warrantless surveillance from helicopter flying at 400 feet); California v. Ciraolo, 476 U.S. 207, 213–14 (1986) (allowing warrantless aerial observation of fenced-in backyard within curtilage from altitude of 1,000 feet); Dow Chemical Co. v. United States, 476 U.S. 227, 229, 239 (1986) (permitting warrantless aerial surveillance of chemical plant where the aircraft was "[a]t all times . . . lawfully within navigable airspace" of 1,200 feet and higher). The issue in these three cases was whether the surveillance was a "search" within the meaning of the Fourth Amendment such that a warrant was required. These cases do not address the extent of the National Airspace System; rather they address what a law-enforcement officer may do when within it.

[107] 49 U.S.C. § 40101(c)(2) (2012).

[108] *Id.* § 40102(a)(32).

kinds of aircraft.[109]

Generally, apart from takeoff and landing, fixed-wing aircraft must be operated at an altitude that allows the aircraft to conduct an emergency landing "without undue hazard to persons or property on the surface."[110] In a congested area, the aircraft must operate at least "1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft."[111] In a non-congested area, the minimum safe-operating altitude is "500 feet above the surface."[112] Over open water or sparsely populated areas, aircraft "may not be operated closer than 500 feet to any person, vessel, vehicle, or structure."[113]

Unlike fixed-wing aircraft, which are subject to specific minimum safe-operating altitudes based on location, regulation of helicopter minimum altitudes is more flexible. Under FAA regulations, a helicopter may fly below the minimum safe altitudes prescribed for fixed-wing aircraft if it is operated "without hazard to person or property on the surface."[114]

The FAA does not currently regulate minimum safe-operating altitudes for drones.[115] In its upcoming regulations the FAA anticipates different

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[109] *See* 14 C.F.R. § 91.119 (2015).

[110] *Id.* § 91.119(a).

[111] *Id.* § 91.119(b).

[112] *Id.* § 91.119(c).

[113] *Id.*

[114] *Id.* § 91.119(d).

[115] DOLAN & THOMPSON, *supra* note 74, at 3. But while the FAA does not currently regulate minimum safe operating altitudes for drones, it did, in 2007, issue a policy statement to the effect that "no person may operate a UAS [unmanned aircraft system] in the National Airspace without specific authority." Unmanned Aircraft Operations in the National Airspace System, 72 Fed. Reg. 6689, 6690 (Feb. 13, 2007). This means that all drone operators who do not fall within the recreational-use exemption must apply to the FAA for permission to fly. *See id.*

Hobbyist drones that do fall within the recreational-use exemption were, until very recently, subject only to a set of recommended standards. *See* FED. AVIATION ADMIN., ADVISORY CIRCULAR 91-57, MODEL AIRCRAFT OPERATING STANDARDS (1981), http://www.faa.gov/documentLibrary/media/Advisory_Circular/91-57.pdf [http://perma.cc/N62S-FRUD]. Compliance with the circular was voluntary. *Id.* But it recommended that operators fly a sufficient distance from populated areas and away from noise-sensitive areas like parks, schools, hospitals, or churches. *Id.* Operators also were asked not to fly in the vicinity of full-scale aircraft or more than 400 feet above the surface. *Id.* When flying within three miles of an airport, operators were urged to notify an airport official. *Id.*

On September 2, 2015 the FAA replaced this guidance. FED. AVIATION ADMIN., ADVISORY CIRCULAR 91-57A, MODEL AIRCRAFT OPERATING STANDARDS 1 (2015), http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-57A.pdf [http://perma.cc/V55U-4AM7]. In the new circular, the FAA now requires compliance. *See id.* at 2–3. While the FAA apparently recognizes that it lacks authority to regulate hobbyist drones directly, it emphasizes its authority to regulate any object—however classified—that threatens the safety of the National Airspace System. *Id.* at 2. The FAA states that if a hobbyist drone endangers the safety of the nation's airspace, the FAA may take legal action. *See id.* With regard to height restrictions, the FAA states that "[m]odel aircraft operators should follow best practices including limiting operations to 400 feet above ground level (AGL)." *Id.* at 3.

classes of rules for drones based on their size and capabilities.[116] However the FAA sets these standards, once in place they will set the lower bounds for where drones may legally fly over private property. If federal law defines a portion of the airspace as publicly navigable, that means that drone operators are safe from an action for simple trespass within that zone. The lack of a cause of action would in turn preclude any self-help privilege. However, an action for nuisance or invasion of privacy would still be possible.[117] Furthermore, since the FAA may not directly regulate recreational use of model aircraft,[118] a classification that could include certain types of drones,[119] state property law will continue to play a role in defining the bounds of private airspace relevant to the use of drones and state tort law will continue to define how landowners may react to trespassory overflights by hobby pilots.

In the zone below that covered by federal law or regulation, just how close to the ground constitutes the "immediate reaches" protected from intruders may vary from state to state.[120] States can set the boundary below the FAA standards. That is, while a state may not prohibit overflights that the FAA permits, the state may expand the navigable airspace at the expense of the property owner's exclusive airspace by setting the trespass

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[116] *See infra* Part III.A for potential administrative regulation.

[117] *See* Nader v. Gen. Motors Corp., 255 N.E.2d 765, 768, 770–71 (N.Y. 1970) (recognizing that the tort of invasion of privacy does not require a physical trespass on plaintiff's property but could be accomplished by remote eavesdropping); Thornburg v. Port of Portland, 376 P.2d 100, 108 (Or. 1962) (noting that the jury could find noise nuisance in spite of the fact that airplanes were within navigable airspace: "[t]here is . . . no merit in the defense argument that all flights within the navigable airspace are automatically free from liability").

[118] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 336(a), 126 Stat. 11, 77 (codified at 49 U.S.C. § 40101 note (2012)).

[119] *See* Huerta v. Pirker, Docket No. CP-217, at 7–8 (Nat'l Transp. Safety Bd. Mar. 6, 2014) (holding that the FAA did not have authority to regulate model aircraft, thus assuming that the aircraft at issue was in fact a hobby aircraft as opposed to a commercial drone as the FAA had alleged). The FAA is appealing this decision. FAA Press Release (Mar. 7, 2014), http://www.faa.gov/news/press_releases/news_story.cfm?newsId=15894 [http://perma.cc/3GMJ-EPKD].

[120] *See* RESTATEMENT (SECOND) OF TORTS § 159 cmt. *l* (1965) ("'Immediate reaches' of the land has not been defined as yet, except to mean that the aircraft flights were at such altitudes as to interfere substantially with the landowner's possession and use of the airspace above the surface. No more definite line can be drawn than is suggested by the word 'immediate.' In the ordinary case, flight at 500 feet or more above the surface is not within the 'immediate reaches,' while flight within 50 feet, which interferes with actual use, clearly is, and flight within 150 feet, which also so interferes, may present a question of fact."); *see also* Bevers v. Gaylord Broad. Co., No. 05-01-00895-CV, 2002 WL 1582286, at *6 (Tex. App. 2002) (declining to specifically define "immediate reaches," but holding that "a single ten-minute hover over [the landowner's] property at 300 to 400 feet does not, as a matter of law, rise to the level of 'substantial interference'" (footnote omitted)). For an example of how one state set aerial boundaries, see Act of July 29, 2013, § 15, 2013-2014 Or. Laws 1869, 1872 (providing trespass cause of action for drone overflight below 400 feet if (1) there has been a previous overflight below 400 feet and (2) the landowner "notified the owner or operator of the drone that the [landowner] did not want the drone flown over the property at a height of less than 400 feet").

line lower than the FAA's minimum altitude.[121]

Deer Trail, Colorado illustrates an extreme version of how state and local law might address these gaps in federal regulation, as the town considered a plan to offer its residents drone-hunting licenses.[122] The FAA, unsurprisingly, expressed skepticism at the legality of shooting down drones. In response to Deer Trail's plan, the FAA stated that "[s]hooting at an unmanned aircraft could result in criminal or civil liability, just as would firing at a manned airplane."[123] However, the FAA did not cite any specific law backing this assertion, and the authority for it depends upon how one reads the statute governing destruction of aircraft.[124]

b. Whether to Require Actual Harm: Conflation with the Tort of Nuisance

While trespass is, for all practical purposes, subject to a rule of strict liability,[125] in cases of aerial trespass the rule merges with the traditional standard for nuisance, which requires actual damages.[126] The Restatement

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[121] *See, e.g.*, Act of July 29, 2013, § 15, 2013-2014 Or. Laws 1869, 1872 (setting minimum height for drone overflight at 400 feet, well below FAA minimum height overflight limits for fixed-wing aircraft).

[122] *See* Ana Cabrera, *Colorado Town's Vote on Drone Ordinance Postponed*, CNN (Dec. 10, 2013, 9:44 AM), http://www.cnn.com/2013/12/10/us/colorado-town-drone-ordinance/ [http://perma.cc/F7FK-9HAN] (reporting that Deer Trail, Colorado entertained a vote as to whether residents could shoot down federal drones).

[123] *Id.* (quoting an FAA press release).

[124] 18 U.S.C. § 32(a)(1) (2012). The issue is whether § 32(a)(1) covers shooting down a drone or whether that statute is best understood as applying solely to the destruction of manned aircraft. Section 32(a)(1) makes it a crime punishable by up to twenty years in prison to willfully destroy "any aircraft in the special aircraft jurisdiction of the United States or any civil aircraft used, operated, or employed in [commerce subject to federal regulation]." *Id.* An "aircraft" is defined as "a civil, military, or public contrivance invented, used, or designed to navigate, fly, or travel in the air." *Id.* § 31(a)(1). Read broadly, § 32(a)(1) would seem to apply even to the destruction of a model helicopter and certainly would cover robotic aircraft.

While § 32(a)(1) makes it a crime to destroy an "aircraft," other subsections of § 32 refer instead to an "aircraft in flight." *See, e.g, id.* § 32(a)(3), (7). The definition of "in flight" assumes that there has been "embarkation" and will be "disembarkation," two terms that generally refer to passengers. *Id.* § 31(a)(4). The different language in § 32(a)(1) provides a textual hook for the argument that Congress intended to extend coverage to the destruction of unmanned aircraft. On the other hand, one could easily ask whether Congress intended such a potentially absurd result. At the time of the passage of the 1956 Act to Punish the Willful Damaging or Destroying of Aircraft or Motor Vehicles, and Their Facilities, and for Other Purposes, Pub. L. No. 709, 70 Stat. 539, the statute enacting what became codified at § 32(a)(1), it seems highly unlikely that Congress intended to impose a twenty-year sentence for destruction of a model airplane or foresaw the introduction of robotic aircraft. *Cf.* United States v. McGuire, 706 F.3d 1333, 1335 (11th Cir. 2013) (concerning enhanced penalties for discharge of handgun "in the general direction of an airborne police helicopter").

[125] RESTATEMENT (SECOND) OF TORTS § 158 (1965); *see also supra* notes 50–51 and accompanying text.

[126] *See* Colin Cahoon, Comment, *Low Altitude Airspace: A Property Rights No-Man's Land*, 56 J. AIR L. & COM. 157, 175–76 (1990) (noting that "commentators seem to have accepted this unconventional approach as unique to airspace trespass analysis").

(Second) of Torts notes in a comment that it is a trespass to "fire projectiles or to fly an advertising kite or balloon through the air above [another's land], even though no harm is done to the land or the possessor's enjoyment of it."[127] This reflects the normal strict-liability rule. But in the very next section, the Restatement declares that "[f]lights by aircraft in the airspace above the land of another is a trespass if, but only if . . . it interferes substantially with the other's use and enjoyment of the land."[128] This rule superimposes a requirement of actual harm, thus conflating the normal strict-liability rule of trespass with the rule of nuisance.[129]

Generally, a private[130] nuisance is a "nontrespassory invasion of another's interest in the private use and enjoyment of land."[131] Whereas a trespass is inherently wrongful, conduct constituting a nuisance is not.[132]

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[127] RESTATEMENT (SECOND) OF TORTS § 158 cmt. i (1965).

[128] *Id.* § 159.

[129] By importing requirements from a nuisance claim, this departure from the trespass rule effectively swallows the aerial trespass action. The courts' detour into aerial nuisance may be based on a misreading of the U.S. Supreme Court's decision in *United States v. Causby*, 328 U.S. 256, 258, 264, 266–67 (1946) (holding that "frequent and regular flights of army and navy aircraft over respondents' land at low altitudes" below those "within the navigable airspace which Congress placed within the public domain" sufficiently diminished value of property to allow Takings claim under the Fifth Amendment). Courts have read *Causby* to require actual interference with the owner's use or enjoyment of her land for the overflight to be an actionable trespass. *See, e.g.*, Pueblo of Sandia *ex rel.* Chaves v. Smith, 497 F.2d 1043, 1045–46 (10th Cir. 1974) (affirming grant of summary judgment in favor of defendant where plaintiff in trespass action failed to allege interference with actual use); *see also* RESTATEMENT (SECOND) OF TORTS § 159 cmt. k (1965) (noting that federal cases have read *Causby* this way in the trespass context). This reading seems anomalous: in *Causby*, the Supreme Court held that for there to be a taking under the Fifth Amendment—that is, for the government to have appropriated private property under circumstances which require payment of just compensation—there must be substantial interference with the owner's use or enjoyment of their property. *See Causby*, 328 U.S. at 266 ("Flights over private land are not a taking, unless they are so low and so frequent as to be a direct and immediate interference with the enjoyment and use of the land."). There is no obvious reason why the interference requirement should be as strict in a trespass claim. If aerial trespass genuinely is to be treated like terrestrial trespass, then all that should be required is entrance into that part of the airspace that remains fully private. *Causby* expressly holds that a landowner's nonuse of airspace does not affect ownership. *See id.* at 264 ("The landowner owns at least as much of the space above the ground as he can occupy or use in connection with the land. The fact that he does not occupy it in a physical sense—by the erection of buildings and the like—is not material." (citation omitted)). Properly understood, then, *Causby* makes actual interference with use relevant only as a matter of substantive constitutional Takings law, not as a matter of property law on ownership of airspace. If, however, state courts continue to import *Causby* into aerial trespass law, the effect will be to minimize the importance of trespass as a potential justification for self-help against aerial intrusions and thus increase the potential importance of nuisance because there will be cases of classic trespass that do not amount to nuisance if only because the interference was neither repeated nor continuous.

[130] This is as compared with a public nuisance. A private nuisance interferes with an individual's use and enjoyment of her land, while a public nuisance interferes with "a right common to the general public." RESTATEMENT (SECOND) OF TORTS § 821B (1979).

[131] *Id.* § 821D.

[132] *See* Gregory C. Keating, *Strict Liability Wrongs*, *in* PHILOSOPHICAL FOUNDATIONS OF THE LAW OF TORTS 292, 296 (John Oberdiek ed., 2014) ("Nuisance law imposes liability for the infliction of unreasonable harm when . . . it holds that damages should be paid for an unreasonable interference

The conduct constituting the nuisance becomes wrongful only when it interferes with the plaintiff's use and enjoyment of her land.[133]

Further, nuisance law usually requires the interference to be repeated or ongoing before it becomes actionable.[134] A one-time interference may be enough where it causes ongoing harm, but otherwise a single instance of nuisance-like activity would not ordinarily give rise to a nuisance cause of action. The question is thus whether the interference is substantial and unreasonable. The types of problems that drones are likely to cause—noise,[135] dust,[136] and low overflights[137]—would ordinarily require multiple instances of inappropriate conduct by a single party before creating a right to sue and thus a right to self-help. However, it is at least theoretically possible that otherwise legal overflights might become a sanctionable nuisance if the light or noise—or even legitimate fears about the privacy consequences—caused a measurable diminution of an owner's enjoyment of her property.

The extent of a property-owner's right of self-help against drone overflights that are only nuisances but not trespasses[138] is a complicated question beyond the scope of this Article. In practice, it is not likely to be a common issue if only because the scenarios where there is only a nuisance but not a trespass are likely to be those in which it will be particularly difficult for the property owner to know who owns the drones overflying her property. In theory, however, in a nuisance-only regime the luckless drone operator who for the first time flew a drone over property that had been overflown many times by others would have a cause of action against a property owner who damaged the drone. In a pure trespass regime, by contrast, the property owner would have the claim so long as she had an exclusive right to the airspace and her self-help was otherwise reasonable.

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with the plaintiff's rights to the reasonable use of their property, even though the conduct responsible for that interference is justified and ought to be continued."); Gregory C. Keating, *Nuisance as a Strict Liability Wrong*, 4 J. TORT L. 1, 3–4 (2012) (noting that nuisance creates strict liability for failure to compensate for harms from an otherwise permissible action).

