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Autonomous Systems in the Intelligence Community: Many Possibilities and Challenges

Jenny R. Holzer, PhD, and Franklin L. Moses, PhD

Advantages that autonomous systems could provide for intelligence purposes include movement through varied terrain and environments, stealth, persistent surveillance, and data processing.

Introduction

The Intelligence Community (IC) has a central mission to help the nation avoid strategic national security surprise. Strategic surprise may come in the form of deliberate actions by adversaries of the United States, or it may emerge as the result of unanticipated consequences of technological, economic, demographic, political, or natural forces. It falls to intelligence practitioners to find the indicators or informal signs of change, to organize knowledge about them, and to identify factors influencing their evolution. Practitioners use the information to support accurate predictions of future situations and their effects and to provide the basis for appropriate decisions.

From its earliest days, the IC has constantly sought new technologies for intelligence gathering, for counterintelligence activities, and for improvements in analyzing and interpreting large amounts of diverse data. These new technologies ideally would be capable of a number of things:

- gathering information from adversaries in inaccessible areas;
- overcoming efforts of adversaries to deny US and allied access to sources of critical information;
- protecting IC systems and networks that contain sensitive information;
- deterring the efforts of others to acquire US information; and
- providing the bases for effective and timely security decision- and policymaking.

This article discusses "autonomous technologies" that promise to make humans more proficient in addressing such needs. Although literature in the field is inconsistent in defining the technology and its components, autonomous systems generally are those that take actions automatically under certain conditions. Put another way, they can be thought of as self-governing systems capable of acting on their own within programmed boundaries.

An autonomous system may be platform based—a machine or a device such as a robot—or it may reside and act entirely in the cyberworld. Depending on a system's purposes and required actions, autonomy may occur at different scales and degrees of sophistication. In addition, autonomous capabilities must be understood and developed within the ecology of specific mission needs, operating environments, users, and, in the case of platform-based systems, the vehicle.[1]

Today's autonomous systems are in their infancy, however, capable only of performing well-defined tasks in predictable environments. Advances in technologies enabling autonomy are needed for these systems to respond to new situations in complex, dynamic environments of the sort that most interest the IC.

Autonomy's Potential in IC Activities

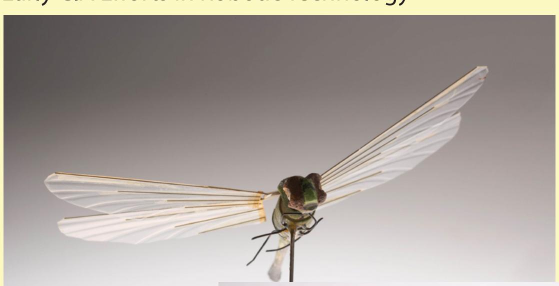
The key advantages that autonomous devices could provide for intelligence purposes include movement through varied terrain and environments, stealth, persistent surveillance, and data processing.

Terrain. The types of terrain and environments encountered on IC missions vary dramatically. They could involve desert landscapes, canopied forests, crowded urban settings, potentially toxic chemical facilities, and more. These environments may be dynamic, changing minute to minute. While humans may not be able to navigate safely or undetected to and through such areas, robots would be able to do so without endangering individuals, and they could be built to linger in areas of interest for long periods of time.

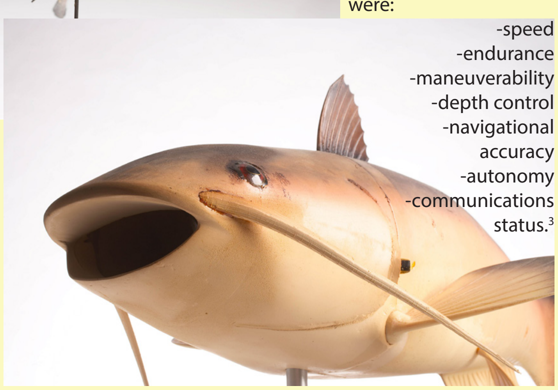
Robots could take several forms and might include swimmers, resembling dolphins, or equipment carriers that might look like mules. To be truly effective, however, these kinds of robots would have to include autonomous systems to automatically control "fins" or "legs" in response to changing water or terrain features.

