Emerging Legal and Ethical Issues in Advanced Remote Sensing Technology

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Abstract

Fundamental changes are taking place in the world of remote sensing with respect to three primary developments. First, a new generation of space-borne sensors will be able to deliver high spatial and spectral resolution imagery on a global basis. Technical advances are making previous restrictions on data scale, resolution, location, and availability largely irrelevant. Second, economic restructuring of the remote sensing community will transform the control and distribution of imagery and imagery-derived information generally away from government and into the private sector. Third, the development of a digital, global information infrastructure, such as the Internet, will allow for rapid global distribution of information to a worldwide user community. The combined effects of these developments could have significant legal and ethical consequences for all remote sensing professionals. For example, remote sensing technology could soon develop the capability to generate and deliver a level of information detail that could violate common societal perceptions of individual privacy, and a number of direct legal and ethical consequences could result.

This paper reviews the legal background of remote sensing and current developments in satellite surveillance and information technology, and outlines a number of legal and ethical issues that could be of future concern to the remote sensing community. Self regulation of the profession is central to maintaining the appropriate balance between the rights of the individual and the economic interests of the remote sensing community and the nation as a whole.

Introduction

The science of remote sensing is commonly defined as methods that employ electromagnetic energy to detect, record, and measure characteristics of a target, such as the Earth's surface (Sabins, 1986). The remote sensing process involves the collection and analysis of *data* about the electromagnetic energy reflected and/or emitted from an object in order to obtain useful information about the object (Lillesand and Kieffer, 1994). Aerial photography and satellite imaging, two of the more traditional forms of remote sensing, have been commonly employed for purposes such as weather forecasting, mapping, intelligence gathering, global process research, land-use planning, conservation, and drug interdiction and control. Additionally, a new generation of sophisticated remote sensing techniques are likely to play an increasingly significant role in the future of an information-driven society. Of particular significance, and the subject of this paper, is the effect of advancing remote sensing technology on issues such as personal privacy, constitutional guarantees against unreasonable search, and law enforcement.

Remote sensing techniques offer inherent advantages to the practice of monitoring activities through the efficiency of areal perspective, temporal definition, change detection, and accurate mensuration capabilities. Aerial photographs dating back to the 1930s and satellite images from the 1970s and 1980s are routinely available and have played a key, albeit subtle, role in public programs and policy development. Aerial photographs and data from satellite systems have been successfully used for a variety of litigation purposes for several decades (Latin *et al.*, 1976; Brennan and Macauley, 1995).

Remote sensing is currently undergoing a dramatic revolution in terms of technical monitoring capabilities. Advances in spectral and spatial resolutions, new sensors, new platforms, and continually improving digital analysis and communications techniques are changing and expanding the level and types of detail that may be extracted from raw imagery. Previously fundamental imaging restrictions on scale, resolution, availability, location, and cost could become largely irrelevant. Also, the growing number of orbital and airborne sensors and subsequent volume of available imaging data is dramatically changing the overall global capability for overhead monitoring.

Remote sensing is also undergoing a revolution in terms of information management, data control, and communication. In the past, the remote sensing community had strong and fundamental connections to the United States government through the design and launch of sensors and orbital vehicles, the sale and distribution of data, and the grant money for research and development of applications. However, the current economic restructuring of the remote sensing community has resulted in a clear trend of foreign governments and multinational corporations entering the remote sensing market. This diversification, coupled with the development of a global information infrastructure, has created a fundamentally different world in the distribution and analysis of high resolution spatial and spectral data.

These developing changes in spatial and spectral monitoring capabilities, coupled with emerging global information management systems, have created a significant potential for the misuse of remote sensing data. Just as the general digital information revolution has created valid concerns about safeguards to an individual's privacy and other basic quality-of-

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life guarantees (Brennan and Macauley, 1995), similarly, the technological advances in remote sensing could be creating a potential to cross legal and/or ethical boundaries with respect to the privacy of the individual citizen and/or corporation.