[133] KEETON ET AL., *supra* note 13, at 623.

[134] There is no actual requirement of continual interference; the requirement is only that the interference be substantial and unreasonable, a requirement that often cannot be met absent repeated offenses. *See id.* at 626–30

[135] *See, e.g.*, Nestle v. City of Santa Monica, 496 P.2d 480, 485, 492 (Cal. 1972) (denying recovery on inverse-condemnation claim predicated on airplane noise interference, but reversing dismissal of nuisance claim); Thornburg v. Port of Portland, 376 P.2d 100, 110 (Or. 1962) (noting that it is a question for the jury as to whether there was a taking by noise nuisance).

[136] *See, e.g.*, Nitram Chems. v. Parker, 200 So. 2d 220, 225 (Fla. Dist. Ct. App. 1967) (concluding that evidence of smoke, noise, and dust was sufficient to support nuisance verdict for landowner).

[137] *See, e.g.*, Seale v. Pearson, 736 So. 2d 1108, 1109–10, 1113–14 (Ala. Civ. App. 1999) (affirming trial court's finding of nuisance based on low overflights).

[138] One example might be flight above the vertical curtilage that nonetheless caused a disturbance or distress. Another example—one subject to First Amendment limitations—might be camera-carrying drones patrolling up and down just outside the property line.

3. *Interaction Between Trespass and Privacy Torts*

In some cases of trespass, the major harm will come not from the technical intrusion, but from the invasion of privacy that follows as the robot or drone takes pictures, conducts other sense-enhanced surveillance, or monitors wireless telephone or Wi-Fi communications. These harms can be conceptualized as damages from the trespass, or as separate privacy torts. In cases where the surveillance does not involve an actual trespass, such as observation from beyond the property line or in public places, the privacy torts will commonly be the property owner's main option. When there is a trespass, the anticipated privacy damages are capable of supplying the grounds for a reasonable belief that self-help is necessary to protect the actor and that "the harm inflicted is not unreasonable as compared with the harm threatened."[139] The Restatement (Second) of Torts limits this privilege "to protect the actor's land or chattels or his possession of them,"[140] but as we argue in the next Part, given the magnitude of the dangers, there are good reasons to extend this right of self-defense to privacy harms also.

D. *Invasion of Privacy by Robots as a Justification for Self-Help*

Privacy torts present the most difficult, but also some of the most important, justifications for self-defense against robots. Invasions of privacy can result in very significant harms, so the privilege of self-help should in theory be broad. That said, there are significant issues with how a person facing a robot could know what it is capable of and (just as in the case of trespass[141]) the extent to which a person is entitled to assume the worst. Whether or not one can assume the worst of the robot, there are also difficult issues of deciding when a potential harm justifies the financial cost of harming the robot.

This cost-benefit analysis is particularly difficult for privacy torts because it involves value judgments about privacy, requiring us to ask what sorts of self-help *should* be permitted, rather than just whether the drone looks more expensive than the property to be defended. It is easy to say that one may not destroy a thing of great value to protect a thing of little value, but it is clearly difficult to extend this precise calculus to areas where the interest in property is to be balanced against a more ethereal, or at least less easily and immediately quantifiable, interest like privacy.

Responses to robot privacy invasions also involve questions of perceived threats by robots—perceptions which may not always be

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[139] RESTATEMENT (SECOND) OF TORTS § 260 (1965).

[140] *Id.*

[141] *See supra* Part II.C.2 (reasoning that the novelty of drones may initially be used to justify more self-help, but that this may change as the technology becomes more common).

accurate, but which sometimes may nonetheless be considered reasonable in law. In addition, they include cases where the intrusion is not necessarily detected while it is ongoing. For example, if the landowner does not see or hear a drone, it will be much harder to make a nuisance claim because it is hard to argue that an unnoticed intrusion interferes with use or enjoyment of the property.

Whether or not the invasion of privacy is detected while it occurs, these intrusions are the domain of a relatively exotic branch of tort law: the privacy torts. Classically, there are four privacy torts[142] including public disclosure,[143] false light,[144] and appropriation of name or likeness,[145] but the only one a robot is likely to commit, and therefore the only one relevant to this Article, is intrusion on solitude and seclusion. Intrusion on solitude and seclusion is a recognized[146] if somewhat unusual tort, but its relative rarity in the courts means that it is poorly charted legal territory.[147]

The tort of intrusion on seclusion protects an individual from (1) "highly offensive" intrusions upon (2) reasonable expectations of privacy.[148] As home-based robots, and the "Internet of Things" more generally, increase the number of devices in the home that can collect data about people and send this data back to a central monitoring station, the tort of intrusion on seclusion might seem poised for explosive growth.[149] Two factors, however, reduce the potential scope of intrusion-on-seclusion claims as against non-strangers. First, many types of quite possibly

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[142] KEETON ET AL., *supra* note 13, at 851.

[143] *See* RESTATEMENT (SECOND) OF TORTS § 652D (1977) ("One who gives publicity to a matter concerning the private life of another is subject to liability to the other for invasion of his privacy, if the matter publicized is of a kind that (a) would be highly offensive to a reasonable person, and (b) is not of legitimate concern to the public.").

[144] *See id.* § 652E ("One who gives publicity to a matter concerning another that places the other before the public in a false light is subject to liability to the other for invasion of his privacy, if (a) the false light in which the other was placed would be highly offensive to a reasonable person, and (b) the actor had knowledge of or acted in reckless disregard as to the falsity of the publicized matter and the false light in which the other would be placed.").

[145] *See id.* § 652C ("One who appropriates to his own use or benefit the name or likeness of another is subject to liability to the other for invasion of privacy.").

[146] *Id.* § 652B; *see also* DOLAN & THOMPSON, *supra* note 74, at 14 n.111 ("North Dakota and Wyoming are the only states not to adopt the privacy tort of intrusion upon seclusion."). *See generally* KEETON ET AL., *supra* note 13, at 854–56 (providing background on the cause of action).

[147] *See, e.g.*, KEETON ET AL., *supra* note 13, at 854–56 (describing examples and principles that form the existing understanding of the tort); *see also* Mitchel J. Ezer, *Intrusion on Solitude: Herein of Civil Rights and Civil Wrongs*, 21 L. TRANSITION 63, 63 (1961); Daniel J. Solove, *A Taxonomy of Privacy*, 154 U. PA. L. REV. 477, 552–55 (2006) (discussing the lack of doctrinal consistency and broadness of this legal area).

[148] RESTATEMENT (SECOND) OF TORTS § 652B (1977).

[149] *Cf.* John Villasenor, *Observations from Above: Unmanned Aircraft Systems and Privacy*, 36 HARV. J.L. & PUB. POL'Y 457, 501 (2013) ("Although privacy expectations are greatly reduced outside the home, the non-governmental use of a UAS to capture images and other information taken while the individual is in a public setting could nonetheless constitute an invasion of privacy.").

outrageous technological monitoring will be swept up by contractual terms of service in which the consumer—in some small print—agrees to the surveillance. So long as those terms of service are not adjudged to be void as against public policy, the contract will preempt the tort.[150] Second, many other robotic intrusions into the home or the curtilage will be by explicit or implicit invitation. Just as the pizza delivery person is not intruding on seclusion as he peers across the threshold while handing over a pie, so too a robot delivering a package (or its controllers) will count as invitees, not privacy invaders. In the case of most deliveries, the terms of sale likely will spell this out also, at least after the first lawsuit.[151] On the other hand, in the absence of a contractual relationship, drones surveying the neighborhood in order to profile residents for marketing purposes would not, we hope, count as either invitees or licensees.

The tort of intrusion on seclusion gains most of its traction in cases against strangers. What is more, the less the victim knows about the robot spy, or suspected spy, the more its surveillance is likely to seem a threat. The more the surveillance seems a threat, the more likely it is that the victim will seek not just a judicial remedy—uncertain, likely time-consuming and costly, and probably much too late to undo the harm—but also self-help remedies. Although the core principles of the intrusion-on-seclusion tort are well defined and fit the robot context, there is uncertainty as to the interaction of the intrusion-on-seclusion tort with the self-help principle. In our research, we found no cases holding that intrusion on seclusion does not justify a privilege for self-help in appropriate circumstances. On the other hand, we have also been unable to find any cases holding that intrusion on seclusion does create a privilege for appropriate self-help.

There is likely a simple reason why case law gives so little—maybe zero—guidance as to when a privacy tort justifies self-help by the victim, and if so, how much. Consider one of the more common types of intrusion-on-seclusion cases: the peeping landlord.[152] These cases never seem to involve any legal issue relating to the tenant's destruction or conversion of

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[150] An example might be the recent revelation that Samsung's SmartTV Privacy Policy warned, "[p]lease be aware that if your spoken words include personal or other sensitive information, that information will be among the data captured and transmitted to a third party through your use of Voice Recognition." *Samsung Television Spies on Viewers*, SCHNEIER ON SECURITY (Feb. 13, 2015, 7:01 AM), https://www.schneier.com/blog/archives/2015/02/samsung_televis.html [http://perma.cc/7MJ3-9XWC]. By warning of the surveillance in terms incorporated into its contract with the consumer, Samsung greatly reduced the likelihood of any tort claim.

[151] *See supra* note 58 (contemplating this issue in the context of Amazon's plan to introduce delivery drones).

[152] *See, e.g.*, Hamberger v. Eastman, 206 A.2d 239, 239 (N.H. 1964) (describing a case where a landlord installed a listening and recording device in a husband and wife's bedroom); Roach v. Harper, 105 S.E.2d 564, 565 (W.Va. 1958) (describing a case where a tenant brought a claim against a landlord who installed a listening device in a tenant's apartment).

equipment placed in order to spy on her because the circumstances would make the spying landlord's complaint about the tenant's self-help almost sanctionable. Suppose the tenant disables or keeps the hidden camera that was placed in a bedroom or bathroom. In these cases we would not expect to see a claim for replevin from the landlord who installed the camera, as a court would see it as pure chutzpah. For example, in *Miller v. Brooks*,[153] an estranged wife trespassed and secreted a camera in the bedroom of her husband's apartment, prompting the husband to take the camera and watch the recording.[154] The court noted this in its survey of the facts, but the wife apparently did not demand the camera or the videotape back.[155]

As far as we are aware, claims of excessive self-help involving chattels have yet to come up in cases about illegal eavesdropping, wiretapping, or recording. But one can imagine many cases in which homeowners and others would be concerned about a drone spying on them and might be motivated to interfere with it or strike at it. A drone following someone around town likely would be an actionable nuisance and in some cases might rise to the level of intentional infliction of emotional distress,[156] not to mention creating civil[157] or criminal liability for stalking.[158] But what happens when a journalist (or paparazzi) drone overflies property whose owner shoots it down fearing that the drone is spying on her? Will the drone-owning journalist have a claim or will the self-help be considered justified?

In the absence of guidance from case law and statutes, we turn to policy arguments for why self-help should and should not be allowed in such instances.

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[153] 472 S.E.2d 350 (N.C. Ct. App. 1996).

[154] *Id.* at 352–53.

[155] *Id.* at 352.

[156] *See* RESTATEMENT (SECOND) OF TORTS § 46(1) (1965) ("One who by extreme and outrageous conduct intentionally or recklessly causes severe emotional distress to another is subject to liability for such emotional distress, and if bodily harm to the other results from it, for such bodily harm.").

[157] *See, e.g.*, CAL. CIV. CODE § 1708.7 (West, Westlaw through Ch. 2 of 2015 Reg. Sess.) (codifying the civil tort of stalking); KY. REV. STAT. ANN. § 411.220 (West, Westlaw through 2015 Reg. Sess.) (providing that a civil action may be maintained against a person who commits the crime of stalking).

[158] *See, e.g.*, FLA. STAT. ANN. § 784.048 (West, Westlaw through 2015 1st Reg. Sess.) (defining the crime of stalking); R.I. GEN. LAWS ANN. § 11-59-2 (West, Westlaw through Ch. 555 of Jan. 2014 Sess.) (same); *see also* NAT'L INST. OF JUSTICE, U.S. DEP'T OF JUSTICE, PROJECT TO DEVELOP A MODEL ANTI-STALKING CODE FOR STATES 43 (1993), https://www.ncjrs.gov/pdffiles1/Digitization/144477NCJRS.pdf [https://perma.cc/8RUV-34LU] (recommending that states make stalking a felony). Although no state has adopted the Model Code in full, a number of states have adopted anti-stalking statutes that incorporate provisions and definitions from the model act. 2 WAYNE R. LAFAVE, SUBSTANTIVE CRIMINAL LAW § 16.4(b) (2d ed. 2003).

1. *Reasons for Permitting Self-Help Against Robotic Intrusions on Seclusion*

The argument for permitting self-help in response to the tort of intrusion on seclusion starts with the two fundamental reasons for permitting self-help at all.[159] First, the intrusion creates an exigency in which resort to legally administered remedies would be impractical because any robot equipped with a radio or a cell-phone chip can transmit the data it records in seconds. Worse, the damage from intrusive recordings may be impossible to remedy after the fact. One cannot purchase new dignity. Second, even violent self-help against an overflying drone poses a reduced risk of breaching the peace compared to the ordinary self-help case. Attacking a drone is not the same as attacking its owner directly.[160] Plus, the drone's owner or operator often may not be in the nearby vicinity and thus will not be able to react impulsively—at least so long as the drone itself is unarmed. Society's interest in law and order thus poses only a reduced barrier to permitting even severe forms of self-help against robots in defense of privacy.

Two specific characteristics of the intrusion-on-seclusion tort provide additional justifications for permitting self-help. First, because the tort requires that the invasion be not just offensive, but "*highly* offensive,"[161] the number of cases where the privilege exists will depend on how offensive society finds robotic spying. But in that set of relatively extreme cases, the scope of permissible self-help deserves to be broad. More serious threats and harms may be met with more vigorous self-help.[162] And while a phrase like "highly offensive" is malleable, it sets a high bar. In one court's words, the invasion must amount to "[o]utrageously unreasonable conduct."[163]

A self-help privilege in response to what reasonably appears to be a robotic privacy intrusion should be permitted because privacy invasions by

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[159] *See supra* notes 22–24 and accompanying text.

[160] Where a paparazzo is holding a camera, the law will unify the person and the chattel so that to strike the camera is to strike the human. *See* RESTATEMENT (SECOND) OF TORTS § 18 cmt. c (1965) (stating that offensive battery covers not just instances of direct contact with the plaintiff, but also contact with "anything so connected with [the plaintiff's] body as to be customarily regarded as part [thereof]"). Where the landlord plants the camera in the tenant's bedroom, however, the unification does not occur because there is neither "offense to the dignity involved in the unpermitted and intentional invasion of the inviolability of his person" nor "any physical harm done to his body." *Id.*

[161] RESTATEMENT (SECOND) OF TORTS § 652B (1977) (emphasis added).

[162] For example, "[a]n individual who is under immediate threat has the option to respond with roughly the same degree of force that a state actor, such as a police officer, could use in the same situation." Adam B. Badawi, *Self-Help and the Rules of Engagement*, 29 YALE J. ON REG. 1, 31 (2012).

[163] N.O.C., Inc. v. Schaefer, 484 A.2d 729, 733 (N.J. Super. Ct. 1984). For a survey of cases in which there was and was not liability for intrusion on seclusion, see RESTATEMENT (SECOND) OF TORTS § 652B (1977).

robots differ from privacy invasions by humans. Robots, especially drones, increase an individual's ability to spy on others in contexts where they have a reasonable expectation of privacy. While a neighbor may have binoculars, and a private detective likely has a telephoto lens,[164] drones are unique in several ways that make them potentially a greater threat to privacy. First, drones can spy on you from vantage points that homeowners have historically had no reason to fear. In addition, drones can spy without trespassing.[165] And when drones do trespass, they are difficult to detect. Further, they may be able to stay in spying position for longer than humans. Drones may also be able to transmit the data more quickly.[166] Finally, even where drones do not in fact heighten these dangers, the risk of privacy invasion may reasonably appear to be large because of the newness of robots. Thus, at least initially, violent self-help will seem—and often may be—reasonable even when the privacy threat is minimal—or not even extant.

2. *Reasons for Not Permitting Self-Help Against Robotic Intrusions on Seclusion*

The arguments against permitting self-help in cases of robotic intrusions on seclusion are not as strong as those for it. One argument is that it will be hard to engage in self-help safely. The fear of injuring others is, however, more an argument against particular methods of self-help than against self-help in general. One can favor a broad right of self-help and still oppose it in the form of shooting guns in the air to down drones.

