Sentient AI Versus Sentient Robots

Does it matter, and why?

by Dr. Jon M. Hackett

The current wars in Ukraine and Gaza have brought small tactical robots into the stark limelight of reality through headlines like "Why Ukraine Remains the World's Most Innovative War Machine"[1] or "Drones in Ukraine, Four Lessons for the West."[2] *Drones* is the current and common vernacular for any type of flying robot, which are also referred to as unmanned aircraft systems or unmanned aerial vehicles. Drones are, but a narrow category, under the broader term of "robot,"which is defined for this article as "a powered machine capable of executing a set of actions by direct human control, computer control, or a combination of both. It is composed of a platform system, software, and a power source."[3] Under this broad definition, robots operate across the physical domains of the battlespace (air, ground, maritime) while maneuvering in physical space, time, and the radio frequency (RF) spectrum. When discussing robots and related technologies, a common language is essential to provide context, clarity, and specificity. While there is a plethora of terms in use within the Department of War (DOW) for robotic systems, industry and academia generally use the noun "robot" combined with a pronoun to describe that robot (e.g., ground robot, manufacturing robot, small tactical air robot, etc.). This article discusses robots within the narrower confines of tactical robots, where the term "tactical" is used more broadly to describe the variety of robotic applications related to military or law enforcement operations, as differentiated from other broad categories of applications for small robots, such as

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manufacturing, safety, medical, commercial, industrial, survey, etc.

Driven by the urgency of current conflicts and the complexion of modern warfare, which is characterized by the widespread use of sophisticated and complex RF jamming, robotic technology is rapidly advancing toward higher levels of autonomy enabled by the incorporation of artificial intelligence (AI)

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software. Taken to its logical conclusion, this trend will ultimately result in the deployment of fully autonomous and lethal robots, which are referred to within the DOW as lethal autonomous weapon systems (LAWS). The DOW defines an autonomous weapon system as "a weapon system that, once activated, can select and engage targets without further intervention by an operator. This includes, but is not limited to, operator-supervised autonomous weapon systems that are designed to allow operators to override operation of the weapon system but can select and engage targets without further operator input after activation."[4] The LAWS rely upon onboard AI to drive their autonomous functions.

It is important to note that "autonomy" and "AI" are not synonymous. Autonomy is a noun that refers to how a system operates, specifically under a condition of self-governance or self-directed freedom. By contrast, the term "artificial intelligence" or "AI" is software. Systems driven by AI software are broadly referred to as "AI systems," which are defined in 15 U.S.C. 9401(3) as:

> a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. Artificial intelligence systems use machine- and human-based inputs to perceive real and virtual environments; abstract such perceptions into models through analysis in an automated manner; and use model inference to formulate options for information or action.[5]

Stated another way, autonomous robots are required to make decisions in real time. Robots operating on the battlefield require information to make decisions in the absence of external guidance based on their ability to sense, make sense of, and interact with their surroundings. The ability to sense and interact with one's surroundings, to feel and perceive, is known as *sentience.* A robot can be fully autonomous and not be sentient—this type of robot is said to be "dumb" to set it apart from "intelligent" or sentient robots. An example of a fully autonomous "dumb" robot is the ubiquitous Shahed family of one-way attack drones that have achieved such prominence in the Ukrainian conflict. Manufactured by Iran and licensed to Russia (as the Geran series), Shaheds operate completely independent from human control (fully autonomous) but cannot sense or interact with their surroundings. Once launched, a Shahed happily navigates on its preplanned route to its target area, oblivious to weather, jamming, and anti-aircraft fire around it. As the conflict in Ukraine has dragged on, updates to the Shaheds give them some improved capability to sense and defend against certain types of Global Navigation Satellite System jamming. Newer Shaheds are also incorporating increasing levels of automatic target recognition capability to improve effectiveness on target. These limited Shahed improvements are representative of the first steps toward sentience and might better be described as "cognizant," where cognizant is defined as "having explicit knowledge or awareness of something." This article posits that *cognizance* as it relates to robots is having some state of awareness based on an organic capability to sense surroundings, while *sentience* couples cognizance with the ability to react to and interact with the environment based on that awareness—to make value-based decisions based on external inputs balanced against the robot's own understanding of its physical state, purpose, and programmed constraints (what it must do) and restraints (what it cannot do).

