

SELF-DEFENSE AGAINST ROBOTS

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I. Introduction

Deployment of robots in the air, the home, the office, and the street inevitably means their interactions with both property and living things will become more common and more complex. This paper 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 Robotics¹ 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 paper 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 regulation may trump the common law. Because it is in most cases obvious that humans can use force to protect themselves against actual physical attack, the paper 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—perceptions which may not always be justified, 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

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 to 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).

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 destroy expensive property to protect inexpensive property. The test is one of cost-benefit: the chattel that poses the threat may be harmed only if the cost of that harm is less than the cost of the harm that will otherwise be done by the chattel.

Privacy intrusions complicate the calculus. Intrusion upon 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. In principle, a tort is a tort, so some self-help should be justified.

In Part II.D we argue that the scope of permissible self-help in defending one's privacy should be quite broad. There is exigency in that 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 hard 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-upon-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 shoot at or disable a drone, as the projectile or the falling drone could injure bystanders or their property.

² See *infra* text accompanying notes 98-100.

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 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 some 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 over-protect their property against damage from robots. What is more, so long as this uncertainty about robot danger (whether as a class, or in

³ See *infra* § II.A.

specific cases of ambiguously dangerous robots) is widespread, tort law will tend to treat this over-protective 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—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 presented a reasonable risk of danger to third parties, such as shooting into the air in populated areas.⁷

5. There is uncertainty as to the vertical perimeter 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 upon 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 ordinary 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

⁴ See *infra* §§ II.B, II.C.

⁵ See *infra* § II.D.

⁶ See *infra* §§ II.C, II.D.

⁷ See *infra* text accompanying note 72.

⁸ See *infra* §II.C.2.a.

⁹ See *infra* § II.D.

¹⁰ See *infra* § II.B.

more expensive than they 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 these problems spring from some kind of uncertainty about, or relating to, robots. We therefore suggest measures to reduce those uncertainties, ranging from forbidding weaponized robots to requiring lights, and other markings that would announce a robot's capabilities, and RFID chips and 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, harming you in your technical right to exclusive possession. Drones, like manned aircraft, will crash, and should Google Maps provide misinformation, the 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.

As technology enables new ways for individuals and their mechanical agents to commit torts, the law must respond. 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

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 they need to defend themselves against a robot our proposals at least address this issue indirectly in that it will matter less frequently.

with a human who appears poised to commit a tort¹² but that strategy may not 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.”¹³ 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 imposed 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,¹⁴ these actions are permissible only because of a legal privilege.¹⁵

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 or even fraud, but we leave those for another day. In order to determine the extent to which people have 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

¹² W. KEETON PAGE ET AL., PROSSER AND KEETON ON 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. Negotiation will never work, so the privilege of self-help should be correspondingly broader than elsewhere.

¹³ Douglas Ivor Brandon et al., *Special Project: Self-Help: Extrajudicial Rights, Privileges and Remedies in Contemporary American Society*, 37 VAND. L. REV. 845, 852 (1984) (hereinafter Vanderbilt Special Project).

¹⁴ Richard A. Epstein, *Property Rights on the Frontier: The Economics of Self-Help and Self-Defense in Cyberspace: The Theory and Practice of Self-Help*, 1 J. L. ECON. & POL’Y 1, 3 (2005).

¹⁵ 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).

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 held liable for their own acts or omissions.¹⁶ Nevertheless, throughout this paper 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.¹⁷

Usually a person who has been wronged is expected to go to law for redress. Indeed, it is common to claim that one of the hallmarks of modern civilization is that personal revenge and vendetta have been displaced by due process and state-controlled remedies.¹⁸ In contrast, self-help is personal and extrajudicial. Nevertheless, two¹⁹ factors justify carving out a self-help privilege.²⁰ First, the law recognizes that the judicial remedies

¹⁶ 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 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*, http://works.bepress.com/curtis_karnow/9.

¹⁷ 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 paper.

¹⁸ See Vanderbilt Special Project, *supra* note 13, 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).

¹⁹ 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 Vanderbilt Special Project, *supra* note 13, at 853 ("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 increase the chances of [the initial] aggression.").

²⁰ See Vanderbilt Special Project, *supra* note 13, at 853.

available may sometimes be inadequate, or self-help remedies superior.²¹ Second, the law recognizes that in certain circumstances the use of self-help will only minimally impair society's interest in law and order.²² 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 proportionate counter-violence.²³ But threats to property, especially meager threats like technical trespass, cannot in the main justify harms to persons.²⁴ A property owner may defend his property only with such steps as society views as reasonably necessary.²⁵ In the classic common law cases, this meant that potentially lethal self-help was rarely allowed just to protect against threats to property.²⁶ That standard has been modified by statute.²⁷ Thus the key issue in mapping

²¹ Richard Epstein notes as an example that no one is forced to pay for goods that have not been delivered. "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." Epstein, *supra* note 14, at 26.

²² See Vanderbilt Special Project, *supra* note 13, at 853.

²³ See RESTATEMENT (SECOND) OF TORTS §§ 63-66 (1965); RESTATEMENT OF TORTS §§ 63-66 (1934).

²⁴ See, e.g., *Anderson v. Smith*, 7 Ill. App. 354, 358 (Ill. 2d Dist. Ct. App. 1880) (noting that because the law places "such a transcendent value upon human life . . . [.] 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 W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS 133-34 (5th ed. 1984) ("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).

²⁵ 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."); *id.* at § 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 . . .").

²⁶ See, e.g., *Bird v. Holbrook*, (1828) 130 Eng. Rep. 911 (C.P.) (imposing liability on an owner who left a spring gun to injure a trespasser); see also RESTATEMENT OF TORTS § 79 (1934) (recognizing privilege to use deadly force in defense of property only where

the scope of permissible self-help against robots will be defining the harm posed by a tortfeasor robot: the threat of limited harms justifies only limited self-help remedies, while great harms may justify unique and severe self-help remedies.²⁸

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. And, while privileging the application of force in self-defense does risk breaching the peace, the damage has in some sense already been done when the initial attacker breached the peace; allowing the invocation of a self-defense privilege will not in most cases make matters notably worse.

necessary to protect the occupant from death or serious bodily harm). *But see* Scheurman v. Scharfenberg, 50 So. 335 (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 more generally permissible. *See* RESTATEMENT 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.* at cmt. e.

²⁷ *See, e.g.,* FLA. STAT. § 782.02 (2013) ("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."); CAL. PENAL CODE § 197 (West, Westlaw through Ch.1 of 2014 Reg. Sess.) ("Homicide is also justifiable when . . . committed in defense of 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 . . .").

²⁸ *See, e.g.,* Hummel v. State, 99 P.2d 913 (Okla. Crim. App. 1940) (recognizing privilege to castrate mongrel bull where it threatened to impregnate thoroughbred cattle); McKeesport Sawmill Co. v. Pennsylvania Co., 122 F. 184 (C.C.W.D. Pa. 1903) (stating in dicta that railroad might be justified in taking more extreme measures than an ordinary landowner because of its public duties and the unique harm posed by obstructions on the tracks).

As a general matter humans may only use reasonable force against other people to protect themselves against from physical harm including both assault and battery.²⁹ When humans are endangered by property, the quantum of force permitted against that property is more expansive than when a person is threatening the harm³⁰ but still not unlimited.³¹ 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.³² 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.³³

At present under the law of all U.S. jurisdictions, all robots, no matter how clever or autonomous, are property.³⁴ Thus, under these standard tort principles, in any case in which a robot reasonably appears to threaten human life or even threatens to commit

²⁹ RESTATEMENT OF TORTS §§ 63-66 (1934); RESTATEMENT (SECOND) OF TORTS §§ 63-66 (1965).

³⁰ See, e.g., *Pennsylvania v. Baker*, 74 Pa. D & C. 2d 595, 600 (C.C.P. Pa. 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.").

³¹ 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 W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS 136 (5th ed.) ("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.").

³² RESTATEMENT OF TORTS § 261 (1934) ("One is privileged to use or otherwise intentionally intermeddle with a chattle in the possession of another for the purpose of defending himself or a third person . . .").

³³ RESTATEMENT (SECOND) OF TORTS §§ 63-64 (1965) (addressing defending against person threatening to cause non-life-threatening personal injury); RESTATEMENT (SECOND) OF TORTS § 261 (1965) (addressing defending against chattel threatening to cause non-life-threatening personal injury).

³⁴ Justice Oliver Wendall Holmes defined "property" as anything for which there exists a market, i.e., anything treated as property over an extended period of time. *The Path of the Law*, 10 HARV. L. REV. 457, 476-77 (1897).

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 decision making from potential victims or rescuers in emergencies.³⁵

In light of the newness of robotic technology, an alternate legal theory for drone-operator liability, and perhaps 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 liability³⁶ 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.³⁷ When airplanes were new and experimental, their use was considered an ultrahazardous activity and was subject to a strict-liability regime.³⁸ The rationale was that airplanes were (1) dangerous

³⁵ See, e.g., *Anderson v. Smith*, 7 Ill. App. 354, 360-61 (Ill. 2d Dist. Ct. App. 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 generally W. Page Keeton, et al., *Prosser and Keeton on Torts* 125 (5th ed. 1984) (“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.”).

³⁶ Strict liability is the opposite of fault-based liability—it imposes liability even absent negligence or intent to harm. In that way it imposes an absolute duty to not cause harm.

³⁷ This again follows from the general reasonableness standard because the harm threatened by ultrahazardous activities is so severe.

³⁸ See RESTATEMENT OF TORTS § 520 cmt. g (1934) (“[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.”); RESTATEMENT (SECOND) OF TORTS § 520A (1965) (“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

and (2) uncommon.³⁹ 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, however, still somewhat uncommon—although the impetus for this paper is the prediction that robots will become common soon. Thus, 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 as regards 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.

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.”); Timothy M. Ravich, *The Integration of Unmanned Aerial Vehicles Into the National Airspace*, 85 N.D. L. REV. 597, 603 (2009) (noting that “an early view of aviation—whether by balloon or by something else—[was] as an ultrahazardous activity”); P.F. Boherty, *Torts in Aeronautical Navigation*, 19 Temp. L.Q. 496, 496 (1946) (noting that at the end of 1945, eighteen states had a rule “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 injury to persons or property on the land or water beneath . . . whether such owner was negligent or not”).