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[164] *See, e.g.*, RESTATEMENT (SECOND) OF TORTS § 652B cmt. b, illus. 2 (1977) ("A, a private detective seeking evidence for use in a lawsuit, rents a room in a house adjoining B's residence, and for two weeks looks into the windows of B's upstairs bedroom through a telescope taking intimate pictures with a telescopic lens. A has invaded B's privacy.").

[165] There can be an intrusion on seclusion without a trespass. *See* KEETON ET AL., *supra* note 13, at 854–55 ("[T]he principle [of intrusion on seclusion] has, however, been carried beyond . . . physical intrusion, and extended to eavesdropping upon private conversations by means of wiretapping and microphones; and there are decisions indicating that it is to be applied to peering into the windows of a home, as well as persistent and unwanted telephone calls." (footnotes omitted)); *see also* RICHARD A. EPSTEIN, CASES AND MATERIALS ON TORTS 1050 (8th ed. 2004) ("The tort of invasion of privacy does not require a physical trespass on plaintiff's property, but may be accomplished by eavesdropping near an open window or by overhearing conversations by means of a parabolic microphone.").

Logically, one might suspect robots that came near to one's property, especially if they hung around, but absent trespass or a pattern of stalking, there will rarely if ever be a privilege to attack a robot off of one's property even if one suspects that it is spying. The existence of a trespass makes it more reasonable to conclude that the robot may be spying. As a general matter, the privilege to defend against spying is not a roving commission to attack nearby robots. A person would need a reasonable belief, supported by evidence, that the robot was spying before having any privilege to react. For example, even if a person suspected that a robot hovering around her property was spying, she would not be able to attack the robot absent a physical trespass or clear pattern of stalking.

[166] One interesting question is whether, all else being equal, being recorded by a robot and thus not knowing who is doing the spying, is more or less offensive than being recorded by a human with a camera. But that is a question legitimately left to a jury.

Another argument against allowing self-help is that it will encourage people concerned about drones to shoot down legitimate overflights such as law-enforcement drones, thus posing a threat to public safety. Or, there is the risk that self-helpers might shoot down a manned vehicle by mistake. Permitting self-help may encourage people to fire guns in the air, and may cause harm when a drone is downed. Further, if the self-helper misjudges the existence or scope of her privilege, she may commit a trespass to chattels or conversion. Self-help actions like these pose a threat to the state's monopoly on force.[167]

All of these arguments are based on general criticisms of self-help, or the reasons why tort law evolved to displace self-created remedies.[168] The primitive but prevailing "ad hoc system" of self-help, it is often argued, inevitably "leads to breaches of the peace, violence, and inequities."[169] As one state supreme court justice declared, "[s]elf-help may well be the first step toward anarchy."[170] These critiques are valid in the robot context too, but just as these legitimate concerns have not proved the death knell for self-help generally, they should not prevent an appropriate right of self-help as against robots. While it is true that the general trend in the law over the past century has been to curtail self-help remedies to specific types of harms, this movement has usually been justified on the theory that the state is ready and able to settle disputes and that self-help carries more risks of social conflict than its benefits justify.[171] Privacy-destroying drones seem like a strong case for another exception to that trend: until and unless society finds a way to hold drone operators accountable for their privacy violations, the ordinary reasons for disfavoring self-help are absent. There do not appear to be any reasons unique to the robot context that weigh against a broad self-help right. In fact, there are unique features weighing in its favor.

III. STATUTORY CONSIDERATIONS RELATING TO DRONES AND DRIVERLESS CARS

While we have thus far concentrated on tort law—the traditional common-law remedy for civil wrongs—statutes and regulations bear on the self-help issues discussed in several ways. To date, legislatures and agencies have generally focused on drones rather than robots more

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[167] *See* Joshua Horwitz & Casey Anderson, *Taking Gun Rights Seriously: The Insurrectionist Idea and Its Consequences*, 1 ALB. GOV'T L. REV. 496, 504 (2008) ("[A] monopoly on legitimate force . . . is the fundamental organizing principle of any political entity, including a democracy like the United States.").

[168] *See supra* text accompanying notes 21–30.

[169] Brandon et al., *supra* note 14, at 853.

[170] Duthie v. Lewiston Gun Club, 663 P.2d 287, 298 (Idaho 1983) (Bistline, J., dissenting).

[171] *See generally* Brandon et al., *supra* note 14.

broadly. FAA rules currently declare the bounds of the airspace in which fixed-wing aircraft and helicopters may fly. These rules have clear consequences for defining the size of the cuboid to which a landowner may claim exclusive possession.[172] While the FAA navigable-airspace regulation is not a privacy regulation, it declares how close others may come to the home and thus bears on the home's solitude. Insofar as the FAA regulation limits when a landowner has a cause of action, it also helps shape her right of self-help.

Further, if the FAA is authorized and undertakes to act in the privacy arena, it would be able to structure the general drone-related privacy regime through private causes of action, civil fines, and even crimes. Here, we examine the FAA's regulatory activities pertaining to drones. We then discuss whether the FAA has authority to regulate drone-related privacy issues and whether it seems intent on doing so. Finally, we look to state laws and how they affect drone-related privacy issues.

A. *Potential Federal Aviation Administration Regulation of Drone Privacy*

The FAA's latest proposed rules, announced in February 2015,[173] would impose severe limits on commercial drone operators. While the proposed rules do not address privacy,[174] they would prevent overflights over individuals not involved in the drone operation,[175] permit operation only during daylight hours,[176] and require the operator or an assigned observer to maintain the drone within eyesight.[177] The proposed rules would not affect hobbyist drones, but the FAA intends to affirm its enforcement authority to pursue hobbyist operators who endanger the safety of the national airspace system ("NAS").[178]

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[172] *See supra* text accompanying notes 100–18 (surveying the bounds of flight for fixed-wing aircraft, helicopters, and drones). While the U.S. Supreme Court has noted that a law-enforcement officer could violate the Fourth Amendment while lawfully within the publicly navigable airspace of the United States, *see* Florida v. Riley, 488 U.S. 445, 451 (1989) ("This is not to say that an inspection of the curtilage of a house from an aircraft will always pass muster under the Fourth Amendment simply because the plane is within the navigable airspace specified by law."), it seems clear that an action for simple trespass under state law would not lie where the FAA has declared that the defendant was within the navigable airspace. *See* U.S. CONST. art. VI, cl. 2 ("[T]he Laws of the United States . . . shall be the supreme Law of the Land . . . .").

[173] Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9544 (proposed Feb. 23, 2015) (to be codified at 14 C.F.R. pts. 21, 43, 45, 47, 61, 91, 101, 107 & 183) [hereinafter Small Drones NPRM].

[174] *Id.* at 9552 (noting that privacy issues "are beyond the scope of this rulemaking").

[175] *Id.* at 9576.

[176] *Id.* at 9561.

[177] *Id.* at 9559, 9560.

[178] *Id.* at 9555. Additionally, on September 2, 2015, the FAA issued Advisory Circular Number 91-57A, asserting its authority to pursue legal remedies against hobbyist drones that endanger the NAS. FED. AVIATION ADMIN., ADVISORY CIRCULAR 91-57A, MODEL AIRCRAFT OPERATING STANDARDS 1

Discussed in more detail below, these proposals are the product of a complicated statutory and regulatory regime. In the FAA Modernization and Reform Act of 2012 ("FMRA"),[179] Congress tasked the FAA with devising rules to ensure the safe integration of drones into domestic airspace. FMRA directed the FAA to engage in two sets of rulemakings. The first required that the FAA issue a final rule on integrating "small unmanned aircraft systems" into the national airspace by September 2015,[180] although this deadline passed without FAA action.[181] The second requires the FAA to develop a "comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system."[182]

The FAA recently published a Notice of Proposed Rulemaking (NPRM) on small drones,[183] defined as those under fifty-five pounds.[184] The specifics of this framework are discussed below, followed by a survey of FMRA and other relevant FAA powers and duties.

The FAA also stated plans to expedite its certification process, moving from a drone-by-drone regime to a model-by-model regime,[185] although drones under fifty-five pounds will not require any airworthiness certification.[186] In addition to certifying the drone or model itself, the FAA will require pilot and aircrew certification.[187] Pilot certification will be important because the FAA has ruled out autonomous flight for most

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(2015), http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-57A.pdf [http://perma.cc/V55U-4AM7].

[179] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, 126 Stat. 11 (codified at 49 U.S.C. § 40101 note (2012)).

[180] *Id.* § 332(b)(1).

[181] *See* U.S. DEP'T OF TRANSP., FAA'S IMPLEMENTATION OF THE FAA MODERNIZATION AND REFORM ACT OF 2012 REMAINS INCOMPLETE: STATEMENT OF THE HONORABLE CALVIN L. SCOVEL III BEFORE THE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE 1 (2014), http://transportation.house.gov/uploadedfiles/2014-02-05-scovel.pdf [http://perma.cc/FTN8-F47Z] ("While FAA has made progress meeting the act's UAS provisions, it has determined that it will not meet the September 2015 deadline for UAS integration due to a series of complex technological, regulatory, and managerial barriers.").

[182] FAA Modernization and Reform Act of 2012 § 332(a)(1).

[183] Small Drones NPRM, 80 Fed. Reg. 9544.

[184] FED. AVIATION ADMIN, INTEGRATION OF CIVIL UNMANNED AIRCRAFT SYSTEMS (UAS) IN THE NATIONAL AIRSPACE SYSTEM (NAS) ROADMAP 48 (2013) [hereinafter FAA ROADMAP], http://www.faa.gov/uas/media/uas_roadmap_2013.pdf [http://perma.cc/GZL2-33JV].

[185] *See id.* at 25 ("Detailed consideration of UAS in the certification process will be limited in number until such time as a broad and significant consideration is given to existing standards, regulations, and policy. This will be facilitated by UAS manufacturers making application for type design approval to the FAA. For type design approval, UAS designers must show they meet acceptable safety levels for the basic UAS design, and operators must employ certified systems that enable compliance with standardized air traffic operations and contingency/emergency procedures for UAS.").

[186] Small Drones NPRM, 80 Fed. Reg. at 9576–77.

[187] *Id.* at 9567–72 (outlining eligibility requirements to obtain a drone operator certificate, which include, inter alia, being at least seventeen years old, possessing proficiency in the English language, and passing initial and recurrent aeronautical knowledge tests).

drones.[188]

In 2012, FMRA directed the FAA to establish six test ranges for drones,[189] and the FAA has used these test ranges as a laboratory for its initial, but somewhat limited, drone privacy policies. In the words of the FAA, "[t]he overall purpose of this test site program is to develop a body of data and operational experiences to inform integration and the safe operation of these aircraft in the National Airspace System."[190] In a recent final rule, the FAA required all test site operators to have written and publicly available privacy policies which are "informed" by Fair Information Practice principles, to accept public comment on their privacy policies, and to review and update the policies as needed.[191] While these policies do not necessarily define the FAA's long-term approach, they are meant to "help inform the dialogue among policy makers, privacy advocates, and the industry."[192] Additionally,[193] operators will need to comply with state and local laws that regulate privacy.[194] This non-preemption of state laws is significant. Of the states that are hosting the test sites, three have enacted drone legislation: Oregon,[195] Texas,[196] and Virginia.[197] These sites will thus test the existing state policies and provide valuable evidence of effectiveness for future state action.

Whether FMRA enables the FAA to regulate privacy issues outside of

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[188] *See* FAA ROADMAP, *supra* note 184, at 33 ("Autonomous operations are not permitted. . . . The [pilot-in-command] has full control, or override authority to assume control at all times during normal UAS operations.").

[189] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 332(c)(1), 126 Stat. 11, 74 (codified at 49 U.S.C. § 40101 note (2012)).

[190] Unmanned Aircraft System Test Site Program, 78 Fed. Reg. 12,259, 12,259 (Feb. 22, 2013) (to be codified at 14 C.F.R. pt. 91). The FAA received 25 applications for test sites located in twenty-four different states. *FAA Announces Six UAS Test Sites*, FED. AVIATION ADMIN. (Mar. 13, 2015, 3:26 PM), http://www.faa.gov/uas/legislative_programs/test_sites/ [http://perma.cc/7QFK-FLYY]. The FAA considered "geography, climate, location of ground infrastructure, research needs, airspace use, safety, aviation experience and risk," and selected the University of Alaska, the State of Nevada, New York's Griffiss International Airport, the North Dakota Department of Commerce, Texas A&M University—Corpus Christi, and Virginia Tech as the test sites. Press Release, FAA Selects Unmanned Aircraft Systems Research and Test Sites (Dec. 30, 2013), http://www.faa.gov/news/press_releases/news_story.cfm?newsid=15576 [http://perma.cc/MD8W-32VM].

[191] Unmanned Aircraft System Test Site Program, 78 Fed. Reg. 68,360, 68,364 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt. 91).

[192] FAA ROADMAP, *supra* note 184, at 12.

[193] This list is not exhaustive of the requirements; see Unmanned Aircraft System Test Site Program, 78 Fed. Reg. at 68,364 for a full list of requirements.

[194] The FAA requires that operators comply with "all Applicable Law regarding the protection of an individual's right to privacy." Unmanned Aircraft System Test Site Program, 78 Fed. Reg. at 68,364. "Applicable Law" is defined to mean "(i) a law, order, regulation, or rule of an administrative or legislative government body with jurisdiction over the matter in question, or (ii) a ruling, order, decision or judgment of a court with jurisdiction over the matter in question." *Id.*

[195] Act of July 29, 2013, 2013-2014 Or. Laws 1869.

[196] Texas Privacy Act, 2013 Tex. Gen. Laws 3691.

[197] An Act to Place a Moratorium on the Use of Unmanned Aircraft Systems, 2013 Va. Acts 1408.

its test-site mandate is debatable. The Congressional Research Service (CRS) concluded that it would be reasonable for the FAA to interpret FMRA as tasking the FAA with addressing privacy in its drone-related rulemaking.[198] The FAA, however, takes a more complicated view of its own authority. It found the authority to regulate privacy at the test sites in 49 U.S.C. § 106(*l*)(6),[199] which authorizes the FAA Administrator to enter into a test-site agreement "on such terms as the Administrator may consider appropriate."[200] On this logic, one would expect that the FAA could find authority to regulate drone-related privacy more generally by latching onto the "acceptable standards for operation" language in FMRA.[201] If the FAA can find specific authority to regulate privacy at test sites in a general grant of power, FMRA would seem to provide, more generally, an equally strong basis for the existence of statutory authority to regulate drone-related privacy.

But the FAA disagrees. It stated in its Roadmap that its "mission does not include developing or enforcing policies pertaining to privacy or civil liberties."[202] Moreover, in establishing privacy policies for the test sites, it stated that its "mission is to provide the safest, most efficient aerospace system in the world and does not include regulating privacy."[203]

In any event, whether or not the FAA has authority under FMRA to regulate drone-related privacy, it seems that the FAA either believes it lacks that authority or has no intention of using it. Instead, the FAA seems willing to have states chart the course for protection of privacy in the drone context and shows no appetite to preempt them.[204] In the recent NPRM on

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[198] DOLAN & THOMPSON, *supra* note 74, at 22–27. The CRS concluded that while under step one of *Chevron*, FMRA does not expressly authorize the FAA to regulate privacy, "the open-ended nature of Congress's instructions to the FAA, coupled with the prominence of privacy concerns, would likely persuade a court that the FAA's potential regulation of privacy as part of formal rulemaking is a reasonable interpretation of FMRA that should be accorded deference under a *Chevron* analysis." *Id.* at 23, 25.

[199] Unmanned Aircraft System Test Site Program, 78 Fed. Reg. at 68,361 ("The FAA's authority for including the Final Privacy Requirements in the Test Site OTAs is set forth in 49 U.S.C. 106(l)(6).").

[200] 49 U.S.C. § 106(*l*)(6) (2012).

[201] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 332(a)(2)(A)(i), 126 Stat. 11, 73 (codified at 49 § U.S.C. 40101 note (2012)).

[202] FAA ROADMAP, *supra* note 184, at 11.

[203] Unmanned Aircraft System Test Site Program, 78 Fed. Reg. at 68,361.

[204] The Joint Planning and Development Agency (JPDO), which includes representatives of the "Next Generation Air Transportation System (NextGen) partner agencies—the Departments of Transportation (DOT), Defense (DoD), Commerce (DOC), and Homeland Security (DHS), the National Aeronautics and Space Administration (NASA), and the Federal Aviation Administration (FAA)," JOINT PLANNING & DEV. OFFICE, UNMANNED AIRCRAFT SYSTEMS (UAS) COMPREHENSIVE PLAN: A REPORT ON THE NATION'S UAS PATH FORWARD 3 (2013) [hereinafter JPDO PLAN], http://www.faa.gov/about/office_org/headquarters_offices/agi/reports/media/uas_comprehensive_plan.pdf [http://perma.cc/D8S5-SXW6], issued a report that suggests that additional regulation of privacy is unnecessary because "many states have laws that protect individuals from invasions of privacy which

drones under fifty-five pounds, the FAA noted that privacy issues are "beyond the scope of this rulemaking."[205] Thus, it seems likely that at least in the near future, state and local laws will continue to play a leading role in privacy protection.