Stealth. Systems are made less detectable by the use of materials applied to an object's surface, by physical properties, and by electronics.

Early CIA Efforts in Robotic Technology



CIA's Office of Advanced Technologies and Programs developed the unmanned underwater vehicle (UUV) fish in the 1990s to study aquatic robot technology. Some of the specifications used to develop "Charlie" were:
-speed
-endurance
-maneuverability
-depth control
-navigational accuracy
-autonomy
-communications status.[3]



Developed by CIA's Office of Research and Development in the 1970s, the above micro unmanned aerial vehicle was the first flight of an insect-sized vehicle (insectothopter). It was intended to prove the concept of such miniaturized platforms for intelligence collection.[2]

These characteristics are typically adjusted to avoid specific types of surveillance systems such as human vision or radar. Autonomy can permit a system, a surveillance device, for example, to quickly and automatically alter its characteristics when it detects changes in its environment that might permit an adversary to detect it.

Persistent surveillance. A high degree of autonomy would be required for long-term surveillance activity, which would require a surveillance vehicle to detect changes in target areas, including spotting and identifying vehicles in motion. The vehicle would have to be able to manage its power and fuel consumption and communicate with an intelligence center and its computers. For example, an airborne surveillance system might employ an unmanned aerial vehicle (UAV) with autonomy to handle flight controls, radar systems, surveillance equipment, fuel stores, and communications. If a swarm of UAVs were used, then an autonomous system could control flight patterns and reconfigure the swarm if members are lost. A passive border-monitoring system would use autonomy for change detection, motion detection, communications, power management, and possibly stealth.

Data processing. Use of autonomous systems for data processing and distributed computing would present clear advantages for the IC, allowing for rapid, timely analysis of large amounts of data and their incorporation into decisionmaking. Autonomous systems can help humans by doing data analysis at greater speed to fit into a decision cycle. Note well that autonomy is a resource multiplier, but it does not remove the human from the system.

In the Hands of Adversaries

The possibility that enemies of the United States would take advantage of autonomous systems technology for their own purposes is high. We must understand what countermeasures would be needed to combat autonomous systems used against the United States and its allies. Possibilities to consider include the following:

- Surprising US and allied forces by using stealth to hide weapons or intelligence projects targeted against friendly autonomous systems. For example, sensors can be fooled by changing target objects or the environment itself (e.g., by increasing turbulence, adding irregular structures, applying different paint coatings, using different surface materials, or changing audible signatures).
- Identifying passwords or pathways to gain access into sensitive US systems and networks. Autonomous systems can be used to combine human intelligence from Internet social engineering with distributed processing to identify passwords and other obstacles to logging into classified systems. An autonomous system might take the form of a well-written computer virus or malicious code capable of modifying itself to move undetected through a network and cause system failure.
- Spoofing current sensor networks or creating alternative networks to follow individuals. For example, homemade submarines or aircraft may become unmanned underwater vehicles (UUVs) or UAVs with autonomous capabilities for tracking friendly individuals or platforms.
- Exploiting technological limitations of sensors against them. For example, our sensors may have gaps in their electromagnetic (EM) spectrums in which data do not register. False or malicious code may be introduced into the processing centers to cause systems to fail. An autonomous system's own failure modes (i.e., stop transmissions or return to origin) could be used for an enemies' purposes.

Enabling Technologies for Autonomous Systems

An autonomous system is an integration of enabling technologies that allows it to understand its designed goals, sense and understand its environment, and make decisions on actions that it must execute to complete its goals. However, a variety of technologies must still be developed (or invented) before the potential of autonomous systems is realized. The most easily observed advances in these enabling technologies are the robotic platforms that allow autonomous systems to perform physical actions or move through their environment.

Researchers are studying biological systems to create robots ideally suited to perform in particular environments. (See examples in the graphic on the next page.) Advances in biomimetics have allowed the creation of new classes of robotic platforms designed to perform in complex and dynamic assignments and environments, such as entering and navigating through buildings, moving underwater, or in environments in which there is no access to the global positioning system (GPS) and where direct, remote control is not possible. Operational capabilities, however, will require more sophisticated software than is currently available. State-of-the-art autonomous capabilities exist at the subsystem level (e.g., obstacle avoidance for ground robots and capabilities to maintain controlled flight for air platforms).