As is often the case, emerging technology can advance faster than society as a whole can reasonably assimilate and create new laws, policies, or ethics to govern the conduct and operation of the technology. New scientific advances can extract an indirect price or create the potential for misuse that society has not fully considered and is, perhaps, not fully prepared to accept.

This paper reviews the legal background of remote sensing technology and identifies some of the policy and ethical issues that could be of future concern to the remote sensing community. Additional background information on privacy issues in the context of geographic information systems may be found in Onsrud *et al.* (1994).

A Changing Landscape

Three fundamental changes are occurring in the world of the remote sensing specialist. The first, and most obvious, involves technical advances in monitoring systems. Although aerial photography is the original form of overhead remote sensing and is still probably the single most widely used form, the world of satellite imaging sensors has expanded dramatically in the past two decades. The United States Landsat series of satellites has provided global multispectral imagery for more than 25 years, and the Russian, French, Japanese, Indian, and Canadian governments, among others, market and sell global imagery acquired by their orbiting imaging systems. Even the once-closed intelligence community is suddenly considering commercial development of high-resolution imaging technology of the extremely fine detail usually reserved for intelligence gathering efforts (Barrett, 1993). Within the next decade, there are planned over 20 polar-orbiting remote sensing satellites. Most are at the very least multispectral, and many have spatial resolutions of less than 5 metres with some even below 1 metre (ASPRS, 1996a; Brennan and Macauley, 1995; Steele, 1991). Additionally, Morain and Budge (1995) list over 20 available and planned hyperspectral instruments that have scores of spectral channels and can operate at ground sample distances of under 1 metre. In addition to the advances in spatial and spectral resolution of a new generation of satellites, new processing techniques and algorithms, such as the use of neural networks and/or sub-pixel land-cover classification, are increasing the level of information that may be confidently extracted from imagery (Foody, 1996; Gong, 1996; Sohn and McCoy, 1997; Huguein *et al.*, 1997).

The second change involves the commercial and global restructuring of the remote sensing infrastructure. There is currently a general evolution of the remote sensing infrastructure from government to commerce, and from domestic to international. Especially in the U.S., much of the routine development and use of remote sensing technology and data has been closely connected, directly or indirectly, with some level of governmental activity. This has provided an inherent level of oversight and control of distributed information, thereby guarding against misuse of data. However, in the current environment, there are several countries, other than the United States, that openly market and sell global imagery from their own orbiting sensors, such as Canada's RADARSAT, France's SPOT, and the Russian SOVINFORMSPUTNIK. Data rights, pricing, and distribution policies reside with the governments owning the spacecraft (United Nations, 1987). Recently, several governments, including the United States, have turned to quasi-public organizations to market and sell imagery from their orbiting platforms (Brennan and Macauley, 1995). Further, the remote sensing community is now experiencing the completely private development, launch, operation and marketing of remote sensing satellites, some with spatial resolutions at the 1- to 3-metre level (Brennan and Macauley, 1995; Bingaman, 1995).

The third issue relates to the rapidly changing nature of information distribution and access in modern society. The development of a global information infrastructure is creating significant new capabilities and unforeseen possibilities for surveillance. Already, many providers of remotely sensed data market and distribute digital imagery directly over the Internet. Whereas, in the past almost all remote sensing involved some level of government involvement and therefore had oversight and appropriate controls on information dissemination and privacy concerns, the next generation of remotely sensed information is likely to come from foreign satellites and multi-national corporations who deal with information technology in a global marketplace and may operate absent of any effective U.S. or international government oversight. The globalization of remote sensing information systems will result in the flow of data and information products outside of the traditional jurisdictional and national boundaries and beyond traditional methods of effective legal control.