Whether the FAA decision to not regulate to protect privacy was reasonable is currently the subject of a challenge before the U.S. Court of Appeals for the D.C. Circuit.[206] Petitioners argue that FMRA requires the FAA to develop a "Comprehensive Plan" to integrate drones into the NAS and that the FAA wrongly concluded that privacy issues are beyond the scope of its authorized rulemaking.[207]

For now, instead of the FAA regulating, and in addition to state and local action, the Commerce Department will coordinate. On February 15, 2015, President Obama issued an order[208] directing all federal agencies that use drones to ensure that their collection of personally identifiable information complies with the Privacy Act of 1974.[209] The order permits data collection via drones only where it is "consistent with and relevant to an authorized purpose."[210] The order also calls for a "multi-stakeholder engagement process to develop and communicate best practices for privacy, accountability, and transparency issues regarding commercial and private UAS use in the NAS."[211] The National Telecommunications and Information Administration, a part of the Commerce Department, is directed to initiate this process, but it must limit its focus to commercial, rather than law-enforcement or governmental use of drones.[212]

But even if the FAA wanted to regulate drone privacy issues generally, there would still be a hole in its authority: FMRA bars the FAA from

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could be applied to intrusions committed by using a UAS." *Id.* at 7. The FAA also noted a similar reason for not imposing privacy requirements beyond the context of the test sites: "there are many privacy laws and applications of tort law that may address some of the privacy issues that arise from UAS operations at the Test Sites." Unmanned Aircraft System Test Site Program, 78 Fed. Reg. at 68,362. The FAA thus concluded that it did not need to "monitor a Test Site's compliance with its own privacy policies" because the FAA "expects . . . [the] respective state/local oversight bodies to monitor and enforce a Test Site's compliance with its own policies." *Id.* at 68,363. Finally, the FAA stated that "[f]orty-three states have already enacted or are considering legislation regulating use of UAS." *Id.* at 68,362.

[205] Small Drones NPRM, 80 Fed. Reg. 9544, 9552 (proposed Feb. 23, 2015) (to be codified at 14 C.F.R. pts. 21, 43, 45, 47, 61, 91, 101, 107 & 183).

[206] *See* Brief for Petitioner at 2, Elec. Privacy Info. Ctr. v. FAA, No. 15-1075 (D.C. Cir. filed Sept. 28, 2015), https://epic.org/privacy/litigation/apa/faa/drones/1575326-EPIC-Opening-Brief.pdf [https://perma.cc/8BY9-PXTW].

[207] *Id.* at 28, 35.

[208] Memorandum on Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems, 80 Fed. Reg. 9355, 9355 (Feb. 15, 2015) [hereinafter Presidential Memorandum].

[209] 5 U.S.C. § 552a (2012).

[210] Presidential Memorandum, 80 Fed. Reg. at 9356.

[211] *Id.* at 9357.

[212] *Id.*

promulgating rules regarding certain types of model aircraft flown for recreational use.[213] This bar applies where the model aircraft is less than fifty-five pounds, does not interfere with any manned aircraft, and is flown in accordance with a community-based set of safety guidelines.[214] The aircraft must also be flown within the line of sight of the operator and be used solely for recreational purposes.[215] But while the FAA is prohibited from writing rules or regulations governing these aircraft, it is not prohibited from pursuing enforcement actions "against persons operating model aircraft who endanger the safety of the national airspace system."[216] In any event, the model aircraft limitation on the FAA's authority does not apply to rules concerning drones flown for commercial purposes.[217]

The NPRM proposes to require commercial drone operators to keep their drones within visual-line-of-sight ("VLOS") of either a drone operator or an assigned observer.[218] The FAA reiterates this requirement, specifically stating that, at all times, the drone "must remain close enough to the operator for the operator to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses."[219] Additionally, the FAA proposes that small drones may not fly over any persons not directly involved in the operation.[220] Finally, the rules would require that small drones be operated only during daylight, defined in the relevant provision as "official sunrise to official sunset, local time."[221]

The FAA's NPRM proposes that drone operators should be licensed, having to pass an "initial aeronautical knowledge test" and be vetted by the Transportation Security Administration.[222] The FAA would not permit operation of small drones by anyone under seventeen years of age, would require operators to make their drones available for FAA inspection or testing upon request, and would require operators to make their own preflight inspection before each operation.[223] Finally, the FAA would require operators to report accidents that cause personal injury or property

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[213] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 336, 126 Stat. 11, 77 (codified at 49 U.S.C. § 40101 note (2012)).

[214] *Id.* § 336(a).

[215] *Id.* § 336(c).

[216] *Id.* § 336(b); *see also* sources cited *supra* note 119.

[217] *See* Presidential Memorandum, 80 Fed. Reg. at 9356.

[218] Small Drones NPRM, 80 Fed. Reg. 9544, 9546 (proposed Feb. 23, 2015) (to be codified at 14 C.F.R. pts. 21, 43, 45, 47, 61, 91, 101, 107 & 183).

[219] *Id.*

[220] *Id.*

[221] *Id.*

[222] *Id.* The aeronautical knowledge test would need to be retaken every twenty-four months, and the operator would also need to obtain an "unmanned aircraft operator certificate with small UAS rating," which the FAA notes would never expire. *Id.*

[223] *Id.*

damage within ten days of the incident.[224]

As to the drones themselves, the FAA proposes requiring that the drones be registered, but not that they obtain the airworthiness certification required of passenger planes.[225] The drones would also need to be equipped with requisite aircraft markings, which the FAA specifies are the "same requirements that apply to all other aircraft."[226] Tellingly, however, the FAA states that "[i]f [the] aircraft is too small to display markings in [the] standard size, then the aircraft simply needs to display markings in the largest practicable manner."[227]

In this last statement, the FAA recognizes the problem of small drones, but then fails to solve it. Requiring "the largest practicable"[228] markings is meaningless where even the largest practicable markings would do little to provide notice to observers. Tiny lettering might help when a drone has crashed or been downed, but it will do little to help victims identify the owner or operator of a drone that commits a tort at night or while on the move.

If the FAA's Final Rule hews to the NPRM, it would not permit commercial drone delivery services, a limitation that brought protests from would-be commercial-drone operators[229] such as Amazon.[230] Indeed, requiring VLOS alone would make drone delivery inefficient, and forbidding flying over anyone not involved with the flight would preclude deliveries in all but the most sparsely inhabited locales.

The NPRM removes some uncertainty about the FAA's plans. That said, the final rule could still be some time away, and so for the moment, commercial operators are still left to petition the FAA for an exemption from the ban on commercial drone operations.[231] As of August 2015, more than 2,500 petitions have been filed, and the FAA has granted more than 1,000.[232]

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[224] *Id.*

[225] *Id.*

[226] *Id.*

[227] *Id.*

[228] *Id.*

[229] Scott Shane, *F.A.A. Rules Would Limit Commercial Drone Use*, N.Y. TIMES (Feb. 15, 2015), http://www.nytimes.com/2015/02/16/us/faa-rules-would-limit-commercial-drone-use.html?_r=2.

[230] Ed Pilkington, *Amazon Threatens to Take Drone Testing Abroad as US Delays Approval*, GUARDIAN (Dec. 9, 2014), http://www.theguardian.com/world/2014/dec/09/amazon-threatens-drone-testing-abroad-us-delays-approval [http://perma.cc/2SED-82J4].

[231] *Petitioning for Exemption Under Section 333*, FED. AVIATION ADMIN. (July 24, 2015), https://www.faa.gov/uas/legislative_programs/section_333/how_to_file_a_petition/ [https://perma.cc/8QM8-2AR4]; *see also* Robert A. Heverly, *The State of Drones: State Authority to Regulate Drones*, 8 ALB. GOV'T L. REV. 29, 57 (2015) ("States have the authority to regulate their own affairs. . . . [s]o long as state laws and policies are not in conflict with Constitutional guarantees or relevant federal policies . . . .").

[232] Clay Dillow, *FAA Approves More than 1,000 Commercial Drone Permits*, FORTUNE (Aug. 9, 2015), http://fortune.com/2015/08/09/faa-commercial-drone-permits [http://perma.cc/CWU7-BCJM].

Although the FAA's proposed rules would bar using drones to deliver goods, Amazon recently petitioned for and received authority to test "Amazon Prime Air," its plan to use delivery drones.[233] In its petition, Amazon notes that its delivery drones can now travel at speeds over fifty miles per hour and will carry up to five-pound payloads, a limit that nonetheless covers eighty-six percent of Amazon's sales.[234] Amazon predicted that "[o]ne day, seeing Amazon Prime Air will be as normal as seeing mail trucks on the road today, resulting in enormous benefits for consumers across the nation."[235] The FAA then issued an experimental airworthiness certificate to Amazon, permitting the company to use it for "research and development and crew training."[236] The certificate permits testing only of drones weighing less than fifty-five pounds, including payload.[237] Additionally, the certificate requires all operations to be conducted at or below 400 feet[238] during daylight hours and in clear weather.[239]

The FAA's experimental airworthiness certificate issued to Amazon maintains a visual-line-of-sight requirement[240]—one of the prohibitive provisions of the proposed rules. The certificate also requires that, subject to a few exceptions, all operations "be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures."[241] This is another of the proposed rules that would effectively bar Amazon from using its drones for delivery. While these limitations will not prevent some testing, the FAA's decision to retain them in the final rules would prevent drones from being an attractive mode for delivery. Furthermore, it remains to be seen how Amazon will be able to demonstrate the safety and efficacy of its delivery drones if it is not permitted to test them in more realistic conditions.

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[233] Letter from Paul Misener, Vice President, Global Pub. Policy, Amazon.com, to the Honorable Michael P. Huerta, Administrator, Fed. Aviation Admin. (July 9, 2014), https://www.faa.gov/uas/legislative_programs/section_333/333_authorizations/media/Amazon_com_11290.pdf [https://perma.cc/YJ5Y-TENY]; *Amazon Gets Experimental Airworthiness Certificate,* FED. AVIATION ADMIN. (Mar. 19, 2015), https://www.faa.gov/news/updates/?newsId=82225 [https://perma.cc/5PKM-UJW2].

[234] Letter from Paul Misener, *supra* note 233.

[235] *Id.*

[236] *Amazon Gets Experimental Airworthiness Certificate, supra* note 233.

[237] Letter from John S. Duncan, Director, FAA Flight Standards Serv., to Paul Misener, Vice President, Global Pub. Policy, Amazon.com (Apr. 8, 2015), https://www.faa.gov/uas/legislative_programs/section_333/333_authorizations/media/Amazon_com_11290.pdf [https://perma.cc/79RQ-JF6B].

[238] *Id.*

[239] *Amazon Gets Experimental Airworthiness Certificate, supra* note 233.

[240] Letter from John S. Duncan, *supra* note 237.

[241] *Id.* at 8–9.

B. *State Drone-Related Legislation*

Substantive[242] drone-related legislation has been enacted in seventeen states:[243] Alaska,[244] Florida,[245] Idaho,[246] Illinois,[247] Indiana,[248] Iowa,[249] Louisiana,[250] Montana,[251] North Carolina,[252] North Dakota,[253] Ohio,[254] Oregon,[255] Tennessee,[256] Texas,[257] Utah,[258] Virginia,[259] and Wisconsin.[260]

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[242] Several test-site states have passed legislation appropriating funds for test-site operations. *See, e.g.*, Act of May 3, 2013, § 14, 2013 N.D. Laws 197, 201 (creating an "unmanned aircraft systems fund, which must be used to defray the expenses of the operations of an unmanned aircraft systems test site officially designated by the federal aviation administration").

[243] For the argument that states should take the leading role in making drone rules, see Kaminski, *supra* note 85, at 67–69.

On September 9, 2015, California Governor Jerry Brown vetoed a bill, S.B. 142, that would have enacted trespass liability for anyone flying a drone within 350 feet above real property without the express permission of the property owner. Letter from Governor Edmund G. Brown to Members of the California State Senate (Sept. 9, 2015), https://www.gov.ca.gov/docs/SB_142_Veto_Message.pdf [https://perma.cc/YM93-T3R5]. Although the bill would have expanded existing statutory civil trespass liability, the strange thing to our eye is that these rights largely exist already under the California common law of trespass. *See* 5 Witkin, Summary 10th (2005) Torts § 694.

[244] Act of July 28, 2014, ch. 105, 2014 Alaska Sess. Laws 1; Alaska Legislative Resolve No. 60 (2014), http://www.legis.state.ak.us/PDF/28/Bills/HCR015Z.PDF [http://perma.cc/6WE6-S4R5].

[245] Freedom from Unwarranted Surveillance Act, 2013 Fla. Laws 364.

[246] Act of Apr. 11, 2013, 2013 Idaho. Sess. Laws 859.

[247] Pub. Act No. 98-402, § 48-3(b)(10), 2013 Ill. Laws 4894, 4898 (prohibiting use of drones to interfere with hunting or fishing); Freedom from Drone Surveillance Act, 2013 Ill. Laws 6803.

[248] IND. CODE § 35-33-5-9 to -10 (West, Westlaw through 2015 1st Reg. Sess. of 119th Gen. Assemb. legislation).

[249] Act of May 23, 2014, 2014 Iowa Acts 324.

[250] LA. STAT. ANN. § 14:337 (Westlaw through 2014 Reg. Sess.).

[251] Act of May 1, 2013, 2013 Mont. Laws 1509.

[252] Current Operations and Capital Improvements Appropriations Act of 2014, §§ 7.16.(g), 34.30.(a)–(g), 2014 N.C. Sess. Laws 328, 356, 580–584; Current Operations and Capital Improvements Appropriations Act of 2013, § 7.16.(e)–(f), 2013 N.C. Sess. Laws 995, 1040.

[253] Act of Apr. 15, 2015, 2015 North Dakota Laws Ch. 239 (H.B. 1328).

[254] OHIO REV. CODE ANN. § 122.98 (West, Westlaw through 2015 Files 1 to 24 of 131st Gen. Assemb.). While it is included in this list, Ohio's legislation is arguably non-substantive. The Ohio Act only creates the Ohio Aerospace and Aviation Technology Committee. *Id.* § 122.98(A). The duties of the Committee include developing strategies to "promote the aviation, aerospace, and technology industry throughout the state, including through the commercialization of aviation, aerospace, and technology products and ideas," encouraging "communication and resource-sharing" among interested individuals and entities, and promoting research and development in the aviation industry, "including research and development of unmanned aerial vehicles." *Id.* § 122.98(B).

[255] Act of July 29, 2013, 2013-2014 Or. Laws 1869.

[256] Freedom from Unwarranted Surveillance Act, TENN. CODE ANN. § 39-13-609 (West, Westlaw through 2015 1st Reg. Sess.); TENN. CODE ANN. § 70-4-302(a)(6) (West, Westlaw through 2015 1st Reg. Sess.); TENN. CODE ANN. §§ 39-13-901 to -907 (West, Westlaw through 2015 1st Reg. Sess.).

[257] Texas Privacy Act, 2013 Tex. Gen. Laws 3691.

[258] Government Use of Unmanned Aerial Vehicles Act, UTAH CODE ANN. §§ 63g-18-101 to -105) (West, Westlaw through 2015 Gen. Sess.).

[259] An Act to Place a Moratorium on the Use of Unmanned Aircraft Systems, 2013 Va. Acts 1408.

[260] Act of Apr. 8, 2014, 2013 Wis. Sess. Laws 1120.

Of these states, four—Alaska, Oregon,[261] Texas, and Virginia—will host test-site operations.[262]

Virginia,[263] along with Oregon,[264] banned the installation of weapons on government drones. North Carolina and Wisconsin similarly banned weaponized drones, although these bans are broader, applying also to privately owned and operated drones.[265] As we note below, these bans make it less reasonable to perceive physical threats from drones.[266] While drones of course can pose physical threats without weapons, the legislation at least minimizes an important variable.

North Dakota, in its wisdom, has chosen the opposite course. A law passed in August 2015 permits the use of drones for the "patrol of national borders" and "exigent circumstances," and only prohibits arming those drones with lethal weapons.[267] In other words, North Dakota permits police use of drones armed with non-lethal weapons.[268] Because the statute limits weaponized drones to official use, it does not follow that this will increase the scope of permissible self-help against drones generally, even though it means that people may be more justified in fearing them.