³⁹ See RESTATEMENT OF TORTS § 520 (1934) (“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.”); RESTATEMENT (SECOND) OF TORTS § 520 (1965) (“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.”).

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 destroy expensive property to protect inexpensive property.⁴⁰ The test is one of cost-benefit: the chattel that poses the threat may be interfered with only if the expected cost of that interference is less than the expected cost of the harm that will otherwise be done by the chattel.⁴¹

If a person may not 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.⁴² 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 decision making under stress need not be perfect. As one court put it, if a chicken-owner was privileged to shoot a trespassing, hungry 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 was 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."⁴³

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.

⁴⁰ Cf. RESTATEMENT (SECOND) OF TORTS § 260 (1965) (noting that the "harm inflicted [must not be] unreasonable as compared with the harm threatened").

⁴¹ See, e.g., *Nesbitt 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 harm threatened, the kind of property in peril, from whom or what the danger proceeds, the relative importance of the harm threatened, and what is done in defense").

⁴² Cf. W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS 136 (5th ed.) ("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.").

⁴³ *Johnston v. Wilson*, 123 S.E. 222, 224 (Ga. Ct. App. 1924).

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.⁴⁴ Trespass is a strict-liability tort, meaning that defendants are liable even in the absence of any negligence on their part.⁴⁵ Trespass is actionable even when accidental. One need only intend to enter the land to commit a trespass, and 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 justify a lawsuit.⁴⁶

Unlike in cases of actual physical harm—where damage includes a physical base 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—just grass that has been trodden down. If the intruder's damage is small, it follows that the self-help reprisal must be small too, or else it exceeds the privilege.⁴⁷

⁴⁴ RESTATEMENT (SECOND) OF TORTS § 158 (1965); RESTATEMENT (THIRD) OF TORTS § 50 (2012).

⁴⁵ RESTATEMENT (SECOND) OF TORTS § 158 (1965); RESTATEMENT (THIRD) OF TORTS § 50 (2012).

⁴⁶ Trespass protects the right of exclusive possession, not merely the tangible property itself. RESTATEMENT (THIRD) OF TORTS § 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 . . .”).

⁴⁷ *Cf.* RESTATEMENT (SECOND) OF TORTS § 260 (1965) (noting that the “harm inflicted [must not be] unreasonable as compared with the harm threatened”).

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.⁴⁸ So when inanimate chattels such as cars,⁴⁹ or construction equipment⁵⁰ 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.⁵¹ The privilege (to interfere with another's chattel) is narrow here because it is triggered by a relatively insignificant harm.

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).⁵² Often granted today by estray⁵³ statutes,⁵⁴ the right to capture and hold as security trespassing animals derives from the ancient legal remedy of *distrain*

⁴⁸ RESTATEMENT (SECOND) OF TORTS § 158 (1965).

⁴⁹ *Rossi v. Ventresca Bros. Const. Co.*, 405 N.Y.S.2d 375 (City Ct. 1978); *Reed v. Esplanade Gardens, Inc.*, 398 N.Y.S.2d 929 (City Ct. 1977).

⁵⁰ *Melbourne Bros. Constr. Co. v. Pioneer Co.*, 384 S.E.2d 857 (W. Va. 1989); *Sears v. Summit, Inc.*, 616 P.2d 765 (Wyo. 1980) (recognizing privilege but finding it exceeded).

⁵¹ See RESTATEMENT (SECOND) OF TORTS § 260 (1965); see also Note, *Torts—Property Accidentally Cast on Land of Another—Unnecessary Damage in Removal*, 27 YALE L.J. 569 (1918); *Grier v. Ward*, 23 Ga. 145 (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); *Louisville & Nashville R.R. Co. v. Joulilian*, 76 So. 769 (Miss. 1917).

⁵² See Robert C. Ellickson, *Of Coase and Cattle: Dispute Resolution Among Neighbors in Shasta County*, 38 Stan. L. Rev. 623, 665-66 (1986) (surveying cases to that effect). Ellickson also notes, however, that “even ranchers who know that they are legally entitled to recover feeding costs virtually never seek monetary compensation for boarding estrays.” *Id.* at 674.

⁵³ “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. 1st Dist. Ct. App. 1923). For a modern, statutory definition, see CAL. AGRIC. CODE § 17001.5 (West, Westlaw through Ch. 309 of 2013 Reg. Sess.) (“For purposes of this chapter, ‘estrays’ means any impounded or seized bovine animal, horse, mule, sheep, swine, or burro whose owner is unknown or cannot be located.”).

⁵⁴ See, e.g., CAL. AGRIC. CODE § 17041 (West, Westlaw through Ch. 309 of 2013 Reg. Sess.).

damage feasant or *distress damage feasant*.⁵⁵ Despite this privilege of self-help, the landowner is generally not privileged to wound or kill the trespassing animals.⁵⁶ 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

⁵⁵ See *Kelly v. Easton*, 207 P. 129 (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.”) (internal citation omitted).

Distress, generally, was defined at common law as, the 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, or 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 ON THE LAWS OF ENGLAND *211; see also *Hall v. Marshall*, 27 P.2d 193, 195 (Or. 1933) (quoting Blackstone’s description with approval); *Kelly v. Easton*, 207 P. 129, 130 (Idaho 1922) (same).

⁵⁶ See Robert C. Ellickson, *Of Coase and Cattle: Dispute Resolution Among Neighbors in Shasta County*, 38 Stan. L. Rev. 623, 666 (1986) (surveying cases to that effect); M.L. Schellenger, *Civil Liability of a Landowner for Killing or Injuring Trespassing Dog*, 15 A.L.R.2d 578 (1951).

suggest that animal law provides a useful model for robot law.⁵⁷ Though animals are technically chattels, the animal cases show a greater solicitude for life, non-human though it may be.⁵⁸ Were courts to decide that robots are more like animals than robots are like 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 self-help against torts committed by or with chattels.⁵⁹

In principle, victims of actionable trespass have a privilege of self-help.⁶⁰ Self-help ranges from stopping the invader⁶¹ to damaging or even destroying it⁶² 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.⁶³ 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.”⁶⁴ But that is what one would expect in a world where aircraft are manned—no

⁵⁷ See e.g., Kate Darling, *Extending Legal Rights to Social Robots*, We Robot Conference, University of Miami, April 2012, available at <http://ssrn.com/abstract=2044797>; F. Patrick Hubbard, “Do Androids Dream?”: *Personhood and Intelligent Artifacts*, 83 TEMP. L. REV. 405 (2011); Mark Coeckelbergh, *Robot Rights? Towards a Social-Relational Justification of Moral Consideration*, ETHICS AND INFORMATION TECHNOLOGY, Sept. 2010, at 209, available at <http://link.springer.com/article/10.1007/s10676-010-9235-5>.

⁵⁸ See, e.g., *Bruister v. Haney*, 102 So. 2d 806 (Miss. 1958) (upholding punitive-damage award against trespass victim who poisoned trespassing cattle); *Strong v. Georgia Ry. & Elec. Co.*, 45 S.E. 366 (Ga. 1903) (eulogizing deceased dog).

⁵⁹ The distraint remedy is not limited to the animal context, see *Sears v. Summit, Inc.*, 616 P.2d 765 (Wyo. 1980) (recognizing privilege to seize construction equipment that causes damage, but finding it exceeded on facts of case because equipment caused little damage).

⁶⁰ RESTATEMENT (SECOND) OF TORTS § 260 (1965).

⁶¹ E.g., *Rossi v. Ventresca Bros. Const. Co.*, 405 N.Y.S.2d 375 (City Ct. 1978) (stopping trespass by car by towing it).

⁶² E.g., *Forster v. Juniata Bridge Co.*, 16 Pa. 393 (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).

⁶³ 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 EMP, or simply cast a net over the drone. This paper focuses on the permissibility of firing a projective at a drone because if shooting down a drone is permissible under any given set circumstances then other less dangerous means also will be permissible in those same circumstances.

⁶⁴ ALISSA M. DOLAN & RICHARD M. THOMPSON II, CONG. RESEARCH SERV., R42940, INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES 29 (2013).

one should be able to risk a life to protect property.⁶⁵ An unmanned drone will not enjoy this blanket legal protection.⁶⁶

In addition to destroying the robotic invader by some means, some sort of distraint remedy,⁶⁷ i.e. capture and security, may also be available where the damages done, or reasonably believed to have been done, appear to at least equal the value of the trespassing robot. In the case of an airborne drone, even if the infringement of airspace did 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.⁶⁸ If the robot appears substantially more valuable than the nominal damage it has done, the victim of the trespass likely cannot hold the robot.⁶⁹

Weighing against the right to shoot down a drone are the risks any shooting or other attempt to jam or disable an airborne vehicle entails. The risks of firing a gun into the air are obvious, as are the risks of causing a drone—which may be rather large—to fall out of the sky.⁷⁰ Tort law's ubiquitous reasonableness standard would demand that a self-helper

⁶⁵ See, e.g., *Anderson v. Smith*, 7 Ill. App. 354, 358 (Ill. 2d Dist. Ct. App. 1880) (noting that because the law places “such a transcendent value upon human life . . . [.] 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 W. PAGE KEETON ET AL., *PROSSER AND KEETON ON TORTS* 133-34 (5th ed. 1984) (“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).

⁶⁶ See *supra* text accompanying note 40.

⁶⁷ See *supra* note 54.

⁶⁸ The general principle is that once a party commits an initial tort (here, the trespass), that party is also liable for all damages proximate caused by that harm – often including many 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.

⁶⁹ See *supra* text accompanying note 42.

⁷⁰ See, e.g., J. David Goodman, *Remote-Controlled Model Helicopter Fatally Strikes Its Operator at a Brooklyn Park*, N.Y. TIMES, A19, (Sept. 6, 2013), available at

Determining the scope of permissible self-help will always be complicated by the difficulty victims will 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 due to distance, speed, and (at night) lighting conditions. At least 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 likely will 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.⁷² They might be armed. As discussed further

⁷¹ 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.