Further, there is a noteworthy and surprising lack of comprehensive policy development with respect to high-resolution remote sensing technology. Major unaddressed concerns still exist relating to such fundamental issues as national security, military intelligence, and terrorist activity (Bingaman, 1995). And while the Land Remote Sensing Policy Act of 1992 (LRSPA) establishes comprehensive data and regulatory policies for Landsat and follow-on systems, the Act's basic assertion that private space-based systems are not currently viable has been challenged by the licensing of several commercial vendors, creating the possibility of large commercial remote sensing markets that were not envisioned, or covered, by this particular law (Gabroynowicz, 1993). Further, as pointed out by Gabrynowicz (1996), the next generation of Unpiloted Aerial Vehicles is likely to operate at altitudes that were not envisioned or addressed in the LRSPA. The United Nations has issued general guidance titled "Principles Relating to Remote Sensing of the Earth From Space," which promotes international cooperation and data sharing between countries, but does not directly address issues of privacy or data misuse at the level of the individual.

The coming advances in remote sensing technology, coupled with the corresponding changes in commercial restructuring and global information distribution, will, within the next decade, drastically change the nature and utilization of imagery and will result in the flow of data and information products outside of traditional jurisdictional and national boundaries that once regulated access, distribution, and appropriate use.

The remote sensing community has already experienced many applications that are far different from those of conventional aerial photography. For example, lidars routinely identify chemical compounds, some radars have the ability to penetrate sandy soils and "see" underneath tree canopies or overhanging structures, and thermal infrared wavelengths can show intimate details of occupance or discharge. With the advent of multispectral instruments with sub-metre pixel resolutions, what these sensors might be able to determine in bandwidth combinations, through logical associations with other data and through "fusion" or combined data analysis (particularly with hyper-spectral data), is a fertile area of research that is likely to yield significant results. In short, the technical capabilities of the future will not simply be limited to the application of classical remote sensing analysis procedures, but will be open to a new generation of high resolution sensors and analytical procedures.

What should be clear to the general remote sensing community is that these fundamental changes in technology and infrastructure may have far reaching implications. A clear problem currently exists with respect to inconsistent remote sensing law, developing information policy, and the interface between the two (Gabrynowicz, 1992). We are about to enter an era where we will have the technical ability to determine and distribute extremely fine details about the home and life of the individual in society, and that this ability, at least in the interim, may be largely uncontrolled because of underdeveloped policy, complex and sometimes incoherent remote sensing laws, and a general inability for enforcement at the international level.

Legal Background

Because of its efficacy and intrusiveness, the technology has always been of interest to the legal community, and, while Constitutional concerns about remote sensing technology have always existed, it has usually not caused any great problem due to technological limitations (Latin *et al.*, 1976). Until recently, the level of detail has been so gross as not to be a concern, and the intrusion is one which society generally accepts as reasonable for some greater overall purpose, such as map making, effective land-use planning, or protecting human health and natural resources.

Latin *et al.* (1976) and Uhlir (1990) categorized three remote sensing applications in the legal arena: (1) applications aimed at the development of public policy, (2) investigatory applications, and (3) applications expected to produce admissible evidence. Aerial photographs and maps have been effectively and extensively used as evidence in court proceedings (Gillen, 1986; Quinn, 1979). Even satellite imagery has been successfully introduced as evidence in pollution control cases such as U.S. v. Reserve Mining and State v. Inland Steel Company (Latin *et al.*, 1976).

Because of the historically strong connection between remote sensing and government, one of the most fundamental issues with respect to advancing remote sensing technology can be found in the Fourth Amendment to the Constitution of the United States:

> "The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized."

The legal issues surrounding the use of overhead remote sensing techniques for monitoring and law enforcement revolve largely around the history and interpretations of the Fourth Amendment to the U.S. Constitution. The basic legal guarantee prohibiting unreasonable searches is a complex, ambiguous, and open ended concept in the American model of civil liberties and is a fundamental component of U.S. constitutional law (Koplow, 1992). Since 1914, in Weeks v. United States, the Supreme Court ruled that evidence obtained through an illegal search (without a warrant based on probable cause) could not be used in a federal criminal prosecution. Since that time, subsequent Supreme Court decisions have further extended the limitation on unwarranted searches to include intrusive activities that do not involve physical trespass, such as wiretapping and electronic eavesdropping (Volkomer, 1972). Repeated Supreme Court decisions have upheld the vitality and importance of the Fourth Amendment, even in cases of important national security issues (Koplow, 1992). In the 1967 Katz v. United States, the seminal case in search and seizure issues, the Supreme Court set out two lines of inquiry to define searches that may be permissible without a warrant. First, has there been exhibited an actual, legitimate expectation of privacy and, second, is this expectation one that society is prepared to accept as reasonable? These two standards form the modern definition of an unwarranted search that is nonetheless legal. If the subject exhibits expectation of privacy and that expectation is one that is deemed reasonable, search may not be conducted without a warrant.