The Alaska legislation has a unique feature. It requires law enforcement to maintain a record of each flight "including the time, date, and purpose of the flight," to establish an "auditable flight record system," and to "establish a method for notifying the public of the operation of an unmanned aircraft system, unless notifying the public would endanger the safety of a person."[269]

Several of the statutes contain provisions aimed at protecting individuals' privacy. North Carolina's legislation states that no individual or entity shall use a drone to conduct surveillance of a person, a residence, or a residence's curtilage absent the person's consent.[270] Another privacy-focused provision bans the use of drones for photographing individuals,

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[261] While Oregon will not play host to a test site of its own, the University of Alaska plans to set up test site operations there. Press Release, FAA Selects Unmanned Aircraft Systems Research and Test Sites (Dec. 30, 2013), http://www.faa.gov/news/press_releases/news_story.cfm?newsid=15576 [http://perma.cc/D6WW-PLM9].

[262] *Id.*

[263] An Act to Place a Moratorium on the Use of Unmanned Aircraft Systems, § 1, 2013 Va. Acts 1408, 1408.

[264] Act of July 29, 2013, § 10, 2013-2014 Or. Laws 1869, 1871.

[265] Current Operations and Capital Improvements Appropriations Act of 2014, § 14-401.24(a), 2014 N.C. Sess. Laws 328, 582; Act of Apr. 8, 2014, § 3, 2013 Wis. Laws 1120, 1121.

[266] *See infra* Part IV.C.1.

[267] Act of Apr. 15, 2015, § 4(1)–(2), 5, 2015 North Dakota Laws Ch. 239 (H.B. 1328).

[268] Cyrus Farivar, *New Law Permits North Dakota Cop Drones to Fire Beanbag Rounds from the Sky*, ARS TECHNICA (Aug. 27, 2015), http://arstechnica.com/tech-policy/2015/08/new-law-permits-north-dakota-cop-drones-to-fire-bean-bag-rounds-from-the-sky/ [http://perma.cc/7NQW-TU32].

[269] ALASKA STAT. ANN. § 18.65.901(a) (West, Westlaw through 2015 1st Reg. Sess.).

[270] Current Operations and Capital Improvements Appropriations Act of 2014, § 15A-300.1(b)(1)(a), 2014 N.C. Sess. Laws 328, 581.

absent their consent, "for the purpose of publishing or otherwise disseminating the photograph."[271] The provision, however, contains an exception for "newsgathering, newsworthy events, or events or places to which the general public is invited."[272] Another interesting aspect of the North Carolina Act is the section regarding limitations on the use of special imaging technology.[273] The Act states that "[c]ommercial and private unmanned aircraft systems may be equipped with infrared or other thermal imaging technology," but only for certain enumerated purposes, which all relate to scientific investigation and farming or environmental evaluations.[274] The Act makes it a misdemeanor to non-consensually publish or disseminate for any purpose images recorded through use of a drone with any thermal-imaging technology that reveals "individuals, materials, or activities inside of a structure."[275]

Other states, meanwhile, have recognized the privacy issue by criminalizing various forms of spying by drone. Indiana created the crime of "Unlawful Photography and Surveillance on Private Property."[276] The Act provides that a "person who knowingly or intentionally places a camera or electronic surveillance equipment that records images or data of any kind while unattended on the private property of another person without the consent of the owner or tenant of the private property" commits a misdemeanor.[277] Louisiana's legislation creates the crime of "Unlawful use of an unmanned aircraft system,"[278] which it defines as "the intentional use of an unmanned aircraft system to conduct surveillance of, gather evidence or collect information about, or photographically or electronically record a targeted facility without the prior written consent of the owner of the targeted facility."[279] Having defined what seems to be a broad privacy right, the act then goes on to limit that right severely by defining the term "targeted facility" to mean only petroleum and alumina refineries, chemical and rubber manufacturing facilities, and nuclear power plants.[280] Tennessee also regulates the use of drones to capture images, making it a misdemeanor to use a drone to "capture an image of an individual or privately owned real property in this state with the intent to conduct surveillance."[281] The statute provides a defense to prosecution,

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[271] *Id.* § 15A-300.1(b)(2).

[272] *Id.*

[273] *Id.* § 15A-300.1(d).

[274] *Id.*

[275] *Id.* § 14-401.25.

[276] Act of Mar. 26, 2014, § 26, 2014 Ind. Acts 2234, 2245.

[277] *Id.* § 1(b).

[278] LA. STAT. ANN. § 14:337 (Westlaw through 2014 Reg. Sess.).

[279] *Id.* § 14:337(A).

[280] *Id.* § 14:337(B)(2).

[281] TENN. CODE ANN. § 39-13-903(a)(1) (West, Westlaw through 2015 1st Reg. Sess.). Some of the exceptions to the ban on capturing images permit a professor, employee, student, or other person

however, where the individual destroys the image immediately upon learning that it was captured in violation of the law, and without having disclosed or displayed the image to any third parties.[282] Texas makes it a crime to capture, possess, or disseminate images of nonconsenting individuals under certain circumstances.[283] The Texas statute also lists nineteen situations in which it is permissible to capture images with drones.[284] Finally, Wisconsin deems it a misdemeanor to use a drone "with the intent to photograph, record, or otherwise observe another individual in a place or location where the individual has a reasonable expectation of privacy," although this latter provision does not apply to law enforcement.[285]

While many states limit or identify the circumstances in which an individual may disclose images captured through use of a drone, Utah's legislation goes further, specifically regulating the situations in which a "nongovernmental actor may . . . disclose data acquired through an unmanned aerial vehicle *to a law enforcement agency*."[286] Private actors may disclose such information to law enforcement only if "the data appears to pertain to the commission of a crime" or if the private actor, in good faith, believes that "the data pertains to an imminent or ongoing emergency involving danger of death or serious bodily injury to an individual" and "disclosing the data would assist in remedying the emergency."[287]

In what seems to be a rare legislative response to the privacy threat of communication interception by drones, Indiana deems inadmissible as evidence a "communication or an image" that is obtained through use of a drone in violation of its drone regulations.[288] Most states that have acted in the drone-privacy area have focused on drones invading individuals' privacy by capturing images; Indiana's approach is notable because it responds to the equally significant threat of drones infringing on privacy rights through interference with and interception of private

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acting on behalf of an institute of higher education to capture images for purposes of research. *Id.* § 39-13-902(a)(1). A person may capture images for purpose of mapping; an electric or natural gas utility may capture images for certain maintenance and developmental purposes; a state agency may capture images for certain security and emergency-response purposes; a "Tennessee licensed real estate broker" may capture images in connection with the marketing or sale of realty, provided that no individual is identifiable; any individual may capture images of public realty of persons on such property; and any individual or entity may use a drone to capture images where permitted by the FAA. *Id.* § 39-13-902.

[282] *Id.* § 39-13-903(c).

[283] Texas Privacy Act, §§ 423.003–.004, 2013 Tex. Gen. Laws 3691, 3692–93.

[284] *Id.* § 423.002(a).

[285] Act of Apr. 8, 2014, § 4, 2013 Wis. Sess. Laws 1120, 1121.

[286] UTAH CODE ANN. § 63G-18-103(2) (West, Westlaw through 2015 Gen. Sess.) (emphasis added).

[287] *Id.* § 63G-18-103(2)(a)–(b).

[288] Act of Mar. 26, 2014, § 20, 2014 Ind. Acts 2234, 2242.

communications.

North Carolina's legislation establishes a detailed licensing regime for commercial drone operators.[289] As part of its rules, North Carolina addressed notice issues, concerns identified in this Article. The North Carolina Division of Aviation must develop "[r]equirements for the marking of each unmanned aircraft system operated pursuant to a license issued under this section sufficient to permit identification of the owner of the system and the person licensed to operate it."[290] The Division must also develop a "system for providing agencies that conduct other operations within regulated airspace with the identity and contact information of licensees and the geographic areas within which the licensee is permitted to operate" the drone.[291] This system for facilitating identification and contacting of drone owners and operators will be key to responding to torts (and crimes) committed by drones. One issue with these otherwise laudable provisions, however, is that they only apply to drones "operated pursuant to a license issued under this section," i.e., to drones flown for commercial purposes.[292] The threat of tortious harm—to person, property, or privacy—is not posed solely by commercial operators. Identification of individuals operating drones for private purposes is equally as important.

Six states provide private, civil causes of action in cases of certain drone-operator actions—Florida, Idaho, North Carolina, Oregon, Tennessee, and Texas. Florida provides a cause of action to individuals who have been surveilled by law-enforcement drones in violation of its statute's prohibitions.[293] Idaho provides a cause of action against law-enforcement officers or private individuals for the gathering of images in violation of its statute.[294] North Carolina's legislation creates a civil cause of action for any individual who is the subject of unwarranted surveillance or whose photograph is taken in violation of the state's laws.[295] The action may be brought not only against private individuals, but also against state agencies.[296] Interestingly, the statute provides that, "[i]n lieu of actual damages, the person whose photograph is taken may elect to recover five thousand dollars ($5,000) for each photograph or video that is published or otherwise disseminated, as well as reasonable costs and attorneys' fees and

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[289] Current Operations and Capital Improvements Appropriations Act of 2014, § 63-96, 2014 N.C. Sess. Laws 328, 583–84.

[290] *Id.* § 63-96(d)(9).

[291] *Id.* § 63-96(d)(10).

[292] *Id.* § 63-96(d)(9).

[293] Freedom from Unwarranted Surveillance Act, § 1(3), 2013 Fla. Laws 364, 365.

[294] Act of Apr. 11, 2013, § 21-213(2)(a)–(b), 2013 Idaho Sess. Laws 859, 859.

[295] Current Operations and Capital Improvements Appropriations Act of 2014, § 15A-300.1(b), (e), 2014 N.C. Sess. Laws 328, 581.

[296] *Id.* § 15A-300.1(e).

injunctive or other relief as determined by the court."[297] Oregon, in addition to criminalizing interference with any FAA-licensed drone, provides a cause of action for individuals harmed by such interference.[298] The Oregon statute also creates a right of action for overflights below 400 feet if there is more than one overflight and the drone operator has been warned.[299] There is a takeoff-and-landing exception to this cause of action,[300] but where successful the statute allows for damages, an injunction, and even attorney's fees.[301] Oregon's statute also authorizes its attorney general to bring actions for nuisances and trespasses arising out of drone operations within the state.[302] Tennessee provides a cause of action against law-enforcement agencies that violate its statute's surveillance prohibitions.[303] Texas provides for a private cause of action against an individual who captures an image of property, the property owner, or the tenant with the intent to conduct surveillance.[304]

State statutes that create private causes of action against the operators of drones should in theory imply a concomitant privilege of self-help. Legislators are generally presumed to make new laws against the background of existing laws.[305] Thus, legislators could be presumed to know that tort causes of action generally provide the victim with some right of self-help, and it could therefore be argued that they should be presumed to have intended to provide a self-help privilege.

An additional issue raised by the statutes that create a civil claim against a government agency or official is whether those statutes permit some form of self-help against a government drone. That is, does the fact that a drone is operated by the Boise, Idaho Police Department instead of the Idaho Statesman newspaper determine whether a person being surveilled is entitled to self-help? One of the state statutes that provides such a cause of action against public entities—Oregon's—expressly declares that it is a crime to interfere with a government drone.[306]

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[297] *Id.*

[298] Act of July 29, 2013, § 14, 2013-2014 Or. Laws 1869, 1872.

[299] *Id.* § 15(1)(a)–(b).

[300] *Id.* § 15(2)(b).

[301] *Id.* § 15(3)–(4).

[302] *Id.* § 15(5).

[303] Freedom from Unwarranted Surveillance Act, TENN. CODE ANN. § 39-13-609(e) (West, Westlaw through 2015 1st Reg. Sess.).

[304] Texas Privacy Act, § 423.003(a), 2013 Tex. Gen. Laws 3691, 3692.

[305] Astoria Fed. Sav. & Loan Ass'n v. Solimino, 501 U.S. 104, 108 (1991) ("Congress is understood to legislate against a background of common-law adjudicatory principles. Thus, where a common-law principle is well established . . . the courts may take it as a given that Congress has legislated with an expectation that the principle will apply except when a statutory purpose to the contrary is evident." (citations omitted) (internal quotation marks omitted)).

[306] Act of July 29, 2013, § 13(2), 2013-2014 Or. Laws at 1871 (declaring it a felony not just to interfere with a government drone, but with any drone licensed by the FAA).

As noted above, Oregon's statute creates a one-bite-rule style civil cause of action for drone overflights below 400 feet. The landowner has a cause of action only if there has been a previous overflight below 400 feet following which the landowner "notified the owner or operator of the drone that the [landowner] did not want the drone flown over the property at a height of less than 400 feet."[307] On the one hand, this has the virtue of clarifying the extent of air rights and also of rejecting the anomalous hybrid trespass-nuisance standard of the Restatement (Second) of Torts.[308] On the other hand, the requirement that a landowner notify a drone owner-operator as a prerequisite to suit ignores the reality that the landowner often may have great difficulty determining the identity of the owner-operator of remotely operated private drones. (It is an interesting question whether a landowner could satisfy the notice requirement by simply posting a "No Drones" sign, and if so, at what angle the sign would have to be posted to be effective.)

"No Trespassing" signs normally alter neither common-law liability for terrestrial trespass nor change the extent to which a landowner may be entitled to self-help. Instead, posting such a sign on land ordinarily serves as a condition precedent to prosecution for criminal trespass, or for enhanced criminal sanctions.[309] In some cases the sign furnishes evidence of mens rea—guilty knowledge that the land trod upon was privately owned and that the owner did not invite or license the entry.[310] Doctrinally, therefore, a "no drones" sign would not be needed to make a drone overflight a trespass, nor would it alter whether self-help was lawful in "posted airspace." On the other hand, if the law were to change to permit low-altitude drone overflights, it would be useful to have a means by which landowners could signal that they wished to overturn that default rule, although there is reason to doubt that a traditional sign, as opposed to

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[307] *Id.* § 15(1)(a)–(b).

[308] *See* RESTATEMENT (SECOND) OF TORTS § 821B (1979) (articulating that a person is liable for a nuisance depending on "(a) Whether the conduct involves a significant interference with the public health, the public safety, the public peace, the public comfort or the public convenience, or (b) whether the conduct is proscribed by a statute, ordinance or administrative regulation, or (c) whether the conduct is of a continuing nature or has produced a permanent or long-lasting effect, and, as the actor knows or has reason to know, has a significant effect upon the public right"); RESTATEMENT (SECOND) OF TORTS § 158 (1965) (articulating that a person is liable for trespass if he "intentionally (a) enters land in the possession of the other, or causes a thing or a third person to do so, or (b) remains on the land, or (c) fails to remove from the land a thing which he is under a duty to remove"); *see also supra* Part II.C.2.b.

[309] *See* WAYNE R. LAFAVE, 3 SUBSTANTIVE CRIMINAL LAW § 21.2(b) (2d ed. 2003) ("About a quarter of the states mandate notice procedures with respect to all forms of real property, while about another eighth require such notice as to all property except dwellings. All the rest draw the line at or close to the dividing line between land (for which notice is required) and structures. This is done by directly stating that appropriate notice is necessary as to entry of or remaining on land . . . ." (footnotes omitted)).

[310] *See id.* § 21.2(c) (explaining the required level of intent to bring charges against an intruder).

some electronic signal or an entry in a database,[311] would be the most efficient means of achieving that end.

C. *Driverless Cars*

States are taking the lead in regulating driverless cars. The National Highway Traffic Safety Administration (NHTSA) issued a Preliminary Statement of Policy Concerning Automated Vehicles.[312] The Preliminary Statement takes a cautious approach, leaving it to states—the traditional source of most road-related rules—to regulate.[313] States, NHTSA suggested, should begin permitting use of driverless cars for testing purposes to help provide data that could guide eventual rulemaking or legislation.[314]

So far, legislative action at the state level has been limited. But because there are few, if any, specific bans on the operation of driverless cars, driverless cars are arguably legal to some extent everywhere.[315] Four states, California,[316] Florida,[317] Michigan,[318] and Nevada,[319] as well as the District of Columbia,[320] specifically permit the operation of driverless cars—with limits. The California[321] and Florida[322] statutes expressly declare that the state does not prohibit the operation of driverless cars.