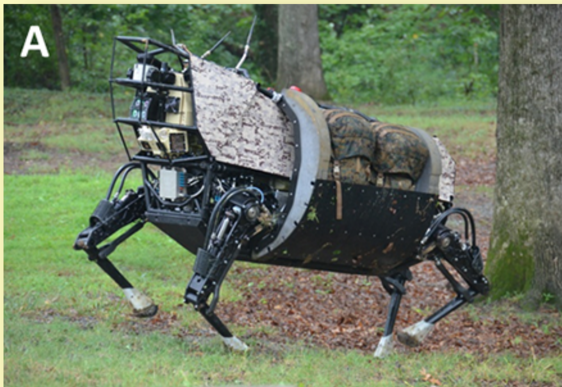
Less well developed is the ability to understand and freely navigate an environment. Sensors (hardware) provide the input, but software provides the understanding. Simultaneous location and mapping (SLAM) is an example of a technique that robotic platforms can use to explore their environment and build up a three-dimensional (3D) map to determine their location and navigate.[4]

However, we must supplement mapping capabilities with software capable of planning courses of action and making decisions to achieve them. Such autonomous systems would lessen the burden on IC controllers, who would otherwise have to make extensive manual inputs such as GPS way points, sensor tasking, or power management.[5]

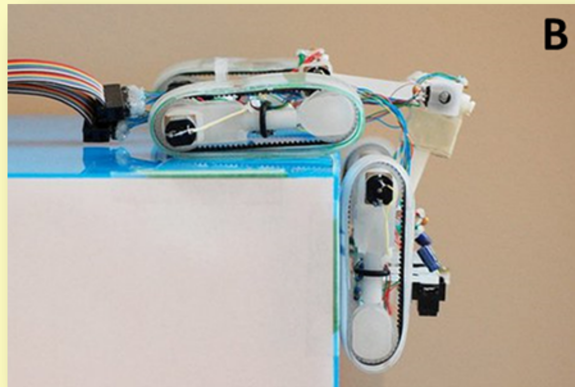
Evolution of Autonomous Systems

Needed Advances in Enabling Technologies

The technologies that make autonomous systems function must continue to mature and evolve in order to deal with the complexities and



A. The Defense Advanced Research Projects Agency (DARPA)-funded BigDog robot uses four animal-like legs to traverse terrain too rough or slippery for conventional vehicles. It is also capable of recovering its "balance" if it slips. The current iteration of the program, the Legged Squad Support System (LS3) (above) seeks to demonstrate that a highly mobile, semiautonomous legged robot can carry 400 lbs. of load through rugged terrain. [6]



B. A Canadian research group addressed the challenge of climbing walls by designing a dry adhesive that mimicked the structures of a gecko's foot pad. The platform, called the Tailless Timing Belt Climbing Platform (TBCP-II), can move from horizontal to vertical surfaces and over both inside and outside corners, as can other gecko-inspired climbing robots.[7]

C. Scientists also are studying the way birds and insects fly to better understand aerodynamics and low-noise systems. The Nano Hummingbird (above) demonstrated controlled, precision hovering and fast-forward flight of a two-wing, flapping-wing aircraft that carries its own energy source and uses only its wings for propulsion and control.[8]

D. Harvard researchers are pushing the technology on an even smaller scale with their RoboBees project (above), which emulates a colony of honeybees containing insect-sized flapping-wing robotic platforms. These biomimetic platforms have the added advantage of stealth.[9]

uncertainties of the IC's real-world environments and tasks.

Current technologies may have the potential to permit greater autonomy, but they primarily now work with well-defined rules and exhibit only limited autonomy in initiating and carrying out innovative tasks intelligently. Surveys done by the International Federation of Robotics (IFR) Statistical Department show that there have been worldwide increases of industrial robots and greater use of service robots. Industrial functions include tending of machines (metal work and plastic molding), palletizing and inventory, and dispensing (painting, sealing, gluing). Service robots work on tasks ranging from household chores (cleaning, lawn mowing) to dirty, dull, distant, dangerous, or repetitive tasks.[10]

Autonomous system technologies must be proficient at operating in a variety of complex, dynamic environments, all of which present challenges. For example:

- In space: zero-gravity, airless, extremes of cold and heat;
- Air: variable pressures, winds, extreme and sudden weather shifts;
- Land: variable gradients or slopes, multitudes of obstacles, man-made and natural;
- Sea: high seas, sharply variable currents, changing weather conditions;
- Undersea: changing pressures of depth, variable terrain near sea bottom, changing currents, and changing temperatures.

