

# Robots, Micro-Airspaces, and the Future of “Public Space”

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## Abstract

In *United States v. Causby*, the Supreme Court conceptualized airspace as a “public highway.” In the same decision, the Court recognized that landowners must be able to “exercise exclusive control of the immediate reaches of the enveloping atmosphere” in order to exercise full enjoyment of their property. The precise boundaries of public and private space have always been contested; however, the lack of clear legal definition of “public space” is increasingly problematic given the growing availability and use of drones.

How should the law conceptualize “public space” in relation to drones and robots? Do drones present legitimately new issues for “public space” jurisprudence, or do they simply present issues of scale? Are there micro-airspaces surrounding individuals and special places that merit the recognition of an increased private interest in airspace? In what contexts should the law privatize or enclose portions of the “public highway” in favor of protecting privacy rights? How can the law reconcile a largely public airspace with diverse privacy expectations on the ground? Should there be restrictions on the use of thermal, infrared, millimeter, or other advanced sensor technologies in the airspaces around public and private spaces? And, to what extent can local and state authorities develop or effect tailored regulations surrounding personal and commercial use of airspace?

In this paper we investigate the phenomenon of state and local jurisdictions taking on the privacy issues raised by small drones and their use by law enforcement or commercial entities. It remains to be seen whether or how Federal authorities, and the FAA in particular, may seek to challenge these new laws. These new potential authorities in the regulation of airspace may create great complexities in the varieties of airspaces and what is permissible in them, but this is not unprecedented. States issue drivers licenses, and local governments established speed limits, and so these “mini-airspaces” may be quite appropriate. Why should airspace be forced into a one-size-fits all model of regulation by a regulatory agency that does not seem sensitive to the needs and desires of numerous and varied localities?

We also raise the question of whether “airspace” is solely or best considered to be a feature of real property such as publicly or privately owned land, or might instead and better be thought of as a feature also belonging to individuals. How might we envision a “micro-airspace” of one’s own person under which the observation, recording, archiving, and transmission to other parties of images or information obtained about you requires various forms of consent, notification, outright prohibitions, strict limitations on the retention of images or other data, and so forth. Such restrictions could also be specified in terms of identifiability of those recorded, or the use of various technologies or sensors, such as infrared or millimeter wave sensors.

In this paper, we consider the various legal precedents which might inform us as to the viability of such regulations. We also consider the various metaphors of “airspace” in play in these cases, how privacy has been conceived in crucial judgements, and whether and how we might articulate a legal framework for “micro-airspaces” that provides a regulatory framework that both protects individual rights, the “public” nature of public space, and provide for the introduction of public and commercial UAVs and other sorts of remote, semi-autonomous and autonomous robots with recording capabilities that can respect these rights and spaces. We contend that it is possible to have robust protections of individual rights and collective public spaces without onerous or industry-killing regulatory policies, and “micro-airspaces” could be part of that solution.

## **Introduction**

In this paper, we wish to consider how the law has thus far conceived of the privacy of individuals in public space, and how technological innovations have thus far challenged those conceptions. We are particularly concerned with how public space has been conceived, and how the boundaries of what is legally observable in such space has been considered. Our aim in doing so is to inform a broad based discussion of the future of privacy in public space, as well as a more focused discussion on how the regulation of airspace might provide potential remedies to the negative impacts such new technologies might have.

There are several aspects of new technologies that both individually and collectively threaten to radically impact social expectations of privacy in public space. These have been addressed in a variety of judicial decisions in part, and occasionally in combination. The result of these decisions has been a fairly limited set of restrictions which, in the absence of new laws and regulations, leave open the possibility of a radical loss of privacy in public space and potentially fundamental transformation which could threaten the value of public space to society and democracy.

Much of the focus of recent discussion has been on information privacy. This is a clearly important and related issue, especially insofar as observations of public spaces are collected and turned into information. However, this paper will limit its scope to the consideration of the right to capture and collect such information in the first place. It is expected that there should also be further limitations on the use and distribution of that information, once collected. It is also expected that a clearer view of privacy interests in collection will help to inform and justify appropriate regulation of the access, ownership and distribution of that data once collected.