Both Florida[323] and Nevada[324] require that a car capable of autonomous

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[311] *See* Megan Geuss, *NoFlyZone Database Will Tell Drones Not to Fly over Your House*, ARS TECHNICA (Feb. 11, 2015, 4:58 PM), http://arstechnica.com/tech-policy/2015/02/11/noflyzone-database-will-tell-drones-not-to-fly-over-your-house/ [http://perma.cc/FWC7-XRY4] (describing attempt to create voluntary no-fly database); *see also infra* notes 328–31 and accompanying text (discussing geofencing).

[312] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES (n.d.), http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf.

[313] *See id.* at 10 ("[W]e believe that states are well suited to address issues such as licensing, driver training, and conditions for operation related to specific types of vehicles.").

[314] *See id.* ("NHTSA has considerable concerns . . . about detailed state regulation on safety of self-driving vehicles, and does not recommend at this time that states permit operation of self-driving vehicles for purposes other than testing.").

[315] Bryant Walker Smith, *Automated Vehicles Are Probably Legal in the United States*, 1 TEX. A&M L. REV. 411, 412–13 (2014). Building on the axiom that "what is not prohibited, is permitted," *id.* at 414 (quoting United States v. Gourde, 440 F.3d 1065, 1081 (9th Cir. 2006) (en banc)), the article notes that most state vehicle codes "assume the presence of licensed human drivers" and so do not prohibit them directly or even indirectly, *see id.* at 413.

[316] CAL. VEH. CODE § 38750(b) (West, Westlaw through urgency legislation of Ch. 32 of 2015 Reg. Sess.).

[317] Act of Apr. 13, 2012, § 3(1), 2012 Fla. Laws 1223, 1225.

[318] MICH. COMP. LAWS ANN. § 257.244(3) (West, Westlaw through P.A. 2015, No. 130, of 2015 Reg. Sess.).

[319] Act of June 2, 2013, § 2.5, 2013 Nev. Stat. 2008, 2009.

[320] Autonomous Vehicle Act of 2012, § 3, 60 D.C. Reg. 2119, 2119–20 (Jan. 23, 2013).

[321] 2012 Cal. S.B. 1298 § (1)(c).

[322] Act of Apr. 13, 2012, § 1(2), 2012 Fla. Laws at 1225.

[323] *Id.* § 4(b).

operation visually indicate whether it is operating in autonomous mode. Unfortunately, both states' requirements seem intended to alert only the human operator, given that the means of alert is to be "inside" the vehicle.[325] While there are situations where it would be vital to inform the operator as to whether the vehicle is operating in autonomous mode or is about to switch to manual mode, one would think that the operator usually would be the one person who knows when the vehicle is in autonomous mode. Surely it is at least as important to provide notice to third parties who have no other means of determining whether the car is being driven by a human or a computer.

IV. IMPROVING THE LAW OF HUMAN-ROBOT INTERACTIONS

It is clear that under U.S. tort law, absent a criminal statute to the contrary, a person has a legal right to defend herself against a perceived or actual physical threat from a robot. Other aspects of self-defense against robots, particularly those relating to defending property or privacy, are significantly less clear. Based on our survey above, we have identified seven specific legal issues relating to unpleasant robot-human interactions.[326] Notably, each of these seven issues involves some kind of uncertainty. Two of the issues involve uncertainty as to either the law (the extent of the self-defense privilege in response to intrusions on seclusion) or legal fact (the extent of the aerial boundary to property). But the other five stem from a reasonable, ordinary person's understandable uncertainty about robots in general and about the capabilities and intentions of the robot they are confronted with in particular. Below we offer proposals designed to reduce these uncertainties. Our proposals will minimize the need for violent self-help and clarify the circumstances where it would be appropriate.

What follows focuses on tort-law-based solutions, and on solutions calculated to make tort-law approaches more effective. Excepting only the case of a delivery drone, which is a sort of invitee, most private[327] drone-person interactions likely will occur between legal strangers, i.e., persons without any relevant contractual relations. This is prime territory for tort law. As robots and drones evolve, and as reasonable expectations about

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[324] Act of June 2, 2013, § 4(2)(b), 2013 Nev. Stat. at 2009.

[325] Act of Apr. 13, 2012, § 4(1)(b), 2012 Fla. Laws at 1225 (requiring that all autonomous cars "[h]ave a means, *inside the vehicle*, to visually indicate when the vehicle is operating in autonomous mode" (emphasis added)); Act of June 2, 2013, § 4(2)(b), 2013 Nev. Stat. at 2009 (requiring all autonomous cars to be equipped with a "visual indicator *located inside the autonomous vehicle* which indicates when autonomous technology is operating the autonomous vehicle" (emphasis added)).

[326] *See supra* Part I.

[327] Public uses can also be problematic. For a survey of some public use issues, see RICHARD M. THOMPSON II, CONG. RESEARCH SERV., DOMESTIC DRONES AND PRIVACY: A PRIMER 3–5 (2015).

robots change with them, tort law too can respond relatively quickly. Alternative regulatory solutions are also possible, but tort-based approaches may have the most to offer in the short run.

Tort- and notice-based solutions certainly seem preferable to attempting to hardwire all drones to restrict them from permissible airspace. After a toy drone landed in a tree inside of the White House fence, its manufacturer announced "that it would issue a 'mandatory' firmware update for its products that would contain built-in geofencing limits—defined boundaries within which their updated, GPS-enabled drones simply would not fly."[328] While geo-fencing drones offers the appealing prospect of certainty that no properly functioning machine will, for example, attempt to overfly a nuclear power plant[329] or the White House, geofencing suffers from a number of problems. First, the boundaries will need constant updating. The updating likely will come from a centralized list maintained either by the government or a private party. In either case the maintainer of that list will have unreasonably great power to control drone use and to, for example, block legitimate uses of drones, such as newsgathering at demonstrations.[330] Second, even if we were to adopt a geo-fencing regime, we would still need a way to deal with failure modes—drones straying because the list was faulty, because the drone was faulty, or because the operator ignored or overcame the restriction.[331]

A. *Clarify State Rules on Vertical Curtilage—Make a National Rule?*

Horizontally, the curtilage of a property is the area "immediately surrounding and associated with the home."[332] In law, the curtilage is considered to be "part of the home itself for Fourth Amendment purposes."[333] The dimensions of the equivalent aerial space above a home and its horizontal curtilage—what is often referred to as vertical

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[328] Jay Stanley, *Building Regulation into Drones*, AM. CIV. LIBERTIES UNION (Apr. 22, 2015, 10:30 AM), https://www.aclu.org/blog/free-future/building-regulation-drones [http://perma.cc/R8DS-7DE7].

[329] *See* Arthur Neslen, *Three Arrests Fail to Staunch Mystery of Drones Flying over French Nuclear Plants*, GUARDIAN (Nov. 6, 2014), http://www.theguardian.com/environment/2014/nov/06/arrests-myster-drones-flying-french-nuclear-plants [http://perma.cc/PU6K-VD9G] (discussing the November 2014 arrests of individuals who flew drones near nuclear power plants in France).

[330] *See* Stanley, *supra* note 328 ("[W]e want to ensure that technology remains at the service of individuals, empowering and enriching their lives, rather than empowering those who would control us.").

[331] For a discussion of how drones might be governed by code instead of law, see Henry H. Perritt, Jr. & Eliot O. Sprague, *Law Abiding Drones*, 16 COLUM. SCI. & TECH. L. REV. 385, 421–33 (2015).

[332] Florida v. Jardines, 133 S. Ct. 1409, 1414 (2013).

[333] *Id.* (quoting Oliver v. United States, 466 U.S. 170, 180 (1984)).

curtilage[334]—are not as clear as those of the horizontal space.[335] FAA rules on minimum navigable heights[336] also play a major part. States could in theory set an upper bound lower than the FAA rules.[337] Oregon recently set an upper bound of 400 feet for drone overflights in certain circumstances,[338] but this upper bound is not lower than any relevant FAA rule because the FAA does not currently have a height rule for drones.[339] Anything in excess of FAA rules on navigable airspace will be preempted.[340]

As the FAA currently does not have authority to regulate hobbyist drones,[341] the main sources of regulation for non-commercial drones are state common law and statutory law. Meanwhile, however, the people on the ground may find it difficult to distinguish a (legal) hobbyist drone from

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[334] According to Brendan Peters, the U.S. Supreme Court "has never adopted the concept of 'vertical curtilage.' Instead, curtilage as viewed from above is analyzed under the *Katz* [*v. United States*, 389 U.S. 347 (1967)] reasonableness framework." Brendan Peters, Note, *Fourth Amendment Yard Work: Curtilage's Mow-Line Rule*, 56 STAN. L. REV. 943, 959 n.95 (2004).

[335] There is still some fundamental uncertainty about the extent of the vertical equivalent of curtilage. *See* Florida v. Riley, 488 U.S. 445, 450 (1989) (holding that public inspection of greenhouse from a police helicopter flying at 400 feet did not require warrant); Dow Chem. Co. v. United States, 476 U.S. 227, 239 (1986) (holding that observation of industrial plant from altitude of 2,000 feet above was not akin to entering into the curtilage of a dwelling and thus did not require warrant); California v. Ciraolo, 476 U.S. 207, 213–14 (1986) (holding that fixed-wing observation of the curtilage from "public navigable airspace," 1,000 feet above ground, did not require warrant); *see also* Commonwealth v. Oglialoro, 547 A.2d 387, 388, 391 (Pa. Super. Ct. 1988), *aff'd*, 579 A.2d 1288 (Pa. 1990) (holding that helicopter operating in "non-navigable airspace" fifty feet above property was intrusive and violated the Fourth Amendment's right against unreasonable warrantless searches); *id.* at 392 (Kelly, J., concurring) (discussing "vertical curtilage," in particular explaining that surveillance from some altitudes under 1,000 feet should not be precluded by default). In contrast, the concept of horizontal curtilage has both "ancient and durable roots," *Jardines*, 133 S. Ct. at 1414, and, the Supreme Court tells us, "is 'easily understood from our daily experience,'" *id.* at 1415 (quoting *Oliver*, 466 U.S. at 182 n.12).

[336] For a discussion of the FAA rules, see *supra* Part II.C.2.a.

[337] At some point, if the boundary were set low enough to interfere with the use and enjoyment of the property, the state rule might infringe the Takings Clause of the Fifth Amendment. *See* United States v. Causby, 328 U.S. 256, 261–62 (1946) (explaining that if flights over property deprived landowners of the use of the property for any purpose, it would be classified as a taking).

[338] Act of July 29, 2013, § 15, 2013-2014 Or. Laws 1869, 1872.

[339] *See supra* note 115 and accompanying text.

[340] *See* 49 U.S.C. § 40103(a)(1) (2012) ("The United States Government has exclusive sovereignty of airspace of the United States."); City of Burbank v. Lockheed Air Terminal Inc., 411 U.S. 624, 633 (1973) ("'Federal control [of air commerce] is intensive and exclusive.'" (quoting Northwest Airlines, Inc. v. Minnesota, 322 U.S. 292, 303 (1944) (Jackson, J. concurring)).

[341] *See* FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 336(a)(1), 126 Stat. 11, 77 (codified at 49 U.S.C. § 40101 note (2012)) ("[T]he Administrator of the Federal Aviation Administration may not promulgate any rule or regulation regarding a model aircraft, or an aircraft being developed as a model aircraft, if . . . the aircraft is flown strictly for hobby or recreational use . . . ."). To address the FAA's lack of authority to regulate hobbyist drones, Senator Diane Feinstein has proposed legislation that would give the FAA such authority and require it to make rules to ensure the safe operation of hobbyist drones. *See* Consumer Drone Safety Act, S. 1608, 114th Cong. (2015).

an (illegal) low-flying commercial newsgathering or paparazzi drone.[342] Thus, they may have a hard time determining their right of self-help. Other than this, at present, the problem of vertical curtilage is not acute. Nevertheless, it is only a matter of time before the FAA permits drone flights over roads, public spaces, and homes[343]—with minimum altitude allowance remaining the sole issue. States, or preferably Congress, could avoid both confusion and litigation if they were to establish a clear minimum height restriction for drone overflights of private property that covered both hobbyist[344] and commercial drones.[345]

B. *Clarify the Right to Self-Defense in Response to Intrusion on Seclusion*

As noted above, we have found no cases delineating the extent of the privilege for self-help in the face of an intrusion on seclusion.[346] Logic and the general sweep of tort law suggest that reasonable self-help should be privileged, but as noted above, it is remarkably difficult to determine how much force would be reasonable given the very great uncertainties about a robot's—especially a drone's—spying capabilities and intentions. In the short term, that uncertainty likely will be found to justify quite energetic self-help efforts. States should provide some guidance or else people may shoot first and ask questions later. This guidance could come by statute, or courts could provide it. In either case, given the difficulties of determining from the ground what a drone is doing or is capable of, one rule that might be worth considering is a presumption that a drone is observing those below—and thus intruding on seclusion—unless the drone makes clear somehow that it is not doing so.

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[342] To the extent that genuine news-gatherers are regulated more stringently than hobbyists who present no greater danger or disruption to the people and property below, the news-gatherers might have a quite substantial First Amendment claim as well. For a slightly contrary view, see Rivera v. Foley, No. 3:14-cv-00196, 2015 WL 1296258, at *2, *9 (D. Conn. Mar. 23, 2015) (holding that officers had qualified immunity from a claim that they unlawfully restricted journalist's use of drone to hover 150 feet above a crime scene because the First Amendment right to record police activity was not clearly established). *But see* Eugene Volokh, *No Drone Surveillance of Crime Scene (Even from 150 Feet Above), Police Say*, WASH. POST (Mar. 30, 2015), http://www.washingtonpost.com/news/volokh-conspiracy/wp/2015/03/30/no-drone-surveillance-of-crime-scene-even-from-150-feet-above-police-say/ [http://perma.cc/H4R3-XW4L] (criticizing the First Amendment analysis in *Rivera v. Foley*).

[343] Note that the overflight issue is distinct from the delivery issue. If an Amazon drone or a TacoCopter is making a delivery in response to an order, the homeowner has presumably consented to the intrusion and there is thus no trespass issue. Any relevant FAA rules would still apply (surprise gifts raise trickier issues).

[344] Note that while the FAA does not have authority to regulate hobby drones, *see* FAA Modernization and Reform Act of 2012 § 336, Congress does, subject only to whether this would be a genuine regulation of interstate commerce.

[345] *See* Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155, 187–197 (2015).

[346] *See supra* Part II.D.

C. *Reduce Uncertainty About Robots Generally*

A person confronted with a robotic trespasser, a robot that might be a spy, or a property-damaging robot, will in many cases have genuine and understandable doubts about the robot's capabilities and intentions. When, as a result of this uncertainty, a person assumes the worst about what the robot is doing or is going to do, her understandable lack of information about what the robot is capable of will—under some circumstances—provide a basis for a legal judgment that her belief was, in law, reasonable.[347] Ordinarily, when confronted with new technologies, people fear them.[348] When a technology is experimental or even just new, the social expectations needed to define a reasonable standard of care do not exist. As the use of the technology is abnormal, the risk is high that courts will find, or allow juries to find, that it is reasonable for people or even animals[349] to be afraid of the technology.[350] Because negligence is often measured against customary behavior, and new technology involves a departure from custom,[351] one would expect that robots, at least for a while, will be reasonably held to appear to pose greater threats than they actually do. At least for the near future, so long as the public remains unfamiliar with, and potentially uncomfortable around, robots, judges and juries will likely find—and would be justified in finding—that a

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[347] For an example of one citizen's reaction to finding a drone outside her window, see Kathryn A. Wolfe, *Dianne Feinstein Spots Drone Inches from Face*, POLITICO (Jan. 15, 2014, 4:15 PM), http://www.politico.com/story/2014/01/senator-dianne-feinstein-encounter-with-drone-technology-privacy-surveillance-102233.html [http://perma.cc/73CJ-D3CM].

[348] *See supra* Part II.C.2 (remarking that the novelty of drones will tend to result in more self-help); *see also* Martin Bauer, *'Technophobia': A Misleading Conception of Resistance to New Technology*, *in* RESISTANCE TO NEW TECHNOLOGY: NUCLEAR POWER, INFORMATION TECHNOLOGY, AND BIOTECHNOLOGY 97 (Martin Bauer ed., 1995) (describing fear regarding initial development of railroad and nuclear power technology); ULRIKE BARTHELMESS & ULRICH FURBACH, DO WE NEED ASIMOV'S LAWS? 5 (2014), http://arxiv.org/pdf/1405.0961v1.pdf [http://perma.cc/RVF6-LX68] ("The technical development in engineering, mining, chemistry and transportation resulted in a dominance of machines, which often was felt as a threat. There was a kind of technophobia which even resulted in fights against machines."); Brian David Johnson, *The Four Stages of Introducing New Technologies*, SLATE (Jan. 17, 2012), http://www.slate.com/articles/technology/future_tense/2012/01/new_technologies_enter_our_lives_and_society_in_four_stages_.html [http://perma.cc/4NPJ-HGU2].