In all conditions they must exhibit endurance while maintaining stable operations, despite attacks and challenges to propulsion, sensors, and communications. Speed, agility, and stealth are essential parts of the IC mission and are ambitious requirements when combined with autonomy.

Ideally, an autonomous system should be able to make informed decisions with human guidance. Current systems require programmers to understand mission parameters and translate them into well-formed rules based on the end user's understanding of the problem.

This approach allows the autonomous system to make decisions but only in the context of how the programmer described the problem. Truly autonomous systems must be able to do complex tasks and perform missions in situations that require modifications to rules. This capability either will come from expanding rule sets or giving systems the ability to learn from their environments. Such advances will require much more research.

Humans Are Part of the System

A human-autonomous technology interface may seem like an oxymoron. Today, however, it is an essential ingredient of semiautonomous systems under direct or indirect human control. In the future, autonomous systems must respond even more to human needs and give meaningful feedback. For example, a user may guide a sensor that is capable of doing surveillance of all data within its frequency and range limitations to focus on certain target characteristics. The sensor system's download capabilities should send relevant data in formats that satisfy the user's needs. At some level, however abstract, a human-machine interface will be necessary, even when autonomous, humanlike decisionmaking may be more sophisticated than it is today.

Analysis and Decisionmaking

Today's user-system interfaces place the burden on humans to acquire relevant data. As described in *Psychology of Intelligence Analysis*—a frequently cited document despite its age—IC analysts use formal and less formal methods to identify data, draw inferences, and find answers.[11] In more formal analysis, inferences are made through procedures that collectively represent the scientific method, including statistical analysis of data on the phenomenon in question. To make analytic arguments, assumptions, or intelligence gaps more transparent, a variety of diagnostic techniques supplement these methods.

The goal of autonomous systems in the realm of intelligence analysis is to provide, in combination with other data sources, an extensive, complex database to assist with analytic techniques. How will analysts quickly extract information relevant to their decisions and narrow the possibilities to significant or actionable items?

A critical foundation for this next generation of decision support is to develop methods that automatically respond to a decisionmaker's needs. One vision is a system that would provide decisionmakers alternative courses of action by selecting, collecting, and formatting data relevant to a problem. The purpose would be to give decisionmakers information-rich environments in which choices are clearly laid out and from which they can rapidly take action specifically suited for the problem. (“agile” and “adaptive” in current business jargon). In this realm, much more research must be done before the IC can gain the benefits of autonomous analytical methods.

The Potential of Biotechnology

Future decisionmaking interfaces will probably integrate advances in biotechnology into autonomous systems. In a concept known as “augmented cognition,” real-time measurements of chemical changes that take place during human cognitive processes may be used to provide information to platforms so they can sense a human’s thinking and act accordingly. For example, orexin is a neurotransmitter that regulates arousal, wakefulness, and appetite.[12] In the past, orexin could be measured only with a spinal tap. Now, we can get the same data using measurements in saliva.[13] Some interfaces might leverage noninvasive brain-machine interface methods such as electroencephalography, which records the small electric field generated by groups of neurons firing, and near-infrared spectroscopy, which uses scattered light to detect changes in the brain.[14]