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below, both air and ground robots also might spy. At least until some standards take shape, the victim of a trespass may be entitled to assume the worst, i.e., 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.⁷³

Before landowners start reaching for their shotguns, however, they should be aware that current trespass law creates at least two 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. 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 a trespass claim, requires actual harm.⁷⁴

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,⁷⁵ but that rule has long been abrogated to allow modern air travel.⁷⁶ Yet a landowner still has exclusive rights to

The privilege to defend one's thoroughbred stock in such a situation at least once supplied an affirmative defense to the criminal charge of malicious mischief. *See Hummel v. Oklahoma*, 99 P.2d 913 (Okla. Crim. App. 1940).

⁷³ See *supra* text accompanying notes 59-65.

⁷⁴ See *infra* § II.C.2.b.

⁷⁵ 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. *See United States v. Causby*, 328 U.S. 256, 260-61 (1946).

⁷⁶ *See United States v. Causby*, 328 U.S. 256 (1946) (holding that "the air is a public highway"); see also Timothy M. Ravich, *The Integration of Unmanned Aerial Vehicles Into the*

some of the airspace over her 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,”⁷⁷ 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,⁷⁸ or on tort and contract principles.⁷⁹ 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.”⁸⁰ That the landowner has not in fact used the airspace is not material; the land must only be reasonably subject to use.⁸¹ Unhelpfully, the Second Restatement 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*.”⁸²

Common-law rules defining a landowner’s airspace can be preempted by statute.⁸³ Congress has declared a “public right of freedom of transit through the navigable airspace”

National Airspace, 85 N.D. L. REV. 597, 604-05 (2009) (discussing history of *ad coelum* and its abandonment during the era of mass air transit).

⁷⁷ 328 U.S. at 265.

⁷⁸ 328 U.S. at 256.

⁷⁹ See, e.g., *Brandes v. Mitterling*, 196 P.2d 464 (Ariz. 1948); *Jones v. Wagner*, 624 A.2d 166 (Pa. Superior Ct. 1993) (dealing with trespass by overhanging tree branches); see also ALISSA M. DOLAN & RICHARD M. THOMPSON II, CONG. RESEARCH SERV., R42940, INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES 11 (2013) (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*.”).

⁸⁰ 328 U.S. at 264.

⁸¹ 328 U.S. at 264.

⁸² RESTATEMENT (SECOND) OF TORTS § 159(2)(a) (1965) (emphasis added).

⁸³ Note that the 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 *California v. Ciraolo*, 476 U.S. 207 (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 (1986) (warrantless aerial surveillance of chemical plant from within “lawful navigable airspace” of 1,200 feet and higher); *Florida v. Riley*, 488 U.S. 445 (1989) (warrantless surveillance from helicopter flying at 400 feet). The issue in these three cases was whether the surveillance was a “search” within the meaning of the Fourth Amendment such that a

of the United States.⁸⁴ “Navigable airspace” is defined as the airspace above the minimum safe operating altitudes, including airspace needed for safe takeoff and landing.⁸⁵ FAA regulations define these minimum safe-operating altitudes for different kinds of aircraft.

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.”⁸⁶ 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 on the aircraft.”⁸⁷ In a non-congested area, the minimum safe-operating altitude is “500 feet above the surface.”⁸⁸ Over open water or sparsely populated areas, aircraft “may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.”⁸⁹

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.”⁹⁰

The FAA does not currently regulate minimum safe-operating altitudes for drones.⁹¹ In its upcoming regulations the FAA might create different classes of rules for drones based

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.

⁸⁴ 49 U.S.C. § 40101(c)(2) (2012).

⁸⁵ 49 U.S.C. § 40102(a)(32) (2012).

⁸⁶ 14 C.F.R. § 91.119(a) (2010).

⁸⁷ *Id.* at § 91.119(b).

⁸⁸ *Id.* at § 91.119(c).

⁸⁹ *Id.*

⁹⁰ *Id.* at § 91.119(d).

⁹¹ See ALISSA M. DOLAN & RICHARD M. THOMPSON II, CONG. RESEARCH SERV., R42940, INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES 3 (2013). But while the FAA does not currently regulate minimum safe operating altitudes for drones, it did, in 2007, issue a policy notice stating that “no person may operate a UAS in the National Airspace without specific authority.” Unmanned Aircraft Operations in the National Airspace System, 72 Fed. Reg. 6689 (Feb. 13, 2007). This means that all drone operators who do not fall within the recreational-use exemption, *id.*, must apply to the FAA for permission to fly. For recreational users of model aircraft—a classification that could include certain types of drones, see *Huerta v. Pirker*, Docket No. CP-217 (FAA Mar. 6, 2014) (holding that FAA did not have authority to regulate model aircraft, thus assuming that the

on their size and capabilities. Larger drones resembling fixed-wing aircraft could be subject to altitude requirements similar to manned aircraft, whereas smaller drones might be regulated like helicopters or might enjoy a *sui generis* rule. However the FAA sets these standards, once in place they will set the lower bounds for where drones may be legally overfly private property. If federal law defines a portion of the airspace as publicly navigable, that means 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.⁹² Furthermore, since the FAA may not regulate recreational use of model aircraft,⁹³ a classification that could include certain types of drones,⁹⁴ state property law will continue to play a role in defining the bounds of private airspace relevant to use of flying robots, and state tort law will continue to define how landowners may react to trespassory overflights by hobby pilots.

aircraft at issue was in fact a hobby aircraft as opposed to a commercial drone as the FAA had alleged)—the FAA currently encourages compliance with a 1981 advisory circular. Unmanned Aircraft Operations in the National Airspace System, 72 Fed. Reg. 6689 (Feb. 13, 2007). Compliance with the circular is voluntary, Advisory Circular 91-57, Model Aircraft Operating Standards (June 9, 1981), *available at* http://www.faa.gov/documentLibrary/media/Advisory_Circular/91-57.pdf, but it makes the following suggestions. Users are urged to fly a sufficient distance from populated areas and away from noise-sensitive areas like parks, schools, hospitals, or churches. *Id.* Users should not 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, users should notify an airport official. *Id.*

⁹² See *Thornburg v. Port of Portland*, 376 P.2d 100, 108 (Ore. 1962) (noting that jury could find noise nuisance in spite of fact that airplanes were within navigable airspace: “[t]here is no merit in the defense that all flights within the navigable airspace are automatically free from liability”); *Nader v. General Motors Corp.*, 255 N.E.2d 765, 768, 770-71 (recognizing that the tort of invasion of privacy does not require a physical trespass on plaintiff’s property but could be accomplished by remotely eavesdropping).

⁹³ FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95 at § 336(a), 126 Stat. 11, 77.

⁹⁴ See *Huerta v. Pirker*, Docket No. CP-217 (FAA Mar. 6, 2014) (holding that FAA did not have authority to regulate model aircraft, thus assuming without discussion 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. See FAA Press Release, (Mar. 7, 2014), http://www.faa.gov/news/press_releases/news_story.cfm?newsId=15894.

In the zone below that covered by federal law or regulation, just how close to the ground constitutes the “immediate reaches”⁹⁵ protected from intruders may vary from state to state.⁹⁶ 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 line lower than the FAA’s minimum altitude.⁹⁷

An extreme version of how state and local law might address these gaps in federal regulation can be found in Deer Trail, Colorado. The town of Deer Trail is considering a plan to offer its residents drone-hunting licenses.⁹⁸ The FAA, however, has expressed skepticism at the legality of shooting down drones. In response to Deer Trail, Colorado’s plan, the FAA stated that “Shooting at an unmanned aircraft could result in criminal or civil liability, just as would firing at a manned airplane.”⁹⁹ However, the FAA did not cite any

⁹⁵ See *supra* text at note 81.

⁹⁶ See RESTATEMENT (SECOND) OF TORTS § 159 cmt. 1 (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.”) (internal quotation marks omitted); *Bever v. Gaylord Broadcasting Co.*, 2002 WL 1582286, *6 (Tx. Ct. 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); Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15 (2013) (providing trespass cause of action for drone overflight below 400 feet if (1) there has been a previous overflight below 400 feet (2) after 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”),

⁹⁷ See *e.g.*, Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15 (setting minimum height for drone overflight at 400 feet, well below FAA minimum height overflight limits for fixed-wing aircraft).

⁹⁸ Ana Cabrera, *Colorado town’s vote on drone ordinance postponed*, CNN U.S., (accessed 1/26/14 11:44 AM) <http://www.cnn.com/2013/12/10/us/colorado-town-drone-ordinance/>.

⁹⁹ *Id.* (quoting uncited FAA press release).

specific law backing this assertion and the authority for it is depends upon how one reads the statute governing destruction of aircraft.¹⁰⁰

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

While trespass is generally subject to a rule of strict liability,¹⁰¹ in cases of aerial trespass the rule merges with the traditional standard for nuisance, which requires actual damages.¹⁰² The *Restatement (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.”¹⁰³ 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,

¹⁰⁰ See 18 U.S.C. § 32(a)(1) (2012). The issue is whether 18 U.S.C. § 32(a)(1) covers shooting down a drone or whether that statute is best understood to apply 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].” 18 U.S.C. § 32(a)(1) (2012). An “aircraft” is defined as “a civil, military, or public contrivance invented, used, or designed to navigate, fly, or travel in the air.” 18 U.S.C. § 31(a)(1) (2012). 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,” 18 U.S.C. § 32(a)(1) (2012), other subsections of § 32 refer instead to an “aircraft in flight.” See, e.g., 18 U.S.C. 32(a)(3), (7) (2012). The definition of “in flight” assumes that there has been “embarkation” and will be “disembarkation,” see 18 U.S.C. § 31(a)(4), two terms that generally refer to passengers. 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 as § 32(a)(1), it seems highly unlikely that Congress intended to impose a twenty-year sentence for destruction of a model airplane or that that Congress foresaw the introduction of robotic aircraft.

¹⁰¹ RESTATEMENT (SECOND) OF TORTS § 158 (1965).