The general technological trends which threaten privacy include: 1) the ubiquity and persistence of technologies which capture and record images, sounds and other data, 2) the development of advanced remote sensing technologies, both passive and active, which offer increasing penetration into areas otherwise obscured to the naked eye, 3) the ability to gain novel vantage points from which to observe private areas without committing physical trespass into private areas, and 4) the aggregation of data in large databases (so-called big-data) which allow the application of data-mining techniques such as network analysis and cross-correlation to reveal through inference information about individuals that is not directly observable in the individual instances and observations of public behavior.

The ubiquity of cellphones and smartphones which are capable of taking images, as well as audio and video recordings, has radically transformed social norms and expectations of privacy as individual citizens capture, record and distribute this information in private and public communications networks. Digital technology has greatly reduced the costs of both capturing, reproducing and archiving images and recordings, and the Internet has greatly reduced the costs of distributing these recordings. As robots, unmanned aerial vehicles, and similar technologies proliferate, they will greatly increase the ubiquity and persistence of digital data collection in public space. Moreover, these technologies could be deployed in deliberate and systematic ways so as to ensure the comprehensive surveillance of particular public areas, or track the activities of

specific individuals in public spaces.

Advances in remote-sensing include the passive sensing of a broad spectrum of radiant energy beyond the normal human visual and auditory ranges, as well as active-sensing systems which emit various forms of radiation and construct images from the reflected energy. These systems range from thermal-imaging (including forward-looking infrared or FLIR), ultrasound and acoustic imaging, millimeter wave and microwave technology (including backscatter), night-vision and zero-lux imaging, various speed and motion detection techniques, ferrous metal and electro-magnetic field detectors, electro-magnetic radio transmission detectors, laser scanning and imaging (LIDAR), optical and acoustic amplification techniques (including extremely high-resolution lenses, cameras, and microphones as well as noise-filtering and image reconstruction techniques), and improvements in x-ray, radar and sonar imaging (such as synthetic aperture radar). Beyond the spectrum of radiation, there are also a range of new sensors capable of identifying chemical and biological agents, on surfaces, in samples and airborne. And a host of advanced forms of medical tests and imaging techniques that offer views inside the human body ranging from chemical levels, to medical conditions, as well as blood and neural activity (such as fMRI) that may potentially indicate psychological states. These technologies are all “remote” in the sense that they do not entail the more clearly intrusive methods which might involve a trespass or require permission or covert activity, including placing bugs or tracking devices, to penetrate the private sphere. All of these technologies, in one way or another, offer a potential challenge to our understanding and expectations of what is “observable” and what constitutes and intrusion of private space.

Aerial surveillance has significant potential implications on privacy. With continuing advances in small unmanned aerial vehicles (UAVs), and the potential for larger airframes being integrated into civil airspace, there are serious questions and concerns over the potential impact these systems will have on privacy (ACLU report). The ability of aircraft to fly over and survey private spaces has been defended as a legitimate use of public airways, at least above 400 feet. Yet even at this altitude, aircraft provide a vantage point which undermines active efforts to ensure privacy, such as hedges and fences, even in private dwellings and curtilage. The development of small highly-capable quadrotors equipped with cameras further extend the vantage points from which otherwise private spaces might be viewed from public vantage points. The development of micro-aerial vehicles, including insect-sized vehicles, could seriously challenge the boundaries of “publically navigable airspace” as it is currently understood.

While ubiquity and persistence, enhanced remote-sensing, and novel observational vantage points all threaten to encroach on the sphere of privacy, the aggregation of this data, and even of mundane observational data, poses a more serious and fundamental threat to our social expectations of privacy. There has been a great deal of recent discussion regarding the ability of data aggregation and analysis to reveal information about individuals that is not directly observable in any particular instance or occasion. This discussion has focused primarily on the data and meta-data generated by on-line transactions and communications, as well as geographical tracking information from cellphones, cars and other devices. In this regard, aerial surveillance is significant largely due to its role as a platform that combines and magnifies all of these effects. This quantitative shift could easily result in a qualitative change as the cost of

establishing persistent and ubiquitous networks of observation—potentially equipped with an array of remote-sensing technologies, capable of accessing novel vantage points, and likely transmitting this observational data to databases and archives—is greatly lowered, thus making it feasible for law enforcement, commercial interests, and private citizens to obtain these capabilities.