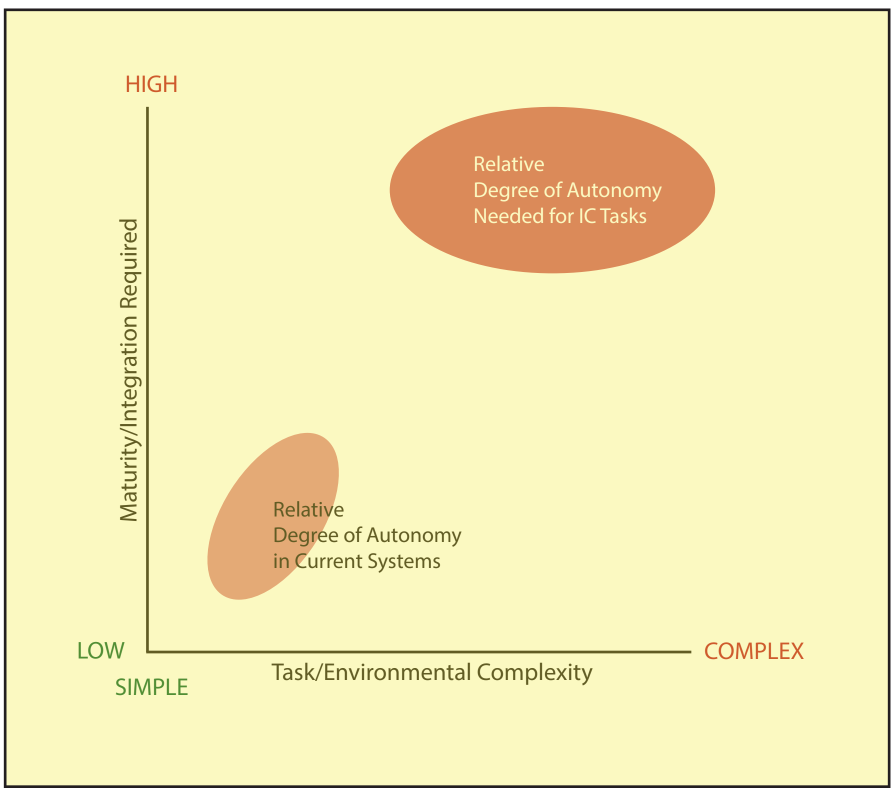
Analysis of Current Autonomous Systems

Many examples exist of autonomous systems being developed by the military, industry, academia, companies, and hobbyists. None has the level of autonomy needed to handle the missions that most interest the IC. To complete complex tasks, a system needs to do many things, such as interact with its environments, process information, and suggest decisions. Most examples shown so far only tackle one component, such as locomotion, at a time and only in laboratory conditions.

The graphic below illustrates this point. Along the bottom is a measure of task/environmental complexity. On one end are very simple tasks such as sensing and moving along the ground in an open area. Laboratory environments are also at this end. Tasks such as flying, swimming, and pattern recognition are more complex. IC mission-level tasks such as “monitor this 10-mile stretch of border for vehicles or people” or “patrol this area underwater and record all communications” are complex tasks that involve multiple system components, integrated and working together.

The left side of the graphic is a measure of technology maturity and integration for autonomous systems. Maturity and integration are different aspects of system complexity that have to be addressed. Maturity is based on the length of time the technology has been developed and used and relates to solving issues dealing with the use of the technology. For example, GPS location services is a mature technology, but automatic identification of objects is much less mature. Integration has to do with the connection, communication, and interaction of components to work together and function properly. Integration differentiates between simple systems, such as geolocation, and a complex system, such as goal-directed surveillance linked to multiple response options.

These definitions help to differentiate autonomous systems. While a simple system can be capable of complex actions, a level of increased



maturity and integration can improve the robustness and range of system capabilities. Integration also informs the number of independent components that a system has. For the examples mentioned in the previous sections, the levels of maturity are low. In some cases, the level of integration is not there because the technology is a component that would have to be integrated into a larger system to complete an IC task. The graphic points to the amount of development needed to take today's systems and demonstration systems to the appropriate levels of maturity and integration required to complete IC tasks successfully.

The Known State of Development Abroad

Several countries are known to be investing in technologies to advance autonomous systems, but publicly available information suggests the United States is the most advanced in the field. Its systems are capable of working in more complex environments and at more complex tasks than systems being developed in Japan, Korea, China, and Israel. All three countries have made significant investments in industrial robots to improve manufacturing processes and in service robots to help meet the needs of aging populations. Assessments of work in the European Union and Turkey place their efforts behind China and Japan's.

The following are snapshots based on open sources of autonomous system research in other countries.

China seems poised for a vigorous and continuing investment in autonomous systems,[15] but it is considered to be in the early stages of competing with robot pioneers in other countries, including Japan, Switzerland, Germany, Sweden, and the United States.[16] China's 15-year science and technology plan published in 2008 identifies 22 specific technologies on which work is planned. Among these are "intelligent perception technology" in the information sciences and "intelligent service robots" in the area of advanced manufacturing.