¹⁰² See Colin Cahoon, *Low Altitude Airspace: A Property Rights No-Man’s Land*, 56 J. Air L. & Com. 157, 175-76 (1990) (noting that commentators “have accepted this unconventional approach as unique to airspace trespass analysis”).

¹⁰³ RESTATEMENT (SECOND) OF TORTS § 158 cmt. i (1965).

but only if, . . . it interferes substantially with the other's use and enjoyment of the land."¹⁰⁴ This rule superimposes a requirement of actual harm, thus conflating the normal strict-liability rule of trespass with the rule of nuisance.¹⁰⁵

Generally, a private¹⁰⁶ nuisance is a "nontrespassory invasion of another's interest in the private use and enjoyment of land."¹⁰⁷ Whereas a trespass is inherently wrongful,

¹⁰⁴ RESTATEMENT (SECOND) OF TORTS § 159 (1965).

¹⁰⁵ 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 United States Supreme Court's decision in *United States v. Causby*, 328 U.S. 256 (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 compensation, *see* U.S. CONST. amend. V, there must be substantial interference with the owner's use or enjoyment. 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. 328 U.S. 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.

¹⁰⁶ This is as compared with a public nuisance. *See* RESTATEMENT (SECOND) OF TORTS § 821B (1965). 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." *Id.*

conduct constituting a nuisance is not. The conduct constituting the nuisance becomes wrongful only when it interferes with the plaintiff's use and enjoyment of her land.¹⁰⁸

Nuisance law usually requires the interference to be repeated or ongoing before it becomes actionable.¹⁰⁹ 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 whether the interference is substantial and unreasonable. The types of problems that drones are likely to cause—noise,¹¹⁰ dust,¹¹¹ low overflights¹¹²—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.

One might reasonably ask how the property owner is supposed 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 a property that had been overflowed 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.

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 be very significant

¹⁰⁷ RESTATEMENT (SECOND) OF TORTS § 821D (1965).

¹⁰⁸ See W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS 623 (5th ed. 1984).

¹⁰⁹ 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 generally W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS 626-30 (5th ed. 1984).

¹¹⁰ See *Nestle v. City of Santa Monica*, 496 P.2d 480 (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 (Or. 1962) (noting that it is a question for the jury as to whether there was a taking by noise nuisance).

¹¹¹ See *Dayton v. City of Asheville*, 115 S.E. 911 (N.C. 1932) (holding that odors, dust, smoke and rats from a sewer plant constituted a nuisance).

¹¹² See *Seale v. Pearson*, 736 So. 2d 1108 (Ala. App. 1999) (affirming trial court's finding of nuisance based on low overflights).

harms, so the privilege of self-help should in theory be broad.¹¹³ 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 trespass¹¹⁴) 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 justified, 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 torts¹¹⁵ including public disclosure,¹¹⁶ false light,¹¹⁷ and appropriation of name or likeness,¹¹⁸ but the only one a robot is likely to commit, and therefore the only one relevant to this paper, is intrusion on solitude and seclusion. Intrusion upon seclusion is a

¹¹³ *Cf.* Hummel v. State, 99 P.2d 913 (Okla. Crim. App. 1940) (recognizing privilege to castrate mongrel bull where it threatened to impregnate thoroughbred cattle); McKeesport Sawmill Co. v. Pennsylvania Co., 122 F. 184 (C.C.W.D. Pa. 1903) (stating in dicta that railroad might be justified in taking more extreme measures than an ordinary landowner because of its public duties and the unique harm posed by obstructions on the tracks).

¹¹⁴ See *supra* text accompanying note 71.

¹¹⁵ See W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS § 117 (5th ed. 1984).

¹¹⁶ RESTATEMENT (SECOND) OF TORTS § 652D (1965).

¹¹⁷ RESTATEMENT (SECOND) OF TORTS § 652E (1965).

¹¹⁸ RESTATEMENT (SECOND) OF TORTS § 652C (1965).

recognized,¹¹⁹ if somewhat unusual, tort, but its relative rarity in the courts means that it is poorly charted legal territory.¹²⁰ The tort of intrusion upon seclusion protects an individual from (1) “highly offensive” intrusions upon (2) reasonable expectations of privacy.¹²¹

Although the core principles of the intrusion-upon-seclusion tort are well defined and fit the robot context, there is uncertainty as to the interaction of the intrusion-upon-seclusion tort with the self-help principle. We found no cases holding that intrusion-upon-seclusion does not justify a privilege for self-help in appropriate cases. On the other hand, we have also been unable to find any cases that say intrusion-upon-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 upon seclusion cases: the peeping landlord.¹²² These cases never seem to involve any legal issue relating to the tenant’s destruction or conversion of equipment placed to spy on her because the circumstances would make the spying landlord’s complaint about the tenant’s self-help so implausible. Suppose the tenant disables or keeps the hidden camera in a bedroom or bathroom. In these cases we would not expect to see a claim for replevin from the landlord who placed the camera as a court would see it as pure chutzpah. In *Miller v. Brooks*,¹²³ for example, an estranged wife trespassed and secreted a camera in the bedroom of her husband’s apartment, prompting

¹¹⁹ See RESTATEMENT (SECOND) OF TORTS § 652B (1965); ALISSA M. DOLAN & RICHARD M. THOMPSON II, CONG. RESEARCH SERV., R42940, INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES 14 n.111 (2013) (“North Dakota and Wyoming are the only states not to adopt the privacy tort of intrusion upon seclusion.”).

¹²⁰ For general discussion see, e.g., W. PAGE KEETON, ET AL., PROSSER AND KEETON ON TORTS 854-56 (5th ed. 1984); Mitchel J. Ezer, *Intrusion on Solitude: Herein of Civil Rights and Civil Wrongs*, 21 Law in Transition 63 (1961); Daniel J. Solove, *A Taxonomy of Privacy*, 154 U. PA. L. REV. 477, 552-57 (2006).

¹²¹ RESTATEMENT (SECOND) OF TORTS § 652B (1965).

¹²² See, e.g., *Roach v. Harper*, 105 S.E.2d 564 (W.Va. 1958); *Hamberger v. Eastman*, 206 A.2d 239 (N.H. 1964).

¹²³ 472 S.E.2d 350 (N.C. Ct. App. 1996).

the husband to take the camera and watch the recording. The court noted this in its survey of the facts,¹²⁴ but the wife apparently did not demand the camera or the videotape back.

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.¹²⁵ But what happens when a journalist (or paparazzi) drone overflies a 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, we turn to policy arguments for why self-help should and should not be allowed in such instances.

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.¹²⁶ The intrusion creates an exigency in which resort to legally administered remedies would be impractical, as 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.¹²⁷

¹²⁴ *Id.* at 352 (noting that husband “remove[d] the camera and videotape” belonging to estranged wife).

¹²⁵ 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.”).

¹²⁶ See *supra* text accompanying notes 19-23.

¹²⁷ 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

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 upon seclusion tort provide additional justifications for permitting self-help. First, because the tort requires that the invasion be not just offensive but *highly* offensive, 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, however large or small, the scope of permissible self-help deserves to be broad. More serious threats and harms may be met with more vigorous self-help. And while a phrase like “highly offensive” is malleable, it sets a high bar. In one court's words, the invasion must amount to “outrageously unreasonable conduct.”¹²⁸

Another justification for allowing a self-help privilege in response to what reasonably appears to be a robotic privacy intrusion is the ways in which privacy invasions by robots differ from privacy invasions by humans. Robots, especially drones, increase individuals' ability to spy on others in contexts where the other has a reasonable expectation of privacy. While neighbors may have binoculars, and a private detective likely has a telephoto lens,¹²⁹ drones are unique in several ways that make them potentially a greater threat to privacy. They can spy without trespassing.¹³⁰ Where they do trespass they

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, 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,” and thus the law will not treat the camera and the landlord as one. *See id.*

¹²⁸ *N.O.C., Inc. v. Schaefer*, 484 A.2d 729, 733 (N.J. Super. Ct. Law Div. 1984). For a survey of cases for which there was and was not liability for intrusion upon seclusion see in RESTATEMENT (SECOND) OF TORTS § 652B (1965).

¹²⁹ *See, e.g.*, RESTATEMENT (SECOND) OF TORTS § 652B cmt. b, illust. 2 (1965) (“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.”).

¹³⁰ There can be an intrusion upon seclusion without a trespass. *See* W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS 854 (5th ed. 1984) (footnotes omitted) (“The principle [of intrusion upon seclusion] has, however, been extended beyond . . . physical intrusion, and

are difficult to detect. They may be able to stay in spying position for longer than humans. They may be able to transmit the data more quickly. (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.)

Finally, as we have noted, because of the newness of robots, even where none of these dangers are in fact greater than previously, at least in the short term the risk may reasonably appear to be large. Thus, at least initially, violent self-help will seem, and often may be, reasonable even when the privacy threat is not great—or 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 self-help in the form of shooting guns in the air to down drones.

Another argument against allowing self-help is that it will encourage people concerned about drones to shoot down legitimate overflights such as a law-enforcement drone, thus posing a threat to public safety. Or, self-helpers might shoot down a manned

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.”); *see also* RICHARD A. EPSTEIN, *CASES AND MATERIALS ON TORTS* 1050 (8th ed. 2004) (“The tort of intrusion upon seclusion] 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 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 – evidence – that the robot was spying before having any privilege to react.

vehicle by mistake. Permitting self-help may encourage people to fire guns in the air, and may cause harm when a drone is downed. And 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.

All these arguments sound in the reasons why self-help is criticized generally, the reasons why tort law evolved to displace self-created remedies. The primitive but prevailing "ad hoc system" of self-help, it is often argued, inevitably "leads to breaches of the peace, violence, and inequities."¹³¹ As one state supreme-court justice declared in dissent, "[s]elf-help may well be the first step toward anarchy."¹³² 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 against robots. This is especially true because, while there do not appear to be any reasons unique to the robot context that weigh against a broad self-help right, as we have seen there are unique features weighing in favor of a self-help right.

III. Statutory Considerations Relating to Drones

So far we have concentrated on tort law, the traditional common-law remedy for civil wrongs. But statutes and regulations bear on the self-help issues in several ways. To date, legislatures and agencies have focused on drones rather than robots in general. 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.¹³³ While FAA navigable airspace

¹³¹ Vanderbilt Special Project, *supra* note 13, at 853.