To date, the landmark legal decision concerning remote sensing and law enforcement has been the 1986 Supreme Court decision, Dow Chemical Company v. The United States (hereafter referred to as Dow). In an attempt to enforce Clean Air Act regulations, the EPA sought access to the Dow Chemical plant in Midland, Michigan. When a request for a follow-up visit was refused, the EPA contracted for an aerial photographic overflight, using a standard mapping camera, to determine if proper equipment was installed and if illegal discharge could be detected. Upon discovering EPA actions, Dow brought suit claiming that the EPA violated trade-secrets law, acted outside of its authority under the Clean Air Act, and conducted an illegal search under the Fourth Amendment. Eventually, the Supreme Court ruled, in a 5 to 4 decision over a spirited dissent, that the EPA had acted legally in the acquisition of the aerial photographs.

There were three key elements in the Dow decision: (1) trade secrets law, (2) the statutory authority of the EPA under the Clean Air Act, and (3) Fourth Amendment guarantees against unreasonable search.

With respect to Trade Secrets Law, which Dow relied heavily upon in its arguments, the Court simply ruled that trade secrets protection was not relevant to the role of regulatory government. Because aerial photographs are commonly available and routinely used in map-making, their use by a government regulatory agency was not an issue with respect to trade secrets protection. The second issue revolved around whether the EPA could use an inspection method (aerial photography) that was not explicitly authorized by the Clean Air Act. Here the Court held that a regulatory agency ". . . needs no explicit statutory provision to employ methods of observation commonly available to the public at large" (Dow, page 6).

However, the most fundamental issue in this case was that of unreasonable search and seizure. Dow claimed that the aerial photographs constituted a search without a warrant. Dow had constructed walls and taken other security precautions to guard against ground-level observation, and by doing this claimed to have exhibited a reasonable expectation of privacy, one of the critical elements of the Katz standard.

Two key legal concepts are relevant to this question of reasonable expectation of privacy, curtilage and open fields as defined in a seminal case of Oliver v. United States. Curtilage is defined as the yard or courtyard surrounding a dwelling, usually within a fence or some other type of perimeter security device. The curtilage of the individual home, under traditional common law, has enjoyed almost the same Fourth Amendment protection that is afforded inside the home. An individual within the curtilage of his/her home has a reasonable expectation of privacy that cannot be intruded upon, except by warrant (Dow, page 8). Open Fields, on the other hand, have been defined as out-of-doors areas, not immediately surrounding the home, where the individual does NOT have a reasonable and legitimate expectation of privacy. Dow tried unsuccessfully to claim that the open areas of a large industrial complex were analogous to a concept of industrial curtilage. Although the court held that a company has a reasonable and legitimate expectation of privacy within their covered buildings, guarding their proprietary industrial processes, this expectation of privacy does NOT translate to the outdoor areas of a manufacturing plant which are more like

"open fields" (Dow, Page 10). In simple terms, because aerial photography is a commonly available technology, and because Dow did not take precautions to guard against it, the Court ruled that it had NOT exhibited a reasonable nor legitimate expectation of privacy.

The second key search inquiry, which also failed the Katz standard, is whether the expectation of privacy is one that society is willing to accept. Here the Court clearly drew distinctions between the rights of individual and the rights of a corporation.

> "We pointed out in Donovan v. Dewey, . . . that the government has 'greater latitude to conduct warrantless inspections of commercial property' because 'the expectation of privacy that the owner of a commercial property enjoys in such property differs significantly from the sanctity accorded an individual's home.' We emphasized that unlike a homeowner's interest in his dwelling, the interest in the owner of a commercial property is not one in being free from inspections . . ." (Dow page 10).