[349] *See* Kyle Graham, *Of Frightened Horses and Autonomous Vehicles: Tort Law and Its Assimilation of Innovations*, 52 SANTA CLARA L. REV. 1241, 1247–50 (2012) (noting that in early automobile cases, the "mere operation of a vehicle likely to frighten horses on a public highway created a jury question as to whether [the defendant] breached his duty of reasonable care," but that "courts swiftly and soundly rejected [this] view").

[350] *See, e.g.*, Peter Huber, *Safety and the Second Best: The Hazards of Public Risk Management in the Courts*, 85 COLUM. L. REV. 277, 307–08 (1985) (arguing that courts prefer familiar hazards to new ones); Gideon Parchomovsky & Alex Stein, *Torts and Innovation*, 107 MICH. L. REV. 285, 291 (2008) (arguing that tort law has a bias against innovation).

[351] *See* Parchomovsky & Stein, *supra* note 350, at 294. This view has its critics, particularly those who see tort law as more efficient, or at least more efficient than alternatives based on regulation. *See, e.g.*, Mary L. Lyndon, *Tort Law and Technology*, 12 YALE J. ON REG. 137 (1995).

heightened level of caution and suspicion was "reasonable."[352] Seeing fear and caution as reasonable will thus tend to push judges and juries towards accepting a more muscular form of self-defense than society as a whole might decide to find reasonable once robots have become domesticated and commonplace—and it is likely to be a higher level than robot owners and operators would like.

It is not surprising that the introduction of a potentially dangerous new technology into homes, offices, and public spaces might create some uncertainty. But if indeed uncertainty is the feature common to each of these legal problems, then it follows that the way to eliminate the problems, or at least reduce their severity, will be to remove or reduce the degree of uncertainty reasonably felt by people who have unexpected or unwanted encounters with robots.

In general, uncertainty about robots will be reduced either by (1) limiting the capabilities that robot makers may legally give their creations, or (2) by creating practical or legal mechanisms by which robots clearly announce their presence, capabilities, and, perhaps, intentions. In some cases, robot operators could be incentivized to give proper notice by creating a legal presumption that it is reasonable to assume that a robot that does not give notice of its harmlessness in some standardized fashion is in fact dangerous.

1. *Prohibit Armed Robots*

Assuming there are no Second Amendment issues involved,[353] it would be entirely proper for state legislatures or Congress to make rules forbidding equipping robots with weaponry such as guns or anti-personnel devices, such as Tasers.[354] A blanket national or international[355] rule

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[352] An alternate possibility is that courts might consider the operation of a dangerous robot in inhabited areas to be an "ultrahazardous activity." An "ultrahazardous activity" is an activity that necessarily involves a risk of serious harm, which cannot be eliminated by the exercise of the utmost care and that is not a matter of common usage. *See supra* notes 39–42 and accompanying text.

[353] The Second Amendment issue would not be the robot's right to be armed, but rather the robot-owners' right to an armed robot. Given that robots operate at a remove from their controller, not to mention potentially autonomously, one could be forgiven for wondering how one could seriously argue that deploying an armed robot was "bearing arms" in a constitutional sense. For an attempt nonetheless to do just that, see Dan Terzian, *The Right to Bear (Robotic) Arms*, 117 PENN. ST. L. REV. 755, 757–58 (2013) (proposing, inter alia, a reinterpretation of *District of Columbia v. Heller*, 554 U.S. 570 (2008), that would protect a right to possess even non-"wearable" arms).

[354] Equipping robots with weaponry is, alas, far from a fantastic suggestion. *See, e.g.*, *SXSW 2014: Stun Gun Drone Zaps Intern*, YOUTUBE (Mar. 7, 2014), https://www.youtube.com/watch?v=M1KdNCMWbU4 (providing video of a Taser-equipped drone built by the Chaotic Moon corporation delivering an 80,000 volt shock to a volunteer, who was the firm's intern); Susanna Kim, *Texas Start-Up Tasers Intern Via Stun-Copter to Spark Discussion About Tech at SXSW*, ABC NEWS (Mar. 10, 2014), http://abcnews.go.com/Business/intern-tasered-drone-sxsw-explains-feels-zapped/story?id=22848505 (discussing incident at SXSW where Chaotic Moon used Taser-equipped drone to stun intern).

making it illegal to arm a robot would make it far less reasonable for a person to fear that a robot was intending to attack her. It is always possible that a rogue robot hobbyist might have equipped Robby with a six-shooter or a stun gun, but without some reason to believe Robby is packing, it will in all but the most exceptional cases be unreasonable to fear that sort of attack.[356]

Prohibiting armed robots will have the additional virtue of weakening the case for finding that operation of robots outside the lab is an ultrahazardous activity. There are substantial reasons to think that operating an armed robot might be ultrahazardous, starting with the fact that robots may be *designed* to be dangerous to people. Even if the robot is completely under the control of the remote operator, there is always a chance that someone might jam the controls, hack the robot's software, or that it might malfunction in some manner. If the armed robot has any sort of autonomy that could conceivably include fire control, the science fiction plots write themselves. The legal system is likely to be very sensitive to these possibilities regardless of the safety precautions included in the robot's design.

2. *Give Notice of Robot Capabilities*

Even if robots are unarmed (or disarmed), other concerns, including the fear of being rolled over by a robot or the fear of a drone crash, may still rise to the level of reasonableness. Personal safety fears that do not prove to be grounded in fact should be cured by time. In the case of robots, however, time alone will provide only a partial cure for uncertainty as to what a given robot can do. It is likely that certain types of robots—autonomous cars for example—will be branded in a manner that makes them distinct. They will have recognizable shapes and bear distinctive corporate logos. Perhaps some day human drivers will become so rare that they will have to give warning that a human-controlled vehicle is coming. At present, however, autonomous mode is the exception, so a car capable of driving itself should indicate when it is in autonomous mode. This would allow cautious or fearful drivers to keep the driverless vehicle at a distance.

If, in the future, Google self-driving cars have an excellent safety record after hundreds of thousands or millions of miles on the road, then it

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[355] *Autonomous Weapons: An Open Letter from AI & Robotics Researchers*, FUTURE OF LIFE INST., http://futureoflife.org/AI/open_letter_autonomous_weapons [http://perma.cc/E5UY-GXBA] (last visited Oct. 12, 2015) (containing a letter signed by more than 2,900 AI/robotics researchers and more than 1,700 other persons urging an international ban on autonomous weapons).

[356] For discussions of the viewpoint that automatic weapons system bans are required by international law, see Peter Asaro, Jus Nascendi, *Robotic Weapons and the Martens Clause*, *in* ROBOT LAW, *supra* note 19; *see also* Rebecca Crootof, *The Killer Robots Are Here: Legal and Policy Implications*, 36 CARDOZO L. REV. 1837, 1872–75 (2015).

should become progressively less reasonable to fear them. On the other hand, if Google self-driving cars were to become known for carrying automated Wi-Fi sniffers that attempt to break into every private network they pass,[357] it would become very reasonable to worry every time one passed, not to mention if one tarried in front of the house. Even after most people become familiar enough with robots to associate various capabilities with different types of robots, as much as most people today can distinguish between a bus and a backhoe, there will still be issues of perception and identification, particularly with regard to aerial robots.

From an economic perspective, the robot operator is clearly the least-cost avoider in this scenario: it would be far more expensive to expect every landowner and occupier to invest in gear capable of discerning the particulars of every robot flying overhead. The overall cost to society would be much less if the robot operator had the burden of advertising the robot's capabilities through markings, lights, or other means. Indeed, in order to shift the costs to this least-cost avoider, it might be sensible to create a general presumption that drones that fail to advertise their harmlessness are reasonably assumed to be dangerous to person or privacy.

Thus, the best way to create a balance—to ensure that drones are not unduly attacked and that people are only duly worried about what drones are doing—is to standardize how drones—and other robots as well—declare their capabilities and intentions, thus changing what fears are legally and morally reasonable. A drone with cameras or Wi-Fi sensors is a greater privacy threat than one lacking means of recording or transmitting personal information. The ordinary person, however, cannot be expected to evaluate the potential harmfulness of a drone as it buzzes along at thirty feet in the air, much less a hundred.

Mandatory—and effective—notice is thus critical both ex-ante and ex-post.[358] Ex-ante notice enables more accurate warnings of what the robot is able to do, thus informing—or defanging—threat assessment. Whatever rules are adopted, society will need standards defining both robot harmlessness and common types of danger, and standardized means of advertising both harmlessness and dangerousness. Developing these grammars may be especially challenging for robots with some autonomy, and even more so for those capable of emergent behavior. In addition, ex-

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[357] Although it did not involve robots or self-driving cars, Google's national mapping initiative included a secret program to capture information about not only the location of public Wi-Fi networks but even private Wi-Fi networks and the traffic carried on those networks. *See* David Kravets, *An Intentional Mistake: The Anatomy of Google's Wi-Fi Sniffing Debacle*, WIRED (May 2, 2012, 7:18 PM), http://www.wired.com/threatlevel/2012/05/google-wifi-fcc-investigation/ [http://perma.cc/8GKC-2E2F].

[358] Despite their critics, notice regimes remain valuable. *See* M. Ryan Calo, *Against Notice Skepticism in Privacy (and Elsewhere)*, 87 NOTRE DAME L. REV. 1027, 1071 (2012) (exploring arguments for and against mandatory notice).

post notice combined with a licensing regime will help connect a malfeasant robot to its owner or operator.

a. Ex-Ante Notice: Warnings

The idea of enacting legal rules requiring the operator of scary new technology to warn the public about it is far from new. The poster child for what now seems like excessive warning is likely the so-called Red Flag Act of 1865,[359] which required:

> Every Locomotive propelled by Steam or any other than Animal Power on any Turnpike Road or public Highway [to have at least three drivers or conductors] . . . [O]ne of such Persons, while any Locomotive is in motion, shall precede such Locomotive on Foot by not less than Sixty Yards, and shall carry a Red Flag constantly displayed, and shall warn the Riders and Drivers of Horses of the Approach of such Locomotives, and shall signal the Driver thereof when it shall be necessary to stop, and shall assist Horses, and Carriages drawn by Horses, passing the same.[360]

The original Red Flag rule lasted seventeen years, being amended in 1878 to require the flagman to be only twenty yards in front of a motorcar.[361] It seems silly now, but in its day, the Red Flag Act may have seemed a reasonable response to the risk of stampeding livestock that could be terrified by the loud noises and occasional steam blasts from early boiler engines.[362]

The Red Flag Act had another provision, however, that looks increasingly modern. In addition to the flagman, the Act required lights: "Sixthly, any Person in charge of any such Locomotive shall provide Two efficient Lights to be affixed conspicuously, One at each Side on the Front of the same, between the Hours of One Hour after Sunset and One Hour before Sunrise."[363] The idea of requiring cars, and now planes and

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[359] Locomotives Act 1865, 28 & 29 Vict. c. 83 (Eng.).

[360] *Id.* § 3.

[361] *See* Highways and Locomotives (Amendment) Act 1878, 41 & 42 Vict. c. 77, § 29 (Eng.) (amending section 3 of Locomotives Act 1865). The Act made no distinction between automobiles and locomotives.

[362] ARVID LINDE, PRESTON TUCKER AND OTHERS: TALES OF BRILLIANT AUTOMOTIVE INNOVATORS & INNOVATIONS 113 (2011). In fact, however, "[a] Parliamentary committee in 1873 determined that a man walking 60 yards ahead of a car and waving a red flag was not particularly effective since roads were often busy enough with horses and carts and bicycles and whatnot that the man got lost in the traffic. Also, waving a red flag on busy streets tended to frighten horses more than it warned their owners of an approaching danger." *The New London to New Brighton Antique Auto Run*, SOLIVANT, http://www.solivant.com/oldcars/ [http://perma.cc/TQC8-9JHQ] (last visited Aug. 15, 2015).

[363] Locomotives Act 1865, 28 & 29 Vict. c. 83, § 3 (Eng.).

helicopters, to have running lights when operating in the dark lives on and needs to be extended to any robots that will travel outdoors, especially aerial ones.

In order for a person to be able to make an accurate threat assessment of a trespassing or nearby robot, something must warn that person of the robot's capabilities or give accurate indication of its relative harmlessness. A solid blue light, for example, might indicate the absence of any surveillance device; flashing red and blue could mean a police drone (don't shoot that); other colors might indicate various surveillance capabilities. Placing the duty on the drone owner by requiring a declaration of harmlessness in order to enjoy a safer—but perhaps not entirely safe—harbor would follow the precedent set by the international conventions regulating civilian aircraft.[364] Similarly, a rule requiring clear markings and lights to distinguish official robots from civilian ones would follow the precedents that restrict distinctive lighting combinations to emergency vehicles and law enforcement. Currently, no international standard for car and truck emergency and police lights exists,[365] and indeed domestic U.S. practices vary somewhat by state or even locality,[366] but one of the advantages of writing a rule now, before large numbers of drones are manufactured and deployed, is that a consistent national (and, ideally,

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[364] Under international humanitarian law, medical aircrafts that identify themselves during armed conflict by using a flashing blue light are entitled to protection and even special assistance and landing rights. Protocol Additional to the Geneva Convention of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts annex 1 art. 6, June 8, 1977, 1125 U.N.T.S. 3, 50; *id.* arts. 24, 30, 1125 U.N.T.S. at 16, 18. For a general discussion of the (relatively narrow) application of international law of armed conflict to the marking of remotely piloted vehicles, see Ian Henderson, *International Law Concerning the Status and Marking of Remotely Piloted Aircraft*, 39 DENV. J. INT'L L. & POL'Y 615, 619–21 (2011).

[365] Although the UN Convention on Road Traffic annex 5 ¶ 42, Nov. 8, 1968, 1042 U.N.T.S. 17, 59 and also UN Regulation No. 65, E/ECE/324/Rev.1/Add.64/Rev.2/Amend.1 ¶¶ 1.1, 2.1 discuss the use of blue and amber as "special warning lamps" and red, white, or blue for flashing lamps, there is no effective international standard color for emergency vehicles, and there are still many countries with other systems even in the EU. "There is currently no uniform approach among all 27 Member States on the colour and use of emergency lights on ambulances and fire engines; the colour used may differ from one Member State to the other." Eur. Parl., Comm. on Petitions, Notice to Members, Petition 1268/2011 by Alberto Lemos da Silva (Port.) (May 30, 2012) (complaining of non-uniformity of Spanish emergency vehicles).

[366] *See, e.g.*, CAL. VEH. CODE § 25259 (West, Westlaw through urgency legislation of Ch. 807 of 2015 Reg. Sess.) (allowing authorized emergency vehicles to display flashing amber warning lights); COLO. REV. STAT. ANN. § 42-4-213(2) (West, Westlaw through 2015 1st Reg. Sess.) (requiring flashing or oscillating red for emergency vehicles and reserving them for their use and permitting blue, white, or blue in combination with white as optional additions); CONN. GEN. STAT. ANN. §§ 14-96p, 14-96q (West, Westlaw through 2015 Reg. Sess. and June Spec. Sess.) (reserving flashing white for officially permitted uses including volunteer ambulances and flashing red for various fire vehicles and vehicles transporting students with disabilities); VA. CODE ANN. § 46.2-1025(C) (West, Westlaw through 2015 Reg. Sess.) (permitting funeral procession vehicles to use purple warning lights); WASH. REV. CODE ANN. § 46.37.190(1) (West, Westlaw through 2015 Reg. Sess.) (requiring that authorized emergency vehicles be equipped with at least one red light and siren).

international) standard could be set.

This last point bears emphasis: the perfect time to establish a national standard for mobile robot warning lights is now, before there is a substantial installed civilian base without standard warning equipment. The more that private owners deploy aerial drones or land-based mobile robots without standard lights, the greater the cost of retrofitting the lights later—or the larger the class of unlighted and grandfathered-in robots, potentially undermining the effectiveness of any warning system.

An alternative but more expensive rule would be to require that drones at least—and perhaps autonomous land- and water-based robots also—carry something akin to the automatic dependent surveillance-broadcast (ADS-B) transponders currently required for aircraft.[367] This device would broadcast information including a unique identification number, location, altitude, velocity, and perhaps basics about the capabilities of the robot. Transponders have advantages and disadvantages over colored lights in that a transponder sends alphanumeric information, which can be detected from farther away, and when decoded is easier to record and harder to misread than a light.[368] The information-bearing potential of lights is also reduced by the color blindness of a substantial fraction of the population.[369] On the other hand, decoding transponder information requires equipment not commonly found in the home.[370] Even if that equipment were issued to first responders, flying intruders, at least, might be long gone before the reader reached the scene. Transponders, however, are expensive[371] (although the readers less so[372]), and are substantially heavier than a few small LED lights.