¹³² *Duthie v. Lewiston Gun Club*, 663 P.2d 287, 298 (Idaho 1983) (Bistline, J., dissenting).

¹³³ See *supra* text accompanying notes 83-93. While the 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) ("[A]n aerial inspection of a house's curtilage may not always pass muster under the Fourth Amendment simply because the aircraft 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, para. 2 (Supremacy Clause).

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.

And if the FAA is authorized to 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 and whether it seems intent on doing so. Finally, we look to state laws, how these affect drone-related privacy issues.

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

1. *Current FAA Approach to Drone Privacy Regulation*

In the FAA Modernization and Reform Act of 2012 (FMRA),¹³⁴ Congress tasked the FAA with devising rules to ensure safe integration of drones into domestic airspace "as soon as practicable, but not later than September 30, 2015."¹³⁵ FMRA directed the FAA to engage in two sets of rulemaking. The first requires that by August 14, 2014, the FAA issue a final rule on integrating "small unmanned aircraft systems" into the national airspace.¹³⁶ The second requires the FAA to (1) develop a "comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system,"¹³⁷ (2) provide notice on the proposed rulemaking to implement this comprehensive plan by August 14, 2014,¹³⁸ and (3) publish a final rule by December 14, 2015.¹³⁹

The FAA has stated that it plans to issue a rule for drones under fifty-five pounds at least a year sooner than it will issue the rule governing larger drones.¹⁴⁰ The FAA has also

¹³⁴ Pub. L. No. 112-95, 126 Stat. 11 (codified as amended in scattered sections of 49 U.S.C.).

¹³⁵ Pub. L. No. 112-95, § 332(a)(1), 126 Stat. 11, 73.

¹³⁶ Pub. L. No. 112-95, § 332(b)(1), 126 Stat. 11, 73.

¹³⁷ Pub. L. No. 112-95, § 332(a)(1), 126 Stat. 11, 73.

¹³⁸ Pub. L. No. 112-95, § 332(b)(2), 126 Stat. 11, 73.

¹³⁹ Pub. L. No. 112-95, § 332(b)(2), 126 Stat. 11, 73.

¹⁴⁰ FED. AVIATION ADMIN., INTEGRATION OF CIVIL UNMANNED AIRCRAFT SYSTEMS (UAS) IN THE NATIONAL AIRSPACE SYSTEM (NAS) ROADMAP at Appendix C.2, C.6 (2013) [hereinafter *FAA Roadmap*].

announced plans also to expedite its certification process, moving from a drone-by-drone regime to a model-by-model regime.¹⁴¹ In addition to certifying the drone or model itself, the FAA will require pilot and aircrew certification, but has yet to define how that process will work.¹⁴² Pilot certification will be important because the FAA has ruled out autonomous flight for most drones.¹⁴³

FMRA also directed the FAA to establish six test ranges for drones.¹⁴⁴ 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 the aircraft in the National Airspace System.”¹⁴⁵ In its most recent rule, the FAA requires all test site operators to have written and publicly available privacy policies “informed” by Fair Information Practice principles, to accept public comment on their privacy policies, and to review and update the policies as needed.¹⁴⁶ While these policies will not conclusively establish the FAA’s long-term approach, they are meant to “help inform the dialogue among policy makers, privacy advocates, and the industry.”¹⁴⁷ Additionally,¹⁴⁸ operators will need to comply with state and local laws that regulate privacy.¹⁴⁹ This non-preemption of state laws is

¹⁴¹ See FAA Roadmap, *supra* note 140, § 3.4.

¹⁴² See FAA Roadmap, *supra* note 140 §§ 3.6, 4.5, 5.5.

¹⁴³ See FAA Roadmap, *supra* note 140, § 4.1 (“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.”).

¹⁴⁴ Pub. L. No. 112-95, § 332(c), 126 Stat. 11, 73.

¹⁴⁵ Unmanned Aircraft System Test Site Program, 78 Fed. Reg. 12259 (Feb. 22, 2013). The FAA received 25 applications for test sites located in 24 different states. 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. FAA 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.

¹⁴⁶ 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).

¹⁴⁷ FAA Roadmap, *supra* note 140, § 1.4.4.

¹⁴⁸ This list is not exhaustive; see the Rule, 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), for a full list of requirements.

¹⁴⁹ The Rule requires that Operators comply with “all Applicable Law regarding the protection of an individual’s right to privacy. Unmanned Aircraft System Test Site Program,

significant. Of the states that will play host to the test sites, three have enacted drone legislation: Oregon,¹⁵⁰ Texas,¹⁵¹ and Virginia.¹⁵² These sites will thus test the existing state policies and provide valuable evidence of effectiveness for future state action.

Whether FMRA entitles the FAA to regulate privacy issues outside of its test-site mandate could be debated. The Congressional Research Service (CRS) recently concluded that it would be reasonable for the FAA to interpret FMRA as tasking the FAA with addressing privacy in its drone-related rulemaking.¹⁵³ 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),¹⁵⁴ which authorizes the FAA Administrator to enter into a test-site agreement “on such terms as the Administrator may consider appropriate.”¹⁵⁵ 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.¹⁵⁶ If the FAA can find specific authority to regulate privacy at test-sites in a general grant of power, FMRA would seem to provide an equally strong basis for the existence of statutory authority to regulate drone-related privacy more generally.

78 Fed. Reg. 68,360, 68,364 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt 91). “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.*

¹⁵⁰ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 (2013).

¹⁵¹ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390.

¹⁵² Act of Apr. 3, 2013, ch. 755, 2013 Va. Acts 755.

¹⁵³ ALISSA M. DOLAN & RICHARD M. THOMPSON II, CONG. RESEARCH SERV., R42940, INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES 22-27 (2013) The CRS concludes 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 25..

¹⁵⁴ Unmanned Aircraft System Test Site Program, 78 Fed. Reg. 68,360, 68,361 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt 91) (“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).”).

¹⁵⁵ 49 U.S.C. §106(l)(6) (2012).

¹⁵⁶ Pub. L. No. 112-95, §332(a)(2)(A)(i), 126 Stat. 11, 73 (2012).

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.”¹⁵⁷ And 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.”¹⁵⁸ So even if it would be reasonable for the FAA to conclude that FMRA gives it authority to regulate privacy, its decision that it lacks the authority is entitled to equal deference. If that interpretation was challenged, which is perhaps unlikely due to Article III standing complications,¹⁵⁹ the question would be whether it is unreasonable for the FAA to have concluded that FMRA does not authorize regulation of privacy.

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.¹⁶⁰

¹⁵⁷ FAA Roadmap *supra* note 140, § 1.4.4.

¹⁵⁸ Unmanned Aircraft System Test Site Program, 78 Fed. Reg. 68,360, 68,361 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt 91).

¹⁵⁹ The challenge would be premised on the theory that the plaintiff was harmed by the FAA’s unreasonable interpretation of FMRA to not permit regulation of privacy issues. Courts have historically been skeptical of standing in such cases because of the general, non-particularized nature of the alleged harm. *See, e.g.,* Lujan v. Defenders of Wildlife, 504 U.S. 555 (1992).

¹⁶⁰ The Joint Planning and Development Agency (“JPDO”), which includes representatives “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 AND DEV. OFFICE, UNMANNED AIRCRAFT SYSTEMS (UAS) COMPREHENSIVE PLAN: A REPORT ON THE NATION’S UAS PATH FORWARD 3 (2013) [hereinafter JPDO Plan], suggests that additional regulation of privacy is unnecessary because “many states have laws that protect individuals from invasions of privacy which could be applied to intrusions committed by using a UAS.” JPDO Comprehensive Plan at 7. And the FAA 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. 68,360, 68,362 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt 91). 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.” Unmanned Aircraft System Test Site

Thus it seems likely that at least in the near future state and local laws will continue to play the leading role in privacy protection.

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 promulgating rules regarding certain kinds of model aircraft flown for recreational use.¹⁶¹ The bar applies where the model aircraft is less than 55 pounds, does not interfere with any manned aircraft, and is flown in accordance with a community-based set of safety guidelines.¹⁶² The aircraft must also be flown within the line of sight of the operator and be used solely for recreational purposes.¹⁶³ 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.”¹⁶⁴ It is unclear whether the FAA will choose to construe model aircraft flown for recreational as including hobbyist drones; in any event this limitation on the FAA’s authority does not apply to rules concerning drones flown for commercial purposes.

2. *Proposed amendments to FAA Modernization and Reform Act of 2012*

Several privacy-related amendments to FMRA are currently before Congress. The Drone Aircraft Privacy and Transparency Act of 2013 (“DAPTA”),¹⁶⁵ proposed by Representative Ed Markey in the 113th Congress, would regulate the private use of drones, specifically as to data-collection requirements and enforcement mechanisms. DAPTA would require the FAA to create guidelines for all domestic drone operations, not just test-site operations, that include data-minimization procedures.¹⁶⁶ The FAA would also be

Program, 78 Fed. Reg. 68,360, 68,363 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt 91). Finally, the FAA stated that “[f]orty-three states have already enacted or are considering legislation regulating use of UAS.” Unmanned Aircraft System Test Site Program, 78 Fed. Reg. 68,360, 68,362 (Nov. 14, 2013) (to be codified at 14 C.F.R. pt 91).

¹⁶¹ Pub. L. No. 112-95 at § 336, 126 Stat. 11, 77 (to be codified at 49 U.S.C. § 40101).

¹⁶² *Id.* at § 336(a).

¹⁶³ *Id.* at § 336(c).

¹⁶⁴ *Id.* at § 336(b).

¹⁶⁵ H.R. 1262, 113th Cong. (1st Sess. 2013).