Although it was clear that the Supreme Court was not willing to extend the same standard of individual protection to commercial enterprises, the Dow decision is of limited definitive value to the remote sensing community because it dealt only with the relatively narrow issues of standard aerial photography and government restrictions under the Fourth Amendment. The are several emerging areas where lack of precedent and expanding technology will require policy development.

Emerging Issues

As a result of the changing political and technical climate, there are a number of technical and legal issues emerging regarding the impacts of advancing remote sensing technology. Although the Dow decision was a landmark with regard to interpretation of the Fourth Amendment, it was problematic and has been criticized on several basic points (Gootee, 1990; Koplow, 1992). Several key issues emerge with respect to future monitoring technology and the Fourth Amendment guarantees. The first two deal directly with the results of the Dow decision. The remaining issues are related to the changing landscape of information technology.

Methods Available to the Public (Ordinary Technology)

Related to the Fourth Amendment guarantees of a reasonable expectation of privacy, the Dow court utilized a concept of "commonly available methods of observation" to justify the warrantless search using aerial photographs. Because the technology of aerial photography is commonly used for a variety of purposes and is generally available and known to the public, the court held that there was no constitutional problem with the government employing the same technology. In Marshall v. Barlow's the court held:

> "[w]hat is observable by the public is observable without a warrant, by government inspectors as well" (Page 315).

However, the Dow court also noted:

> "It may well be, as the Government concedes, that surveillance of private property by using highly sophisticated surveillance equipment not generally available to the public, such as satellite technology, might be constitutionally proscribed absent a warrant" (Dow page 11).

Here, the court was clearly drawing a distinction between aircraft technology and other, more sophisticated systems such as satellites, which are not as widely available to the public. However, this argument weakens as technology expands in society. One could easily argue that satellite technology has become widely known and available to the public through routine television usage, through education, and through digital network media such as the Internet. At some point in time, it is reasonable to assume that satellite technology *per se* will cross the line into the realm of "ordinary technology."

Another possible reason for drawing an aircraft/satellite distinction, as pointed out by Steele (1991), is that aircraft are presumably detectable by the observee; that is, a person can be aware of overhead aircraft but may not be able to fairly sense that they are being observed by satellite systems. This is also problematic in that many sophisticated camera systems now exist that allow for highly detailed imagery to be observed from very high altitudes. The ER-2 aircraft that is flown by NASA, takes imagery of sub-metre ground resolution from an altitude of 65,000 feet, placing it far out of the range of casual ground observation (NASA, 1990). Unpiloted Aerial Vehicles, many carrying imaging sensors, routinely operate at altitudes of greater than 50,000 feet and could not be detected by the casual ground observer (Gabrynowicz, 1996).

Human Vision and Multispectral Remote Sensing

One of the most important issues in considering the legal parameters of remote sensing is the now common availability of multi- and hyper-spectral imagery covering a wide range of the electromagnetic spectrum. With the availability of such spectral imagery comes the capability to determine a number of potential details that are beyond common sensory perceptions.

In the Dow decision, Justice Burger wrote, "The mere fact that human vision is enhanced somewhat, at least to the degree here, does not give rise to Constitutional problems" (Dow, page 11). Assuming that the word "vision" is interpreted to mean the sensory process of the human eyes, the Dow decision implies that the Supreme Court has only ruled on the remote sensing processes that use only visible light. Numerous sensors detect information in other parts of the electromagnetic spectrum outside the wavelengths of visible light. These wavelengths offer numerous advantages in detecting heat, radiation, vegetation growth, geologic patterns, and even underground morphology, and are routinely used by many scientific disciplines. How this issue would be interpreted by the court in terms of regulatory monitoring and Constitutional issues is presently unknown, but the implications to the remote sensing and regulatory communities could be monumental.