Not only do these different dimensions of technological advancement mutually amplify and reinforce each other in their encroachment on the private sphere, but the central test in judging the right to privacy under the 4<sup>th</sup> Amendment protection from unreasonable search and seizure rests upon “socially reasonable expectations” of privacy. The objective expectations are subject to change with the development and adoption of new technologies and social behaviors.

Indeed, if we had to really exclusively on 4<sup>th</sup> Amendment decisions to protect the right to privacy, we might feel quite desperate or hopeless in the face of technological advancement. The aim of this paper is to suggest that there are other legal routes available to protect privacy in public space against these technological advances. This paper will sketch out a few of these routes, based in other constitutional protections as well as statutes and torts.

#### **4<sup>th</sup> Amendment Protections & Private Property**

Existing restraints on the use of aerial surveillance, based on privacy rights, have been largely shaped by 4<sup>th</sup> Amendment claims against the use of aerial surveillance, imaging technologies, tracking devices, call loggers, bugs, and wiretaps by law enforcement (*Katz v. United States* 1967, *Kyllo v. United States* 2001, *California v. Ciraolo* 1986, *Dow Chemical Company v. United States* 1986, *Florida v. Riley* 1989, *United States v. Knotts* 1983, *United States v. Jones* 2012). In their decisions for *California v. Ciraolo*, *Dow v. U.S.*, and *Florida v. Riley*, the Supreme Court has developed a view on aerial surveillance that is largely shaped by property considerations, along with a two-part test derived from *Katz v. U.S.*

The property perspective on privacy stems from ancient laws of trespass, which prohibit the authorities of the state from entering private property without warrant to conduct an unreasonable search. Within this history, modern courts have held that the private dwelling is sacrosanct due to the intimacy of personal and family life conducted therein. The courts have also extended this protection to the curtilage of a dwelling—the immediate vicinity of a dwelling, the use of which is enjoyed with the same personal and family intimacy as the home itself. The courts have been less inclined to extend this protection to the “open fields” of private property beyond the curtilage.

However, the courts have held that law enforcement can observe individuals in public space, as well as view private property from public spaces. With the advance of technology, the courts have been forced to consider the limits for what counts as truly “private” property, what forms of technologically enhanced observation might be acceptable, and the nature of property rights in the airspace above a property.

To a lesser extent, courts have extended the protected sphere of privacy to places of business,

and other private spaces. They have also recognized the privacy of vehicles, baggage and personal affects.

The application of the standard test for privacy was established in *Katz v. U.S.*. This test involves two questions: 1) Did the individual have a subjective expectation of privacy? 2) Is that expectation of privacy objectively reasonable, given the current state of technology and social expectations. The subjective expectation can be judged by the actions of the individual as well as their claim to have such and expectation. By indexing privacy to the social expectations, the objective part of the rule can adapt to new technology, however it is also at the mercy of disruptive technologies to erode the sphere of privacy as new technological capabilities become available to the general public. Thus, as new technologies proliferate in public usage, and the social perceptions shift so as to accept their use as reasonable or expected, then their use becomes acceptable for police and state surveillance of public spaces.

### **Territorial Privacy, Inequality & Democracy**

There are two serious limitations to the territorial approach to privacy, with regard to the protection of democracy. The first is that territorial privacy, in both its historical origins and its modern formulation, results in highly unequal protections to individuals based upon their wealth, class and access to private property. The second is that the systematic surveillance of public space can also directly impact fundamental democratic rights. Both of these limitations may find legal grounding in constitutional law, but do not yet have the benefit of case law. And thus the constitutional rights to equal protection, as well as freedom of assembly and association, may also be impinged upon by the combined effects of new surveillance technologies.