¹⁶⁶ *Id.* at § 339.

required to create a public database of all licensed drones, the details of their operations, and a data-collection statement from each drone user.¹⁶⁷

The Preserving American Privacy Act of 2013,¹⁶⁸ introduced by Representative Ted Poe, would prohibit the use of drones to capture images in a manner highly offensive to a reasonable person where the individual is engaging in a personal activity under circumstances in which the individual has a reasonable expectation of privacy, regardless of whether there is a physical trespass.¹⁶⁹ The bill also addresses the admissibility of evidence obtained via drone surveillance,¹⁷⁰ prohibits the weaponization of drones,¹⁷¹ and declares that “[n]othing in this Act shall be construed to preempt any state law regarding the use of unmanned aircraft systems exclusively within the borders of that State.”¹⁷²

B. *State Drone-Related Legislation*

Substantive¹⁷³ drone-related legislation has been enacted in nine states: Florida,¹⁷⁴ Idaho,¹⁷⁵ Illinois,¹⁷⁶ Montana,¹⁷⁷ North Carolina,¹⁷⁸ Oregon,¹⁷⁹ Tennessee,¹⁸⁰ Texas,¹⁸¹ and Virginia.¹⁸² Of these states, three—Oregon,¹⁸³ Texas, and Virginia—will host test-site operations.¹⁸⁴

¹⁶⁷ *Id.* at § 340(a).

¹⁶⁸ H.R. 637, 113th Cong (1st Sess. 2013).

¹⁶⁹ *Id.* at § 3119f.

¹⁷⁰ *Id.* at § 3119c.

¹⁷¹ *Id.* at § 3119h.

¹⁷² *Id.* at § 3119i.

¹⁷³ Several test-site states have passed legislation appropriating funds for test-site operations. *See, e.g.*, Act of May 3, 2013, ch. 49, 2013 N.D. Laws 49.

¹⁷⁴ Freedom from Unwarranted Surveillance Act, 2013 Fla. Laws 33.

¹⁷⁵ Act of Apr. 11, 2013, ch. 328, 2013 Idaho. Sess. Laws 328.

¹⁷⁶ Act of Aug. 16, 2013, Pub. Act No. 98-402, 2013 Ill. Laws 402 sec. 5, § 48-3(b)(10) (prohibits using drone to interfere with hunters or fishermen); Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569.

¹⁷⁷ Act of May 1, 2013, ch. 377, 2013 Mont. Laws 377.

¹⁷⁸ Act of Jul. 26, 2013, ch. 360, 2013 N.C. Sess. Laws 360.

¹⁷⁹ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 (2013).

¹⁸⁰ Freedom from Unwarranted Surveillance Act, ch. 470, 2013 Tenn. Pub. Acts 470.

¹⁸¹ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390.

¹⁸² Act of Apr. 3, 2013, ch. 755, 2013 Va. Acts 755.

Two states—North Carolina¹⁸⁵ and Virginia¹⁸⁶—enacted general moratoria on public use of drones until July 1, 2015. North Carolina provides an exception in cases of specific approval by the state Chief Information Officer,¹⁸⁷ while Virginia provided a variety of exceptions, including emergency situations, training of officers, and traffic assessment.¹⁸⁸ Virginia¹⁸⁹ also, along with Oregon,¹⁹⁰ banned the installation of weapons on government drones.

Seven¹⁹¹ of the nine states to have passed drone legislation—all except North Carolina and Virginia, which instead enacted general moratoria on drones—have included a warrant requirement for government surveillance via drone.¹⁹² Several of these laws provide for exceptions in case of terrorist activity¹⁹³ or where “swift action” is required to prevent harm to human life.¹⁹⁴ Montana¹⁹⁵ and Oregon¹⁹⁶ bar the use of information

¹⁸³ 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. FAA 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.

¹⁸⁴ FAA 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.

¹⁸⁵ Act of Jul. 26, 2013, ch. 360, 2013 N.C. Sess. Laws 360 § 7.16(e).

¹⁸⁶ Act of Apr. 3, 2013, ch. 755, 2013 Va. Acts 755 sec. 1, § 1.

¹⁸⁷ Act of Jul. 26, 2013, ch. 360, 2013 N.C. Sess. Laws 360 § 7.16(f).

¹⁸⁸ Act of Apr. 3, 2013, ch. 755, 2013 Va. Acts 755 sec. 1, § 1.

¹⁸⁹ Act of Apr. 3, 2013, ch. 755, 2013 Va. Acts 755 sec. 1, § 1.

¹⁹⁰ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 10 (2013).

¹⁹¹ Texas does not explicitly require a warrant. The statute enumerates nineteen lawful uses of drones, one of which is surveillance with a warrant. Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, § 423.002(a)(7). It stands to reason, then, that unwarranted surveillance is not lawful.

¹⁹² Freedom from Unwarranted Surveillance Act, ch. 2013-33, 2013 Fla. Laws 33 sec. 1, § 4(b); Act of Apr. 11, 2013, ch. 328, 2013 Idaho. Sess. Laws 328 sec. 1, § 21-213(2)(a); Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569 § 15(2); Act of May 1, 2013, ch. 377, 2013 Mont. Laws 377 sec. 1, § 1(a); Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 3(1)(a) (2013); Freedom from Unwarranted Surveillance Act, ch. 470, 2013 Tenn. Pub. Acts 470 sec. 1, § d(2); Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, § 423.002(a)(7).

¹⁹³ See, e.g., Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569 § 15(1).

¹⁹⁴ See, e.g., Freedom from Unwarranted Surveillance Act, ch. 2013-33, 2013 Fla. Laws 33 sec. 1, § 4(c).

obtained through drone surveillance to establish probable cause. Tennessee, in addition to its warrant requirement, explicitly declares that drone surveillance constitutes a search,¹⁹⁷ presumably to avert any attempt to argue otherwise.

The Illinois, Oregon, Tennessee, and Texas statutes all contain data minimization or reporting requirements. Illinois requires law-enforcement agencies to delete recorded information within thirty days¹⁹⁸ unless there is reasonable suspicion that the information contains evidence of criminal activity¹⁹⁹ or is relevant to an ongoing investigation or criminal trial.²⁰⁰ The law also bans disclosure of such information subject to the same exceptions.²⁰¹ The Oregon statute bans the disclosure of such information by law-enforcement agencies subject to certain emergency exceptions.²⁰² The Tennessee statute requires law-enforcement agencies to delete information within twenty-four hours of recording, but this rule applies only to information obtained in violation of the Act, not information lawfully obtained.²⁰³ The Texas statute does not contain data-minimization requirements, but does contain detailed reporting requirements.²⁰⁴ The Act requires each state law enforcement agency to provide to the governor and each state legislator a report including details on “the type of information collected on an individual, residence, property, or area that was not the subject of a law enforcement operation and the frequency of the collection of this information.”²⁰⁵

¹⁹⁵ Act of May 1, 2013, ch. 377, 2013 Mont. Laws 377 sec. 1, § 2.

¹⁹⁶ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 11(2) (2013).

¹⁹⁷ Freedom from Unwarranted Surveillance Act, ch. 470, 2013 Tenn. Pub. Acts 470 sec. 1, § g(1).

¹⁹⁸ Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569 § 20.

¹⁹⁹ Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569 § 20(1).

²⁰⁰ Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569 § 20(2).

²⁰¹ Freedom from Drone Surveillance Act, Pub. Act No. 98-569, 2013 Ill. Laws 569 § 25.

²⁰² Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 §§ 3, 5, 6 (2013).

²⁰³ Freedom from Unwarranted Surveillance Act, ch. 470, 2013 Tenn. Pub. Acts 470 sec. 1, § f.

²⁰⁴ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, § 423.008.

²⁰⁵ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, § 423.008(b)(4).

Several of the statutes contain provisions governing private use of drones. Oregon makes it a crime to use a drone as a weapon²⁰⁶ or interfere with any FAA-licensed drone;²⁰⁷ Texas makes it a crime to capture, possess, or disseminate images of unconsenting individuals under certain circumstances.²⁰⁸ The Texas statute also lists nineteen situations in which it is permissible to capture images with drones.²⁰⁹

Five of the states—Florida, Idaho, Oregon, Tennessee, and Texas—provide civil causes of action in cases of certain violations. Florida provides a cause of action to individuals who have been surveilled by law-enforcement drones in violation of the Act's prohibitions.²¹⁰ Idaho provides a cause of action against law-enforcement officers or private individuals for gathering of images in violation of the Act.²¹¹ Oregon, in addition to criminalizing interference with any FAA-licensed drone, provides a cause of action for individuals harmed by such interference.²¹² 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.²¹³ There is a takeoff-and-landing exception to this cause of action,²¹⁴ but where successful the statute allows for damages, an injunction, and even attorney's fees.²¹⁵ Oregon's statute also authorizes its attorney general to bring actions for nuisances and trespasses arising out of drone operations within the state.²¹⁶ Tennessee provides a cause of action against law-enforcement agencies that violate the Act's surveillance prohibitions.²¹⁷ Texas provides for a privacy cause of action against an

²⁰⁶ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 13(1) (2013).

²⁰⁷ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 13(2) (2013).

²⁰⁸ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, §§ 423.003, 423.004.

²⁰⁹ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, § 423.002(a).

²¹⁰ Freedom from Unwarranted Surveillance Act, ch. 2013-33, 2013 Fla. Laws 33 sec. 1, § 5.

²¹¹ Act of Apr. 11, 2013, ch. 328, 2013 Idaho. Sess. Laws 328 sec. 1, § 21-213(3).

²¹² Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 14 (2013).

²¹³ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15(1) (2013).

²¹⁴ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15(2) (2013).

²¹⁵ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 §§ 15(3), (4) (2013).

²¹⁶ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15(5) (2013).

²¹⁷ Freedom from Unwarranted Surveillance Act, ch. 470, 2013 Tenn. Pub. Acts 470 sec. 1, § e.

individual who captures an image of property or the property owner or tenant with the intent to conduct surveillance.²¹⁸

As mentioned above, Oregon's statute creates a civil cause of action for drone overflight below 400 feet if (1) there has been a previous overflight below 400 feet (2) after 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."²¹⁹ This provision 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.²²⁰ 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 in figuring out 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.)

The state statutes that create private causes of action should in theory create by implication a concomitant privilege of self-help. Legislators are generally presumed to make new laws against the background of existing laws.²²¹ In other words, legislators are presumed to know the state of the law as it exists when they draft new laws. 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 right.

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,

²¹⁸ Texas Privacy Act, ch. 1390, 2013 Tex. Gen. Laws 1390 sec. 2, § 423.006.