Koplow (1992) suggests that the remote sensing ability to determine details of human activity within the home would be clearly prohibited by the courts in terms of Fourth Amendment protection of individual liberty. However, in several early cases, there have been mixed results. In United States v. Penny-Feeny, the 11th District Court held that evidence obtained from a heat-sensitive infrared device was sufficient to obtain a search warrant for illegal indoor marijuana cultivation (Steele, 1991). In United States v. Ford, and United States v. Ishmael, similar decisions were reached concerning unwarranted searches with thermal infrared devices. However, in States v. Young and United States v. Cusumano and Porco, the use of a thermal infrared device was held to be an unconstitutional search (although in Cusumano the conviction was upheld for other reasons). To date, the Supreme Court has not addressed any cases related specifically to the use of multispectral remote sensing.

Privacy

Beyond the issue of unreasonable search and seizure and Fourth Amendments protection lies the more complex issue of personal privacy. Privacy is not a clear-cut concept in law.

Justice Louis Brandeis once called the right to privacy ". . . the most comprehensive of rights most cherished by civilized men" (Olmstead v. United States). However, as pointed out by Alderman and Kennedy (1995), nowhere in the Constitution is privacy *explicitly* guaranteed to the individual in society. Because of the traditionally significant role of government in remote sensing technology, most of the legal interest and concern has involved use of the technology for law enforcement purposes and subsequently involved interpretation of the Fourth Amendment. However, one of the most significant changes in the present remote sensing world is the commercial and international marketing and development of remote sensing technology. *The Fourth Amendment protects U.S. citizens against unreasonable search and seizure by the government, for purposes of law enforcement. It does not protect against invasions of privacy by other parties for commercial or financial purposes.*

There are two dimensions of personal privacy that figure prominently in legal literature and when considering remote sensing technology: spatial and informational (Brennan and Macauley, 1995). The obvious spatial aspects of technology relate to the physical space of an individual and to the intimate space around the home where one might reasonably expect to be free of monitoring and surveillance. As satellite remote sensing begins to routinely gather data at or below the metre level of resolution, privacy suddenly becomes a major concern as imagery suddenly has the potential to detect levels of detail that were previously impossible with space-borne sensors. The second dimension of privacy is informational and relates to those attributes, activities, or information that an individual may wish to conceal from others. These may include personal relationships, property, time utilization, and any number of attributes that an individual may deem essentially of a personal nature. Although this type of data may require complex analyses from multiple sources, multispectral remote sensing data certainly has the potential to deliver intimate details about human behavior and property.

If highly detailed personal information can be acquired by the next generation of remote sensing instruments, as it almost certainly will, and if that information has market-value in global commerce, a dangerous situation will exist with respect to what all people consider basic personal privacy. The potential for invasion of personal privacy is both obvious and disturbing.

Commercial Information Markets

In the highly competitive global marketplace, information is a critical resource and the activities, preferences, movements, and behavior of potential purchasing populations are an area where business has traditionally committed significant resources for marketing purposes. With the availability of high spectral and spatial resolution imagery (and kindred spatial technologies), new levels of detail about intimate personal activities may suddenly be of interest to the business community. This is further complicated by the commercialization of remote sensing technology and the global nature of the information infrastructure. The possibility of international "data havens" or even "rogue data states" that operate outside of any enforceable legal system create a vast potential for misuse of highly detailed spatial data (Weinstein, 1995).

Direct Criminal Activity

Deliberate criminal activity is another category of remote sensing data misuse that at first may seem somewhat far-fetched but could easily become an emerging issue with a new generation of sensors and data delivery systems. The level of detail and ease of information acquisition in the near future will undoubtedly create this possibility. It is reasonable to speculate that the sophisticated criminal of the Twenty-First Century may be able to include high-resolution satellite data and image processing in targeting victims. Imagine a burglar using the Internet to pull down a near-real time multispectral image of an individual's home to determine occupance, visibility, ingress/egress, and value of property. None of this is outside the realm of currently planned capabilities.

Additionally the use of one-metre satellite imagery for terrorist purposes has been raised and is a major policy concern that currently has no clear-cut solution, especially when the satellite and the sponsoring agency/government is outside of effective control of the U.S. government. (Rye, 1995; Bingaman, 1995).