From their inception, the right to privacy within one's dwelling was largely a protection of the aristocracy and landed gentry against the king and other authorities to intrude upon the privileged classes on their own property. Such a territorial view presumes the ownership of land and a dwelling to ensure protection from searches. There is a rather obvious inequality that stems from this approach to privacy, namely that it favors the privacy of those who can afford to own and occupy private spaces over those who cannot. There is a clear and stark difference between an individual with a large estate and servants who could thereby afford to dwell indefinitely within their private abode, when compared to the homeless individual who might live in a shelter, their vehicle or even on the street, and who must effectively dwell in public spaces, or spaces not necessarily considered as dwellings.

But there are further inequalities following from this notion of privacy when it is extended to vehicles and modes of transit. Insofar as individuals are able to drive, ride and fly in private vehicles, they enjoy a greater protection of privacy than those who must use public and commercial forms of transit. This privacy includes both protection from searches by the state, but also from searches and the collection of information about them by commercial interests. To the extent that chauffeured cars, private planes and yachts afford their owners and occupants an unequal privacy privilege over public taxis, buses, commercial airlines and ferries, then we must in turn understand that the "consent" to the loss of such privacy by those who cannot afford more private modes is in some sense economically coerced. This is especially true when transit is not

purely voluntary or recreational, but necessary to secure livelihood, to conduct business and personal affairs, or even to exercise democratic rights and duties of citizenship such as voting and jury duty.

This is simply to acknowledge that the territorial notion of privacy effectively institutes class differences. That was the original intention when it was introduced several centuries ago, and it continues to accomplish this despite some broadening of the category of private estate to private dwelling (which might be rented). Indeed, it is the most democratic modes of transit, particularly public mass transit but also being a pedestrian, that are the least protected in terms of privacy. And while the courts have embraced such inequalities, it has usually been to promote public interest in a constitutional freedom, such as speech. To the extent that these inequalities in privacy impact democracy negatively, the courts might view them differently.

Of greatest concern in this regard is the potential of aggregated, persistent, ubiquitous technologies to jeopardize the freedom of assembly and association. The courts have generally viewed the freedom of assembly as the right to protest, typically in public spaces, and to petition the government for redress of grievances. The use of surveillance technologies can have a chilling effect on public assembly, especially when there is a potential for later reprisals against those who are known to have participated in a given demonstration.

To the extent that these technologies can remove the anonymity of participation in a crowd or protest (as either protestor or audience), they present a threat to a recognized and valued form of democratic expression under the 1<sup>st</sup> Amendment. An essential component of democracy is the freedom of public discourse and debate. The freedom of individual speech is only one element of that discourse, while the right to assemble and express a grievance is another element, and the freedom of the press yet another. Each of these elements of public discourse have been radically transformed by mass media and information technologies such as the internet. We can expect them to be further transformed by the technologies of aerial surveillance.

The right to anonymity is quite limited, but there is a certain expectation that one can in general move through public space without broadcasting one's identity. This right is diminished for celebrities and public figures, and even non-public figures might be recognized by those who know them. But one is not generally required for individuals to produce identification or to identify themselves to others. To the extent that surveillance technologies could reliably, accurately and continuously identify individuals, they would also effectively track their movements and actions in public space. As such, preserving a degree of anonymity may prove a crucial element in regulating these technologies. Beyond simply limiting the ability of such systems to explicitly identify individuals, they may also be required actively obscure identifiable traits—not just faces and voices, but any type of information which might reliably allow data analysis to infer the identity of an individual.

More concerning is the potential impact these technologies may have upon the freedom of association. As generally construed by the courts, this is the freedom to form private groups or clubs. Its exercise includes the self-determination of membership in the group (which may be overridden by social concerns over discrimination). It also includes the ability to keep private the

membership list of a group. This freedom would seem to be clearly threatened by persistent, ubiquitous, aggregated surveillance. That is to say that if the group holds meetings, it would be possible to observe and identify the people who attend the meetings. Even if the meeting times and locations are not announced publicly, with sufficient aggregated data, this is precisely the kind of information that could be deduced—a particular network of individuals who assemble with some pattern of regularity. And thus, while they may not be compelled to produce a membership list, the membership could be deduced from such surveillance.