Yet another possibility would be to require RFID chips in drones, as

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[367] *See* 14 C.F.R. § 91.225 (2015) (defining ADS-B requirements for aircraft and requiring that aircraft carry them by 2020).

[368] *ADS-B Frequently Asked Questions*, FED. AVIATION ADMIN., http://www.faa.gov/nextgen/programs/adsb/faq/ [http://perma.cc/3DS3-CSCG] (last visited Sept. 4, 2015).

[369] *See* Ananya Mandal, *Color Blindness Prevalence*, NEWS MED. (Feb. 5, 2014), http://www.news-medical.net/health/Color-Blindness-Prevalence.aspx [http://perma.cc/9NKT-76GR] ("According to 2006 estimates from the Howard Hughes Medical Institute, around 7.0% of the male population and 0.4% of the female population cannot differentiate between red and green or they perceive red and green differently to other people.").

[370] Another, far too expensive, alternative would be to set up a national grid akin to air-traffic control for drones.

[371] Current prices for an ADS-B transponder for an aircraft are about $10,000. *See* Jim Moore, *Many Choices for ADS-B Equipage*, AOPA (Mar. 28, 2013), http://www.aopa.org/News-and-Video/All-News/2013/March/28/Many-choices-for-ADS-B-equipage [http://perma.cc/EGB6-89CJ]. Less capable transponders are less expensive, with Mode C transponders selling for under $2,000. *Featured Mode C Transponders*, SARASOTA AVIONICS INT'L, http://sarasotaavionics.com/category/transponders/mode-c-transponders [http://perma.cc/889X-Y2FM] (last visited Sept. 4, 2015).

[372] *See, e.g.*, *Encoders*, WINGS & WHEELS, http://wingsandwheels.com/avionics-instruments/transponders/encoders.html [http://perma.cc/RRA7-9F2H] (last visited Aug. 15, 2015) (pricing encoders at around $300).

these are much lighter weight.[373] Passive RFID chips are much less expensive than transponders,[374] but their range is also much shorter—commonly, only a few meters.[375] Battery-powered RFID tags, however, already can achieve a range of up to 300 feet.[376] RFID readers cost about $500.[377] Until the ordinary person has an RFID reader, this solution too will be of limited value.

The lowest-cost, but also only partially effective, real-time notice alternative would be to require drones, and especially indoor and land-based robots, to bear distinctive exterior markings giving notice of their capabilities. The marking strategy might be as simple as having a reserved safe-harbor color for robots that record no information about their surroundings, or it could be as complicated as developing a national or international code for robot capabilities somewhat like the widely used U.S. road symbols.[378] A suitable pictogram-based marking strategy could, in the best case, convey important information quickly, but would not be effective in all scenarios.

The fuselage-marking option has the great disadvantage of being of little value at night. Markings on most drones, not to mention on the smaller ones, would be hard to discern once the drones achieved any substantial altitude. On the other hand, markings might work better for land-based robots, and they could work particularly well for robots that would be used in situations where people would likely encounter the robot repeatedly, such as a household or office robot.

b. Ex Post Notice: Robot Identification

When, by accident or plan, a robot has harmed a person or property, the victim will need a way to trace the robot to the party responsible for the damages.[379] For remotely controlled robots, the responsible party will usually be the robot's operator or owner. Other scenarios are possible,

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[373] *Active vs. Passive RFID*, JOVIX, http://atlasrfid.com/jovix-education/auto-id-basics/active-rfid-vs-passive-rfid/ [http://perma.cc/U8DN-6QC6] (last visited Sept. 4, 2015).

[374] *Id.*

[375] *Id.*

[376] *RFID Frequently Asked Question: From How Far Away Can a Typical RFID Tag Be Read?*, RFID J., http://www.rfidjournal.com/faq/show?139 [http://perma.cc/E4FF-F3MJ] (last visited Aug. 15, 2015).

[377] *RFID Frequently Asked Question: How Much Do RFID Readers Cost Today?*, RFID JOURNAL, http://www.rfidjournal.com/faq/show?86 [http://perma.cc/6RVP-SX8A] (last visited Aug. 15, 2015).

[378] For a list, see U.S. DEP'T OF TRANSP., MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (2009), http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/mutcd2009r1r2edition.pdf [http://perma.cc/P4CG-ECL5]; *see also* National Standards for Traffic Control Devices; the Manual on Uniform Traffic Control Devices for Streets and Highways; Revision, 74 Fed. Reg. 66730 (Dec. 16, 2009) (describing changes from earlier edition).

[379] *See, e.g.*, Act of July 29, 2013, § 15(b), 2013-2014 Or. Laws 1869, 1872 (requiring trespass victims to give notice to drone owner before cause of action accrues).

however. For example, if the injury was due to a design or manufacturing defect in a mass-produced robot, then under basic product liability rules the manufacturer and seller would be liable instead of the owner. If the robot has indicia of a manufacturer, as does a modern car or boat, that will suffice to trace a responsible party. Even in this case, however, the third-party victim would still be entitled to sue the owner or operator who would then have to sue the manufacturer or seller. There will be few if any robot-harm scenarios, however, in which the victim would have no claim at all against either the owner or operator except for those (1) where the robot was blameless and the harm was in fact caused by a third party;[380] (2) a third-party interferes with or takes control of the robot and the owner or operator is blameless for failing to prevent it; or (3) the owner or operator herself is the victim.

For autonomous robots, the responsible party will in the most common cases be the owner. There are, however, esoteric possibilities that go beyond the scope of this Article. For example, imagine a gardening robot, with significant autonomy, capable of learning from experience. Imagine further that the robot owner's neighbor has been teaching the robot silly robot tricks while the owner is at work. In the course of demonstrating the robot trick, while both the owner and the neighbor are away, the robot injures a worker who has come to deliver something. Depending on the facts and on one's theories of responsibility and deterrence, one might assign responsibility for this tort to the neighbor, the owner, the robot's programmer, the robot's designer, and/or the robot's manufacturer.[381]

Setting up a licensing regime and national or state-based registries would help connect a malfeasant robot to its owner or user. Unfortunately, no single system is likely to work in all circumstances. Because drones can be small and may be used outdoors in low-light situations, license plates or airplane-style markings alone may be poor solutions. Conversely, license plates or markings should work well for larger and purely terrestrial robots. The RFID and transponder regimes discussed above[382] require detection gear and may not be effective if the robot does not remain at the scene of the injury.

Even if they are not always visible, giving flight-capable robots an equivalent to aircraft tail markings would at least provide some means of connecting robots to responsible parties. Land-based robots, and perhaps airborne ones also, could be required to carry a standardized internal marking equivalent to Vehicle Identification Numbers (VINs). NHTSA has required that all cars sold in the United States since model year 1981 carry

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[380] For example, if a third party pushes the robot onto the victim.

[381] Scenarios like this make one doubt projections about the future shortfalls in lawyer employment, at least until robots themselves can do the work.

[382] *See supra* notes 367–68 and accompanying text.

a seventeen-character VIN,[383] and the rule has since been extended to other vehicles and certain car parts.[384]

Requiring the equivalent of VINs on mobile robots and creating an owner's registry would not only help identify the responsible party in the case of robot torts, but would also have the side-benefits of helping deter robot thefts and of making it easier to reunite owners with stolen robots after they were recovered. Interestingly, NHTSA's authority to issue a safety standard requiring standardized VINs has been upheld on the grounds that the requirement contributed to vehicle safety (indirectly) by reducing errors in compiling data on motor vehicle crashes that could be used to understand safety problems, support future safety standards, and help trace stolen vehicles.[385] As this Article went to press, the FAA announced it was creating a task force to develop recommendations for required registration of drones.[386]

A better solution, inspired somewhat by Alaska's drone legislation,[387] would be to require drones or drone operators to file flight logs. For travel over urban or other sensitive areas, the flight plan requirement might be ex-ante, just as current pilots must file a flight plan before takeoff. In other cases, however, one might require real-time transmissions for drones of a certain size or value and post-flight filing of time-stamped position data for others. Both would require mandating an on-board GPS-based position-logging device, akin to the wrist-watch-sized devices available today for runners and bicyclists.[388] The data could be provided to the public in searchable form like existing real-time flight trackers for manned aircraft.[389] Indeed, NASA and Verizon are developing technology to use

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[383] *Vehicle Identification Numbers (VINs)*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., http://www.nhtsa.gov/Vehicle+Safety/Vehicle-Related+Theft/Vehicle+Identification+Numbers+(VINs) [http://perma.cc/JYQ7-T4LK] (last visited Aug. 15, 2015). The National Motor Vehicle Title Information System, operating under the authority of the U.S. Department of Justice by the American Association of Motor Vehicle Administrators, maintains and tracks motor vehicle title histories. 49 U.S.C. §§ 30502, 30503 (2006).

[384] *Vehicle Identification Numbers (VINs)*, *supra* note 383.

[385] Vehicle Equip. Safety Comm'n v. NHTSA, 611 F.2d 53, 54 (4th Cir. 1979); *see also* New York v. Class, 475 U.S. 106, 111–12 (1986) (discussing advantages of VINs including reducing the number of people not compensated for accidents, working with state registration and safety requirements, and concluding that because VINs help identify stolen autos, which are disproportionately involved in accidents, "the VIN safeguards not only property but also life and limb").

[386] *U.S. Transportation Secretary Anthony Foxx Announces Unmanned Aircraft Registration Requirement*, U.S. DEP'T OF TRANSP. (Oct. 19, 2015), https://www.transportation.gov/briefing-room/us-transportation-secretary-anthony-foxx-announces-unmanned-aircraft-registration [https://perma.cc/DW9N-KG8P].

[387] *See supra* note 269 and accompanying text.

[388] Email from Edward Hasbrouck to author (May 26, 2014) (on file with author).

[389] *See, e.g.*, FLIGHTRADAR24, http://www.flightradar24.com (last visited Aug. 15, 2015) (providing a real-time searchable online flight tracking service).

cellphone towers to monitor the location of low-altitude drones.[390]

3. *Recommendation: A Mixed Approach*

In light of these considerations, we suggest a mixed approach in which all mobile robots[391] would be required to carry warning markings, lights, and the equivalent of a VIN that would be recorded in a state or national registry. We do not recommend the RFID chip solution as readers are not in common use, and, in any case, the detection range is not yet adequate. Drones capable of carrying a camera or other sensor should be required to carry a sealed position-logging device that timestamps the drone's location, and the operator should be required to file flight plans, either in real time, if practicable, and otherwise within twenty-four hours of flight.

No discussion of a notice regime would be complete without some discussion of cheating. Notice regimes are ineffective when there are a sufficient number of bad actors. In a world with widespread cheating, notice is not reliable, so it becomes more reasonable to look at all drones as potential threats. Even a relatively small number of bad actors—or liars—can undermine a notice regime if they cause dangerous false reliance. Enforcement of disclosure rules for robots in general, and drones in particular, will be difficult, but civil and even criminal penalties for false statements may be in order. Were society to transition to a legal regime in which the default rule privileged reasonable self-defense, but the owner-operator's standardized and intelligible declaration of harmlessness made self-defense presumptively *un*reasonable, then a false statement of harmlessness should be considered fraud or worse. We propose that misidentifying a robot not only be tortious, but also subject the responsible party to a criminal penalty comparable to that for falsifying or obscuring a license plate,[392] and that the penalty for falsifying or altering a robot's internal unique identification number be equivalent to the penalty for altering a VIN.[393]

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[390] Mark Harris, *NASA and Verizon Plan to Monitor US Drone Network from Phone Towers*, GUARDIAN (June 3, 2015), http://www.theguardian.com/technology/2015/jun/03/verizon-nasa-drones-cellphone-towers [http://perma.cc/K5YD-268S].

[391] One could limit it to mobile robots that operated outside the owner's property, but that would fail to cover the cases of robots operating on properties where tradespeople and members of the public might be invited to enter.

[392] *See, e.g.*, CAL. VEH. CODE § 20 (West, Westlaw through Ch. 3 of 2014 Reg. Sess.) (making it a crime to make a false statement in applying for a license plate).

[393] *See, e.g.*, 18 U.S.C. § 2321 (2012) ("Whoever buys, receives, possesses, or obtains control of, with intent to sell or otherwise dispose of, a motor vehicle or motor vehicle part, knowing that an identification number for such motor vehicle or part has been removed, obliterated, tampered with, or altered, shall be fined under this title or imprisoned not more than ten years, or both.").

V. ROBOT RIGHTS AGAINST PEOPLE

People have significant rights and privileges permitting them to defend themselves against various physical, property, and privacy harms that might be committed by robots. These rights, however, are not unlimited. The existence of limits on human rights to self-defense tells that there must be cases where, in effect, the robots have a right not to be harmed. We hasten to add that today "robot rights" can only be shorthand for the rights of the robots' owners or the owner's agents. In law, at present, a robot has the same rights as a sock.[394] Perhaps someday robots will achieve or simulate sentience to the point where society recognizes them as legitimate holders of some bundle of rights, be it those held by animals, citizens, or something in between. At present, however, the idea of "robot rights" is in fact only a proxy for "robot-owner's rights."

Even so, we can deduce some correlatives[395] from the description of when people are privileged to fight back and when they are not. In Hohfeldian terms, when the state creates a right for one person, it creates a corresponding duty to respect that right on one or more others.[396] Similarly, if the state gives a person a privilege to act, it disables others from making legal complaints if that privilege is exercised.[397] We have seen that a person has a privilege to self-defense against robots if the robot attacks her or if she reasonably believes the robot is about to harm her. The same holds true for threats to third parties. The only limit on this privilege is that the belief must be objectively reasonable, in that a judge or jury would find that a reasonable person could have believed it under the circumstances. Thus, the correlative right of a robot—recall, this is shorthand—is to not be injured by persons who unreasonably believe the robot is dangerous.

Regarding threats to and damage to property, the calculation is more complicated. People have a privilege to damage a robot to protect property, but only so long as the property being protected reasonably seems more

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[394] *See* Richards & Smart, *supra* note 19.

[395] *See generally* Wesley Newcomb Hohfeld, *Some Fundamental Legal Conceptions as Applied in Judicial Reasoning*, 23 YALE L.J. 16 (1913).

[396] Joseph William Singer, *The Legal Rights Debate in Analytical Jurisprudence from Bentham to Hohfeld*, 1982 WIS. L. REV. 975, 987 (1982) ("Legal rights, according to Hohfeld, are not merely advantages conferred by the state on individuals. Any time the state confers an advantage on some citizen, it necessarily simultaneously creates a vulnerability on the part of others. Legal rights are not simply entitlements, but jural relations. Correlatives express a single legal relation from the point of view of the two parties. '[I]f X has a right against Y that he shall stay off the former's land, the correlative (and equivalent) is that Y is under a duty toward X to stay off the place.'").

[397] *Id.* ("[P]rivileges are the correlatives of no-rights. 'Whereas X has a *right* or *claim* that Y, the other man, should stay off the land, he himself has the *privilege* of entering on the land; or in equivalent words, X does not have a duty to stay off.' If A has no duty toward B, A has a privilege to act and B has no right against A. Thus, if A has the privilege to do certain acts or to refrain from doing those acts, B is vulnerable to the effects of A's actions. B cannot summon the aid of the state to prevent A from acting in such a manner no matter how A's actions affect B's interests.").

valuable than the robot, subject always to the reasonable imperfections of the victim's ability to discern the relative values. Thus, the robot's right is to not be damaged in order to save clearly less valuable property.

Privacy is more complicated still. First, although we suggest that intrusion on seclusion should give rise to a privilege of self-help, the question is not free of all doubt. Assuming there is a self-help privilege, there are still the twin problems of valuation and detection. Not only are robots hard to value, but so too are many forms of privacy. Worse, at present, it is nearly impossible for the reasonable person to tell if a robot that enters her property is collecting images, seeking local Wi-Fi or other data, or if it might be about to do so. If it is really the case that a reasonable person will be justified in suspecting any robot that is hovering nearby (or maybe that has been hovering for some time) of seeking to invade her privacy, then the conclusion is that trespassing robots have no rights at all until and unless they do something to demonstrate that they are not a threat to privacy.

Finally, we note that even when a person unjustly attacks a robot, the robot has no privilege, much less a right, to harm a person in its own defense. In this sense, Isaac Asimov predicted at least one law of robotics completely accurately.