Ethical Considerations

It is an unfortunate reality in modern society that there is a significant period in which formal policy development often lags behind technology advancements. The result is that we will experience a substantial period (probably several years) where there will be an absence of legal and policy constraints on a new generation of highly detailed remote sensing technology. Concurrent with the increased capabilities of remote surveillance technologies and a shift from government to private responsibility for the deployment of the sensors and collection of the data is the increased potential for use of the data and technology without the benefit or safeguard of effective or enforceable legal protection. Additionally, as remote sensing technology expands in the international corporate arena, the issue becomes complicated by the need for international policy and regulation. There are even serious concerns at the level of national security which, although beyond the scope of this paper, demonstrate the lack of formal policy development as related to the explosion of remote sensing capabilities (Bingaman, 1995).

The developmental changes being experienced by the remote sensing community call for the articulation of ethical guidelines to provide a moral philosophy in the absence of a comprehensive legal or policy framework. All remote sensing professionals should realize the potential dangers associated with these technological developments and should consciously re-visit the ethical standards of this profession.

Revision of the ASPRS Code of Ethics

It is in the above light that the American Society for Photogrammetry and Remote Sensing (ASPRS) has recently begun the task of assessing and revising the scope of its Code of Ethics. Historically, the Code has dealt almost exclusively with issues of business and professional conduct. Accordingly, the Code did not directly address the broader concerns of ethics pertaining to the use and misuse of data and technology (ASPRS, 1996b). In recognition of this need, the ASPRS Board of Directors approved (on 10 April 1997) the following revision to the Code:

> "Recognize the proprietary, privacy, legal, and ethical interests and rights of others. This not only refers to the adoption of these principles in the general conduct of business and professional activities, but also as they relate specifically to the appropriate and honest application of photogrammetry, remote sensing, geographic information systems, and related spatial technologies. Subscribers to this code shall not condone, promote, advocate, or tolerate any organization's or individual's use of these technologies in a manner that knowingly contributes to:
>
> a. deception through data alteration;
> b. circumvention of the law;
> c. transgression of reasonable and legitimate expectation of privacy.[1]"

[1]The revised Code was first published in its entirety in *Photogrammetric Engineering & Remote Sensing*, 63(5):554.

Simultaneous with approval of the above, the ASPRS Board also recommended that the Society's Professional Practice Division be charged with a total review and evaluation of the Code with recommendation for Code interpretation and enforcement. In making this recommendation, the Board also specified that "It is envisioned that this process continue to develop a set of principles and values governing the ethical application of all technologies referenced within the Code."

The Challenges Ahead

As one of the largest professional and scientific organizations in the world concerned with the development and application of remote sensing and related spatial technologies, ASPRS is attempting to provide a leadership role in calling attention to the ethical considerations attendant to these rapidly changing technologies. The Code should serve as a source of inspiration for newcomers to this field and as a source of pride and accomplishment for more experienced practitioners. However, the real challenges in this arena are ahead. Altruistic principles that look good on paper are often difficult to translate into day-to-day business decisions. For example, data collected and provided for presumably noble purposes can often be used for less noble ones. Choosing among worthy yet conflicting principles will also characterize many aspects of applying future technology.

The central point to be made here is that the remote sensing "professional" cannot let existing and future technology simply take him or her down certain paths of behavior merely because these activities are technologically feasible and/or economically profitable. Indeed, it is consistent conformance to a common set of moral principles and values about what is right and wrong, coupled with common technical standards, that defines what a profession is and does. The challenge ahead is to continually define and appropriately modify these professional ideals, both individually and collectively, because law and public policy will likely never "catch up" to the issues surrounding this rapidly changing technology. All remote sensing professionals dealing with advanced technology should be aware of the ethical dangers ahead and should consciously revisit the code of ethics of the profession. We contend that such self-regulation is central to maintaining the rights of individuals, the trust of the public, and the economic vitality of the profession and nation as a whole.

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