The focus on industrial and service robots is supplemented by other developments such as a robot dolphin that swims through water to measure its quality and robots that exhibit capabilities for more complex tasks such as assisting with surgical procedures. Two leading robotics laboratories in China have computer science research including pure artificial intelligence (AI) that specializes in natural language, machine translation, and reinforcement learning, with related AI work in multimedia, distributed computing, and pervasive computing.

European Union. A European Commission report, *Future and Emerging Technologies (FET) Projects Compendium for 2007–2012*[17] presents research under an information and communications technology program, including autonomy initiatives such as adaptive autonomy and autonomy of collectives such as robot swarms.

Japan and Korea embrace the power and potential of robots and autonomy, particularly as applied to the industrial and service industries.[18] Industrial robotics already supports export-driven manufacturing industries and is, as in China, looking past that to using service robotics as a solution for looming societal and demographic problems.

Humanoid robots are a particular area of new development and include auditory analysis and speech communication, sensory integration, and brainlike information processing.[19] However, its near-term relevance to the IC is difficult to derive other than as interesting technology developments in sensing, deciding, and acting.

Israel. An American Technion Society (ATS) web article describes the scope of Israel's interests in autonomous systems as shown in a program of the Technion-Israel Institute of Technology.

The program is described as a "multi-pronged" approach to surveillance, including the use of swarms of UAVs and/or satellites with the capability to cooperate with one another while operating under extreme conditions on the ground and in the sea. The program even includes experimentation, the article claims, on "bio-inspired" snake robots that propel themselves segment by segment as a snake does.[20]

Turkey has begun to produce its own surveillance and attack capabilities as a move away from depending on other countries for such technology. Its procurement authorities are preparing to field a semiautonomous surveillance aircraft capable of munitions delivery. The Turkish government announced in March 2013 that it plans to sign a contract for the acquisition of 10 locally made drone systems, dubbed the ANKA. One version will be armed. Turkish officials often look pleased portraying the ANKA as a "fully Turkish, national, purely indigenous aircraft," but the drone's imported parts include the engine, automatic take-off and landing system, landing gear, and radio.[21]

Conclusions

Autonomous systems are tools intended to increase the proficiency of key capabilities. In the case of intelligence, they would help gather, analyze, and protect vital information, but current systems are not close to the levels of maturity and systems integration that would allow them to autonomously undertake complex IC missions.

Advances in technologies will be needed to achieve such capabilities, especially in the fields of perception, planning, learning, human-robot interaction, natural language understanding, and multiagent coordination. And even with developments in these areas, fully autonomous systems will only be achieved through the integration of these and other technologies—some still to be invented (including hardware and software). These developments will have to come from at least three sources, none of which is likely to alone provide all the needed innovation, invention, and applications:

- academia (journals, university projects);
- inventions (toys, hobby kits, social intelligence devices); and
- independent technology investments.

Academia always has been a source of innovation and new development. It tests innovative directions by building on theories and principles. For example, flying nanorobots like the RoboBees pictured earlier are inspired by biological research and build on the known behavior of insects. Inventions are often the products of young adults with fertile minds or are creations designed to meet special human needs.[22] They can be inspired by commercial technologies (e.g., toys, hobby kits, and computers) and vivid imaginations. Independent investment of resources is the engine of change when the innovation or invention shows promise.

Today, except in the field of industrial robotics, autonomous systems exist at the level of innovation and invention. Even the semiautonomous robots already developed for military and security purposes (e.g., iRobot; L3 CyTerra) for surveillance and aerial and ground delivery of supplies and equipment are limited production items.

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Endnotes:

1. Defense Science Board, *Task Force Report: The Role of Autonomy in DoD Systems* (Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, July 2012), 15 (available at http://www.fas.org/irp/agency/dod/dsb/autonomy.pdf.)
2. https://www.cia.gov/about-cia/cia-museum/experience-the-collection/index.html#!/ artifact/14
3. https://www.cia.gov/about-cia/cia-museum/experience-the-collection/index.html#!/ artifact/16
4. Hugh Durrant-Whyte and Tim Bailey, "Simultaneous Localization and Mapping: Part I," *Robotics and Automation Magazine* 13, no. 2 (2006): 99–110, at http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1638022; Tim Bailey and Hugh Durrant-Whyte, "Simultaneous Localization and Mapping (SLAM): Part II," *Robotics and Automation Magazine* 13, no. 3 (2006):108–117, doi: 10.1109/MRA.2006.1678144.
5. See "Scalable sWarms of Autonomous Robots and Mobile Sensors (SWARMS) Project," http://www.swarms.org/.
6. See "BigDog –The Most Advanced Rough-Terrain Robot on Earth," http://www.bostondynamics.com/robot_bigdog.html; See "Legged Squad Support System (LS3)," http://www.darpa.mil/Our_Work/TTO/Programs/Legged_Squad_Support_System_(LS3).aspx.
7. J. Krahn, Y. Liu, A. Sadeghi, and C. Menon, "A Tailless Timing Belt Climbing Platform Utilizing Dry Adhesives with Mushroom Caps," *Smart Materials and Structures* 20, no. 1 (2011): 115021–115031, doi: 10.1088/0964-1726/20/11/115021; TaeWon Seo and Metin Sitti, "Tank-Like Module-Based Climbing Robot Using Passive Compliant Joints," *IEEE/ASME Transactions on Mechatronics* 18, no. 1 (February 2013): 397–408, doi: 10.1109/TMECH.2011.2182617; See "Waalbot: A Wheel/Leg Robot for Wall Climbing," http://nanolab.me.cmu.edu/projects/waalbots/tri-leg.shtml.
8. See "Nano Hummingbird," http://www.avinc.com/nano.
9. See "RoboBees: A Convergence of Body, Brain, and Colony," http://robobees.seas.harvard.edu/.
10. See "Welcome to the IFR Press Conference, 30 August 2012, Taipei," http://www.worldrobotics.org/uploads/tx_zeifr/Charts_IFR__30_August_2012.pdf.
11. Richards J. Heuer, Jr., *Psychology of Intelligence Analysis* (Central Intelligence Agency: Center for the Study of Intelligence, 1999), https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/books-and-monographs/psychology-of-intelligence-analysis/PsychofIntelNew.pdf.
12. Sere "Orexin," http://en.wikipedia.org/wiki/Orexin.
13. J. Hagen, W. Lyon, Y. Chushak, M. Tomczak, R. Naik, M. Stone, and N. Kelley-Loughnane, "Detection of Orexin A Neuropeptide in Biological Fluids Using a Zinc Oxide Field Effect Transistor," ACS Chemical Neuroscience 4, no. 3 (March 20, 2013): 444–453, doi: 10.1021/cn300159e.
14. E. Akhadov, A. Speed, A. Konkel, and R. Held, *The Human Side of the Net* (Sandia National Laboratories, Sandia Systems Assessment and Research Center, March 2010).
15. David Atkinson, *Assessing Current Research on Autonomous Systems and Related Technologies in Australasia* (Institute for Human and Machine Cognition, August 1, 2011). http://www.academia.edu/1056646/Assessing_Current_Research_on_Autonomous_Systems_and_Related_Technologies_in_Australasia.
16. See "China Looking to Lead on Robot Innovation," http://www.southerninnovator.org/index.php/innovation/196.
17. *Future and Emerging Technologies (FET) Projects Compendium 2007-2012*. Commission of the European Union, Communications Networks, Content & Technology Directorate-General, Future and Emerging Technologies unit.
18. IACF Industry Study Group, *Robotics and Autonomous Systems Industry* (National Defense University: Industrial College of the Armed Forces, 2011), http://www.ndu.edu/es/programs/academic/industry/reports/2011/pdf/icaf-is-report-robotics-autonomous-systems-2011.pdf.
19. Ibid, 15.
20. See "The Technion Autonomous System Program (TASP)," http://www.ats.org/site/PageServer?pagename=about_research_autonomous_systems.
21. Turkish UAV market may boom after development Burak BEKDİLHürriyet Daily News, August 27 2013
22. Harry S. Dent, *The Great Crash Ahead: Strategies for a World Turned Upside Down* (Free Press, 2011).

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14. ABSTRACT

The paper addresses the need for new technologies to assist the IC for intelligence gathering, for counterintelligence, and to facilitate the collection and interpretation of diverse data. The paper's focus is on making humans more proficient in addressing such needs through the use of autonomous system technologies.

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