²¹⁹ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15(1) (2013).

²²⁰ See *supra* § II.C.2.b.

²²¹ *Astoria Fed. Sav. & Loan Ass'n v. Solimino*, 501 U.S. 104, 108 (1991) ("Congress is understood to legislate against a background of [the common law.] 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).

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—does expressly declare that it is a crime to interfere with a government drone,²²² taking the issue off the table for that state, but not the others.

IV. **Improving the Law of Human-Robot Interactions**

It is clear that a person in the United States 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.²²³ 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 upon seclusion) or legal fact (the extent of the aerial boundary to property). But the others five flow 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 this uncertainty. These proposals will minimize the need for violent self-help but also clarify the circumstances where it would be appropriate.

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.”²²⁴ In law, the curtilage is considered to be “part of the home itself for Fourth Amendment purposes.”²²⁵ The dimensions of the equivalent aerial space

²²² Oregon declares it a felony not just to interfere with a government drone, but with any drone licensed by the FAA. Act of Jul. 29, 2013, ch. 686, 2013. Or. Laws 686 § 13(2) (2013).

²²³ See *supra* § I (listing seven issues).

²²⁴ *Florida v. Jardines*, 133 S.Ct. 1409, 1414 (2013).

²²⁵ *Florida v. Jardines*, 133 S.Ct. 1409, 1414 (2013); *Oliver v. United States*, 466 U.S. 170, 180 (1984).

above a home and its horizontal curtilage, what one might call the vertical curtilage,²²⁶ are not as clear as those of the horizontal one.²²⁷ FAA rules on minimum navigable heights²²⁸ also play a part major part. States could in theory set an upper bound lower than the FAA rules.²²⁹ Oregon recently set an upper bound of 400 feet for drone overflights in certain circumstances,²³⁰ but this upper bound is not lower than any relevant current FAA rule because the FAA does not currently have a height rule for drones.²³¹ Anything in excess of FAA rules on navigable airspace will be preempted.

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

²²⁶ According to Brendan Peters, *Fourth Amendment Yard Work: Curtilage's Mow-Line Rule*, 56 STAN. L. REV. 943, 959 nn. 96-96 (2004), 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."

²²⁷ There is still some fundamental uncertainty about the extent of vertical equivalent of curtilage. See *Florida v. Riley*, 488 U.S. 445 (1989) (holding that observation from police helicopter flying at 400 feet did not require warrant); *Dow Chemical v. United States*, 476 U.S. 277, 239 (1986) (holding that observation from altitude of 2000 feet was not akin to entering into curtilage and thus did not require warrant); *California v. Ciraolo*, 476 U.S. 207, 213 (1986) (holding that fixed-wing observation of the curtilage from "public navigable airspace," 1000 feet above ground, did not require warrant). See also *Commonwealth v. Ogialoro*, 547 A.2d 387 (Pa. Super. Ct. 1988) aff'd, 579 A.2d 1288 (Pa. 1990) (holding that helicopter operating in "nonnavigable airspace" 50 feet above property was intrusive enough to violate 4th Amendment right against unreasonable warrantless search); *id.* at 392 (Kelly, J., concurring) (discussing "vertical curtilage"). In contrast, the concept of horizontal curtilage both has "ancient and durable roots," *Florida v. Jardines*, 133 S.Ct. 1409, 1414 (2012), and, the Supreme Court tell us, "is 'easily understood from our daily experience.'" *Id.* at 1415 (quoting *Oliver v. United States*, 466 U.S. 170,182, n.12 (1984).).

²²⁸ See *supra* § II.C.2.a.

²²⁹ 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 *Causby v. United States*, 328 U.S. 256 (1946).

²³⁰ Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15(1) (2013).

²³¹ See *supra* text accompanying note 91.

drone.²³² They may thus 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 homes²³³—the only issue is the minimum altitude. States, or preferably a 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 hobbyist²³⁴ and commercial drones.

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

As noted above,²³⁵ we have found no cases delineating the extent of the privilege for self-help in the face of an intrusion into seclusion. Logic, and the general sweep of tort law, suggests that reasonable self-help should be privileged, but as we noted above, it is remarkably difficult to determine how much force would be reasonable given the very great uncertainties about a robot's, and especially a drone's, spying capabilities and intentions. In the short run, that uncertainty likely will be found to justify quite energetic self-help efforts. States should provide some guidance by statute or else people may shoot first and ask questions later.

C. *Reduce Uncertainty about Robots Generally*

A person confronted with a robotic trespasser, or 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

²³² To the extent that genuine news-gathers were regulated more stringently than hobbyists who presented no greater danger or disruption to the people and property below, the news-gathers might have a quite substantial First Amendment claim as well.

²³³ Note that the overflight issue is distinct from the delivery issue. If an Amazon drone or a Taco copter is making a delivery in response to an order, the homeowner has presumably consented to the intrusion and there is thus no trespass issue. (Surprise gifts raise trickier issues.) Any relevant FAA rules would still apply.

²³⁴ Note that while FAA does not have authority to regulate hobby drones, see F.A.A. Modernization and Reform Act of 2012, Pub. L. No. 112-95 at § 336, 126 Stat. 11, 77 (to be codified at 49 U.S.C. § 40101), Congress does, subject only to whether this would be a genuine regulation of interstate commerce.

²³⁵ See *supra* § II.D.

assumes the worst about what the robot is doing or is going to do, her understandable lack of information about what the robot might be capable of will, under some circumstances, provide a basis for a legal judgment that her belief was, in law, reasonable.²³⁶ Ordinarily when confronted with new technologies, courts and juries tend to find that it is reasonable for people to fear them: thus we would expect that robots, at least for a while, will be held reasonably 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 thus potentially uncomfortable around robots, judges and juries²³⁷ likely will find—and would be justified in finding—that a great level of caution and suspicion was “reasonable.”²³⁸ Seeing fear and caution as normal 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.

²³⁶ For an example of one citizen’s reaction to finding a drone outside her window, see Kathryn A. Wofe, *Dianne Feinstein spots drone inches from face*, POLITICO (Jan.16, 2014), <http://www.politico.com/story/2014/01/senator-dianne-feinstein-encounter-with-drone-technology-privacy-surveillance-102233.html>.

²³⁷ Juries find facts; judges decide questions of law. In a civil trial, whether a belief or an action was reasonable under the circumstances is usually a question of fact for a jury unless either the parties both waive their right to a jury trial or, in the case of jury trial, the judge resolves the question as a matter of law by holding that no reasonable jury could find otherwise.

²³⁸ 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* text accompanying notes 36-39.

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, their capabilities, and perhaps their intentions.

1. *Prohibit Armed Robots*

Assuming there are no Second Amendment issues involved,²³⁹ 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.²⁴⁰ A blanket national rule 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 case be unreasonable to fear that sort of attack.

Prohibiting armed robots will have the additional virtue of weakening the case for finding that operation of a robot 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 the robot is *designed* to be dangerous to people. Even if the robot is completely under the control of the remote operator there is always the chance that someone might jam the controls, hack the robot's software, or that it might malfunction in some manner. Plus, if the armed robot has any sort of autonomy that could conceivably include fire control, the science fiction plots just about write themselves. The legal system

²³⁹ The Second Amendment, U.S. CONST. AMEND. II, 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 (2013) (proposing, inter alia, a re-interpretation of *District of Columbia v. Heller*, 554 U.S. 570 (2008)).

²⁴⁰ This is, alas, far from a fantastic suggestion. See, e.g., <https://www.youtube.com/watch?v=M1KdNCMWbU4> (video of a Taser-equipped drone built by the Chaotic Moon corporation delivering an 80,000 volt shock to a volunteer – the firm's intern); Susanna Kim, *Texas Start-Up Tasers Intern Via Stun-Copter to Spark Discussion About Tech at SXSW*, <http://abcnews.go.com/Business/intern-tasered-drone-sxsw-explains-feels-zapped/story?id=22848505> (Mar. 10, 2014).

is likely to be very sensitive to these possibilities no matter how many safety precautions are included in the robot's design.

2. *Give Notice of Robot Capabilities*

Even if robots are unarmed (or disarmed), other concerns including fear of being rolled over by a robot, or fear of having a drone crash into one, may still rise to the level of reasonableness. Personal safety fears that do not prove to be grounded in fact should, however, be cured by time. In the case of robots, however, time alone will provide only 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. If, say, Google self-driving cars have an excellent safety record after hundreds of thousands or millions of miles on the road, then it 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 to every private network they pass,²⁴¹ it would become very reasonable to worry every time one went past, not to mention if one tarried in front of the house. Even after most people become familiar enough with robots to associate capabilities with different types, much as most people today can distinguish between a bus and a backhoe, there will still be issues of perception and identification, particularly regarding 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.

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

²⁴¹ Although it did not involve robots or self-driving cars, Google's national mapping initiative included a secret program to capture information about not just the location of public wi-fi networks but also private wi-fi and even to copy traffic carried on those networks. See David Kravets, *An Intentional Mistake: The Anatomy of Google's Wi-Fi Sniffing Debacle*, WIRED (May 2, 2012), <http://www.wired.com/threatlevel/2012/05/google-wifi-fcc-investigation/>.

standardize how drones, and other robots also, 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*. *Ex ante* notice enables more accurate warnings of what the robot is able to do, thus informing—or defanging—threat assessment. Whatever rules we adopt, we 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 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 excessive warning is likely the so-called Red Flag Act of 1865,²⁴² which required

[e]very Locomotive propelled by Steam or any other than Animal Power on any Turnpike Road of 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 Horses, passing the same.²⁴³

The original Red Flag rule lasted seventeen years, being amended in 1879 to require the flagman to be only twenty yards in front of a motorcar.²⁴⁴ It seems silly now, but its day, the Red Flag Act may have seemed a reasonable response to the risk of stampeding

²⁴² Locomotives Act, 1865 and Locomotives Act, 1861, 28 & 29 Vict., c. 83 (1865) (Eng.).

²⁴³ *Id* at §3.