Taken to the Orwellian extreme, we might imagine all of our activities in public spaces to be recorded and stored. This could include meetings and conversations with strangers, acquaintances, and even intimate conversations on secluded forest paths and desolate beaches. Such surveillance would certainly have a chilling effect on conversations of all types, especially those of an intimate or political nature. Indeed, such an environment would greatly restrict our ability to hold private communications, impede public discourse, and undermine the democratic use of public space.

The ability to assemble and demonstrate in public space has itself been challenged by the encroachment of regulations governing public spaces. Curfews, requirements for permits to march or demonstrate, and restrictions on noise, nuisance, and disruption have all been used by municipalities to limit the ability of assemblies to protest in what have long been considered the public venues where such protests ought to be held. Most notably, during the Occupy Wall Street demonstrations, protestors occupied a private park in lower Manhattan for several months. Due to the terms of its creation this park was required by law to be open to the public 24 hours a day (as part of a deal to win easements in building construction). Had the demonstrators occupied a typical public park in the city, they would have been evicted within a day, for staying beyond the park's curfew or for 'camping' in an unapproved area. This is indicative of a radical transformation in the conception of "public" space away from what is enshrined in Swedish law as "the freedom to roam" ([http://en.wikipedia.org/wiki/Freedom\\_to\\_roam](http://en.wikipedia.org/wiki/Freedom_to_roam)) and towards a management of public space in which the public has little voice in how that space is actually utilized.

Running in some sense counter to these constitutional claims it has been asserted that there is a freedom of speech interest in protecting the distribution of information, once it has been legally gathered (ACLU 2013).

### **Voyeurism & Paparazzi Laws**

To some extent, the courts have also protected the sphere of the individual person from search, even in public spaces, without probable cause. Law enforcement tactics, such as stop-and-frisk, have challenged these protections. There have also been challenges based on social interest in security that provide for far more invasive screening and searches of persons and vehicles in public transit systems and commercial airports, as well as public and government offices, public schools, courts, and military installations. Security screening at auditoriums and stadiums is further enhanced in virtue of these typically being privately owned and requiring tickets which can carry terms.

There are few restrictions on many private and commercial uses of surveillance technologies to collect observable data on people in public without consent. Where these exist they are primarily based in state laws.

Paparazzi, photographers who typically photograph celebrities, have few legal restrictions provided that they are photographing from a public vantage point, and beyond the perimeter of any specifically imposed restraining orders. Even when their subjects believe that they are not being observed or photographed, courts have held that they do not have a reasonable expectation of privacy when they are in public space (e.g. <http://arstechnica.com/tech-policy/2007/06/youtube-wins-privacy-case-against-brazilian-supermodel/>).

Short of harassment or nuisance, or the applicability of certain stalking laws, there are few restrictions on the collection of information and images of celebrities in public spaces for private or commercial use. Partly this is due to the belief that public figures are subject to greater scrutiny than the general public, which is tied to a public interest in supporting journalistic freedom, and that there is an implied consent to such scrutiny in becoming a public figure. Non-public figures are granted a greater degree of privacy in public, with some states requiring consent for the images or information to be reproduced or distributed, as well as protections for minors who cannot grant consent.

Peeping-tom laws typically apply to intrusions upon the private dwelling by private persons to observe or photograph individuals in states of undress. In many states, there is no reasonable expectation of privacy from such surveillance, and even recording, in apartments, hotel rooms, public bathrooms, changing rooms, and other spaces where one might presume such privacy exists.

As a recent case in Massachusetts makes clear (Boston upskirt), the photographing of private parts of one's body, even when clothed, may not constitute a violation of privacy in most states. Hawaii and Washington have stricter laws which criminalize this type of photography. We could easily imagine technologies of remote sensing which permit the imaging of bodies through walls and clothes becoming both technologically possible and potentially publicly accessible. We could also image micro UAVs which could fly under skirts or even inside clothes to obtain images of the private parts of bodies.