²⁴⁴ See Highways and Locomotives (Amendment) Act, 41 & 42 Vict., c. 77 at § 29 (1878) (Eng.) (amending section three of Locomotive Act, 1865). The Act made no distinction between automobiles and locomotives.

livestock that could be terrified by the loud noises and occasional steam blasts from early boiler engines.²⁴⁵

The Red Flag Act had another provision, however, that looks much more 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 Sunset.²⁴⁶

The idea of requiring cars, and now planes and 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 robots.

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.²⁴⁷ Similarly, a rule requiring clear

²⁴⁵ See ARVID LIND, PRESTON TUCKER AND OTHERS: TALES OF BRILLIANT AUTOMOTIVE INNOVATORS AND 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*, <http://www.solivant.com/oldcars/>.

²⁴⁶ Locomotives Act, 1865, *supra* note 242, at § 3.

²⁴⁷ Under international humanitarian law, medical aircraft that identify themselves during armed conflict by using a flashing blue light are entitled to protection and even special assistance and landing rights. See Protocol additional to the Geneva Convention of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts, opened for signature Dec. 12, 1977, art. 6, 1125 U.N.T.S. 3. See also Michel Bourbonniere, Louis Haeck, *Military Aircraft And International Law: Chicago Opus 3*, 66 J. AIR L. & COM. 885, 965 (Summer 2001). For a general discussion of the (relatively narrow) application of international law of armed conflict to the marking of remotely piloted vehicles see

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. There is currently no international standard for car and truck emergency and police lights²⁴⁸ and indeed domestic U.S. practices vary somewhat by state or even locality,²⁴⁹ but one of the advantages of writing a rule now, before large numbers of drones are manufactured and deployed, is that we could set a consistent national (and, ideally, international) standard.

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 robots, potentially undermining the effectiveness of any warning system.

An alternative, much more expensive, rule would be to require that drones at least, and perhaps autonomous land-based robots also, carry something akin to the Automatic

generally Ian Henderson, *International Law Concerning The Status And Marking Of Remotely Piloted Aircraft*, 39 DENV. J. INT'L L. & POL'Y 615 (2011).

²⁴⁸ Although the UN Convention on Road Traffic (1968) and the UN Convention on Road Traffic (with 1993 amendments) Art. 2 & Id. Annex V § 42, and also EU Regulation 65, E/ECE/324/Rev.1/Add.64/Rev.2 at ¶¶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 with 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.” European Parliament, Committee on Petitions, Notice to Members, Petition 1268/2011 by Alberto Lemos da Silva (Portuguese), on the lack of uniformity of emergency signs in ambulances and fire fighting vehicles (May 20, 2012) (complaining of non-uniformity of Spanish emergency vehicles).

²⁴⁹ Compare, e.g. Colorado Rev. Stat. § 42-4-213(2) (flashing or oscillating red required for emergency vehicles and reserved to their use; blue, white, or blue in combination with white allowed as optional additions) with Connecticut Gen. Stat. § 14-96p (reserving flashing blue and green for officially permitted uses including volunteer ambulances; flashing red for vehicles transporting students with disabilities and for ambulances and school buses; flashing red or white or amber for certain official vehicles on the way to emergencies; flashing or revolving white for fire vehicles).

dependent surveillance-broadcast (ADS-B) transponders currently required for aircraft.²⁵⁰ This device would broadcast information including a unique identification number, location, altitude, and 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 further away, and when decoded is easier to record and harder to misread than a light. The information-bearing potential of lights also is reduced by the color blindness of a substantial fraction of the population.²⁵¹ On the other hand, decoding transponder information requires equipment not commonly found in the home.²⁵² 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 expensive²⁵³ (although the readers less so²⁵⁴), and are substantially heavier than a few small LED lights.

Yet another possibility would be to require RFID chips in drones, as these are much lighter weight. Passive RFID chips are much less expensive than transponders, but their range is also much shorter, commonly only a few meters. Battery-powered RFID tags,

²⁵⁰ See Federal Aviation Administration, Automatic Dependent Surveillance—Broadcast (ADS-B) Out Performance Requirements To Support Air Traffic Control (ATC) Service, 14 C.F.R. Part 91 (defining ADS-B requirements for aircraft and requiring aircraft carry them by 2020).

²⁵¹ “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.” Ananya Mandel, *Color Blindness Prevalence*, NEWS MEDICAL, <http://www.news-medical.net/health/Color-Blindness-Prevalence.aspx>.

²⁵² Another, far too expensive, alternative would be to set up a national grid akin to air-traffic control for drones.

²⁵³ 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>. Less capable transponders are less expensive, with Mode C transponders selling for under \$2000.

²⁵⁴ See, e.g. Wings & Wheels Inc, price list, <http://www.wingsandwheels.com/Transponders%20encoders%20PCAS%20MRX%20XR%20TTPAS%20Becker%20TRIG%20Microair.htm> (starting at around \$500).

however, already can achieve a range of up to 300 feet.²⁵⁵ Until the ordinary person has an RFID reader, this solution too will be somewhat limited in value, but RFID readers are about \$500.²⁵⁶

The lowest-cost, but also only partially effective, 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 United States road symbols.²⁵⁷ A suitable pictogram-based marking strategy could, in the best case, convey important information quickly, but is likely to be effective only in some scenarios while ineffective in others. The fuselage-marking option has the great disadvantage of being of little value at night. Markings on most drones, not to mention the 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 could work particularly well for robots that would be used in situations where people would be likely to encounter them 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.²⁵⁸ For remotely

²⁵⁵ Battery-powered tags typically have a read range of 300 feet (100 meters). RFID Frequently Asked Question, How much do RFID readers cost today?, RFID Journal, <http://www.rfidjournal.com/faq/show?139>.

²⁵⁶ RFID Frequently Asked Question, RFID Journal, How much do RFID readers cost today?, <http://www.rfidjournal.com/faq/show?86>.

²⁵⁷ For a list see U.S. Dept. of Transportation, Federal Highway Administration, *Manual on Uniform Traffic Control Devices (MUTCD)* (2009 MUTCD with Revision Numbers 1 and 2 incorporated, dated May 2012), http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm; see also U.S. Dept. of Transportation, Federal Highway Administration, *National Standards for Traffic Control Devices; the Manual on Uniform Traffic Control Devices for Streets and Highways; Revision*, 74 Fed. Reg. 66720 (Dec. 16, 2009) (describing changes from earlier edition), <http://edocket.access.gpo.gov/2009/pdf/E9-28322.pdf>.

²⁵⁸ See, e.g., Act of Jul. 29, 2013, ch. 686, 2013 Or. Laws 686 § 15(1) (2013) (requiring trespass victim to give notice to drone owner before cause of action accrues).

controlled robots the responsible party will usually be the robot's operator or the robot's owner. Other scenarios are possible. 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 will be liable as well in addition to the owner. If the robot has indicia of manufacture, 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 some third party, e.g., someone who pushed the robot onto the victim, or (2) some third party interfered with or took control of the robot and the owner or operator was blameless for failing to prevent it, or (3) the owner or operator herself was 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 paper. For example, imagine a gardening robot with significant autonomy and capable of learning from experience. Imagine further that the robot owner's neighbor has been teaching the robot stupid robot tricks while the owner is at work. In the course of demonstrating a stupid 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 depending 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.²⁵⁹

Setting up a licensing regime and national or state-based registries would help connect a malfeasant robot to its owner or user, but 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

²⁵⁹ Scenarios like this make one doubt projections about the future shortfalls in lawyer employment at least until robots themselves can do the work.

robots. The RFID and transponder regimes discussed above,²⁶⁰ 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 the Vehicle Identification Numbers (VINs). The National Highway Traffic Safety Administration (NHTSA) has required that all cars sold in the US since model year 1981 carry a 17-character VIN,²⁶¹ and the rule has since been extended to other vehicles and certain car parts.²⁶²

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 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, in NHTSA's authority to issue a safety standard requiring standardized VINs has been upheld on the grounds 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 standards, and help trace stolen vehicles.²⁶³

²⁶⁰ See *supra* text accompanying notes 250-255.

²⁶¹ See generally National Highway Traffic Safety Administration, *Vehicle Identification Numbers (VINs)*, <http://www.nhtsa.gov/Vehicle+Safety/Vehicle-Related+Theft/Vehicle+Identification+Numbers+%28VINs%29>.

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. See 49 U.S.C. §§ 30502, 30503 (2012).

²⁶² National Highway Traffic Safety Administration, *supra* note 261.

²⁶³ See *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 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 accidents, "the VIN safeguards not only property but also life and limb").

3. *Recommendation: A Mixed Approach*

In light of these considerations, we suggest a mixed approach in which all mobile robots²⁶⁴ would be required to carry warning markings, lights, and the equivalent of a VIN that would be recorded in a state or national registry. In addition, all aerial robots would be required to carry an active RFID chip with the maximum practicable range given the state of RFID technology. The range required could be adjusted annually for new robots based on improvements in RFID technology until the range slightly exceeded the minimum height requirement established for drones.

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—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 we 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 *unreasonable*, then a false statement of harmlessness should be considered fraud or worse. We propose that the penalty for mis-identifying a robot be comparable to that for falsifying or obscuring a license plate,²⁶⁵ and that the penalty for falsifying or altering a robot's internal unique identification number be equivalent to the penalty for altering a VIN.²⁶⁶

²⁶⁴ 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.

²⁶⁵ 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).

²⁶⁶ 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 possible 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 a 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. 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, or 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 correlatives²⁶⁷ 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.²⁶⁸ Similarly, if the state gives a person a privilege to act, it disables others from making legal complaints if that privilege is exercised.²⁶⁹ 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.

²⁶⁷ See Wesley Newcomb Hohfeld, *Some Fundamental Legal Conceptions as Applied in Judicial Reasoning*, 23 YALE L.J. 16 (1913).

²⁶⁸ “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.’” Joseph William Singer, *The Legal Rights Debate in Analytical Jurisprudence from Bentham to Hohfeld*, 1982 WISC. L. REV. 975, 987.

²⁶⁹ “[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.” *Id.*

The only limit on this privilege is that the belief must be objectively reasonable, in that a judge or jury would find that an ordinary 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 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 upon 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 average person to tell if a robot that enters her property is collecting images or 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 robot is unjustly attacked by a person, 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.