## **Airspaces**

The ancient legal principle of *cuius est solum, eius est usque ad coelum et ad inferos* held that the ownership of land extended from the surface up to the heavens, and down to hell. With the invention of balloons and eventually other aircraft, it became apparent that to facilitate the use of such aircraft would require flying over private property without obtaining prior approval from land owners. As it took for in the US, the FAA regulates the "navigable airspace" which is typically 400 feet above the ground. There are exceptions, where buildings exceed 400 ft., and for helicopters which are permitted to fly much lower than this as long as they do not endanger

anyone. The FAA has also issued guidelines to model R/C pilots which limits their operation to below 400 feet, a weight restriction, line-of-sight operation, and avoidance of restricted air corridors, such as around airports and heliports.

The FAA has been mandated by Congress to promulgate rules for the regulation of UAVs in civilian airspace. This will presumably cover the airframes, pilot certification and air-traffic control of such aircraft alongside manned aircraft at airports and within air-corridors. Smaller UAVs will presumably still fall under the guidelines applicable to model R/C aircraft. The longer-term and persistent surveillance UAVs are more likely to be of the larger and higher-flying types of aircraft, while the ubiquitous varieties are more likely to be the smaller model types. The more sophisticated remote sensing technologies, being heavier and more expensive, are also likely to appear first on the larger aircraft types, while becoming smaller and cheaper over time and appearing on the smaller model aircraft.

The FAA has traditionally been concerned with safety as the principle goal of their regulations, but is under increasing pressure to acknowledge and seek to protect privacy in its regulation of UAVs. Just what this might mean, or how it might look, or how they will acquire the necessary expertise, remain to be seen.

Industry trade groups, such as AUVSI, are eager for regulations which will permit UAV operations, but a weary of restrictions that might impact the commercial applications of these aircraft. Given that many of the foreseeable applications are based in various forms of surveillance and data collection, any restrictions in this domain could impact the viability of commerce. They re also concerned that UAVs might be singled out with restrictions that are not currently imposed on manned aircraft. Blanket prohibitions on aerial surveillance, it is feared, could have devastating impacts on the emerging industry.

In the midst of this uncertain regulatory framework, many states and local jurisdictions have begun working on statutory measures to protect privacy in the coming era of civilian UAVs. 43 states have proposed legislation, while 9 have enacted legislation restricting drone use. For the most part these laws have focused on uses by law enforcement and state agencies, requiring warrants for police use, and limiting the conditions of use by other state agencies. Most of the legislation remains silent on the use of these technologies by commercial interests or private citizens. This leaves open the question of whether data about and recordings of the activities of private persons in public spaces can be collected legally.

In the absence of strong FAA regulations covering privacy issues, or comprehensive national legislation governing the uses of aerial surveillance, the best hop for effective regulation lies in state and local jurisdictions. This piece-wise construction of regulation itself raises various issues.

Not only might every state enact different regulations, but individual counties and cities might enact regulations restricting the use of these technologies. This could result in a highly diverse patchwork of regulations. There may be jurisdictional issues that arise near the borders of different jurisdictions. Consider twin cities or dense suburbs where it is possible to observe one

jurisdiction while flying over another. Can a jurisdiction only legislate for the airspace over its own boundaries, or can it restrict the collection of data from vantage points beyond its boundaries? Does its ability to legislate extend up to the navigable airspace (400 ft. above ground) or above (where it may conflict with FAA regulation) and what about space? What happens when there are overlapping jurisdictions with differing regulations, and Federal legislation is not available? Does interstate commerce become implicated when flights or surveillance spans state borders?

States and cities have been effective in lobbying the FAA to establish specifically shaped air-corridors (*e.g.* NY after Cessna hit a building). Could such a strategy work for protecting privacy over cities? For example, that certain restricted airspaces might be created which specifically prohibit various forms of aerial surveillance, that could be established by local jurisdictions, but enforced by the FAA?

Could individuals, or individual properties have their own micro airspaces? How could one put up a no trespassing sign demarcating the airspace up to 400 ft above one's property as a no-fly zone, or area where surveillance and imaging is restricted?

Could surveillance be limited or regulated on a sensor by sensors basis? Many sensors might have social, environmental or commercial value without impinging on individual privacy, while other may have little such value while posing significant threats to privacy, while other may offer both value and threats.

Or should restrictions focus not on the collection of data, but on its archiving and distribution? Various sorts of regulations and requirements for transparency, imposed obscurity, etc. could be imposed.

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