Sentient robotic responses to stimuli can be classified as either deterministic or non-deterministic. Deterministic behavior is rule-based behavior that results in the same output for a given input and initial conditions. Non-deterministic behavior introduces variability where different outcomes can result from the same input and initial conditions. Now that a combination of hardware and software technologies has converged, where fully autonomous robots driven by sophisticated AI models are a practical reality, we must more fully understand what types of AI are appropriate for LAWS applications and what behaviors are legally, morally, and ethically appropriate for LAWS employed by U.S. forces. Artificial intelligence is a vast area of study and science unto itself, and this article will in no way attempt to unpack that massive topic other than to identify some very basic types of AI and to place those types of AI within a useful framework related to the stipulations for LAWS set forth by *DOD Directive 3000.09* (2023), which states that "the design, development, deployment, and use of AI capabilities in autonomous and semi-autonomous weapon systems will be consistent with the DoD AI Ethical Principles and the DoD Responsible Artificial Intelligence Strategy and Implementation Pathway." Those ethical principles state that AI must be responsible, equitable, traceable, reliable, and governable. A practical definition of responsible AI is "Ethics and Policy applied to AI that has been assured and proven safe and trustworthy by testing, validation [and] verification against objective performance parameters derived from standardized metrics."[6] In other words, responsible AI consists of AI software that is trustworthy and reliable and is employed under consistent and ethical policy. Artificial intelligence is *trustworthy* if it is *explainable* (humans can understand why a model produces the results it produces), *interpretable* (humans can understand how the model produces its results), *traceable* (we know where the model came from), and *transparent* (the algorithm itself is understandable, tested, verified and validated). Artificial intelligence is *reliable* (or safe) if it produces consistently accurate responses and results over time during both testing and real-world operation of the model (inferencing). All this suggests that the more deterministic an AI model's responses, the more reliable/safe that model is. As responsible AI applies to LAWS, I assert that only deterministic models are appropriate—the understanding of and distinction between deterministic versus non-deterministic behaviors are important and will be discussed in more detail later in this article.

Having defined *sentience* as it applies to robots, we must now explore that same term as it applies to AI in order to understand the difference between the two. As previously stated, AI is software-driven behavior—one such behavior can be autonomy. While autonomy does not necessarily require AI in a technical sense, the level of autonomy required for LAWS demands on-board AI, often referred to as "edge autonomy" or "edge processing" to delineate that all AI processing occurs on the robot itself as opposed to running "off board" using a cloud-based AI methodology. Artificial intelligence can be divided into two broad categories: handcrafted/traditional and generative as depicted in Figure 1 on following page.[7]

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Per Figure 1, handcrafted/traditional appears at the top left, with generative AI depicted on the bottom and right, where explainability and interpretability decrease from top to bottom and left to right as the AI models become more sophisticated, hardware-intensive, and complex. At the very lower right corner of Figure 1, we find artificial general intelligence (AGI), which can be defined as "the representation of generalized human cognitive abilities in software so that, faced with an unfamiliar task, the AGI system could find a solution. The intention of an AGI system is to perform any task that a human being is capable of."[8] Artificial general intelligence is also referred to as "strong AI" in contrast to "weak AI," which encompasses today's hand-crafted and generative AI. Alternatively, AGI can be defined as an attempt to create intelligent machines that are indistinguishable from the human mind, which implies self-awareness and possibly emotion. These two definitions exemplify the opposing views on AGI between the scientific community, which views AGI as the highest evolution in problem solving, and the psychology community, which views AGI as a function of self-aware adaptability or survival instinct. This second psychology-based view is also referred to as *sentient AI*, which should not be confused with sentience or sentient robots as previously defined. When discussing AGI as it relates to robotics, the reader must draw a clear line of distinction between the objective science-based definition and the subjective emotion-based definition presented by the psychology community—*sentient AI*.

Let us examine the concept of sentient AI more deeply and within the framework of deterministic and non-deterministic behaviors, as previously introduced. The concept of sentience as it relates to robotics has enjoyed an increasing amount of study and interest with the recent rapid advances in the areas of autonomy and AI. Indeed, most of the recent professional writing and reporting on sentience and robotics deals with sentient AI versus sentient robots; this nuance is a very important distinction relative to tactical robotic applications. A small amount of elementary research in any online academic or research repository will yield large numbers of papers and articles dedicated to sentient AI. Ellen Glover defines sentient AI as "an artificial intelligence system capable of thinking and feeling like a human. It can perceive the world around it and have emotions about those perceptions."[9] A key characteristic of sentient AI is the presence of emotion or feeling—of self-awareness. In 2022, controversy swirled around Google researcher Blake Lemoine, who was suspended after releasing transcripts of a conversation with Google's LaMDA (Language Model for Dialogue Applications). Lemoine claimed that LaMDA was sentient and aware of itself.[10] Robots employing sentient AI would be capable of non-deterministic (random) behavior, which is antithetical to the goals of responsible AI, particularly where LAWS

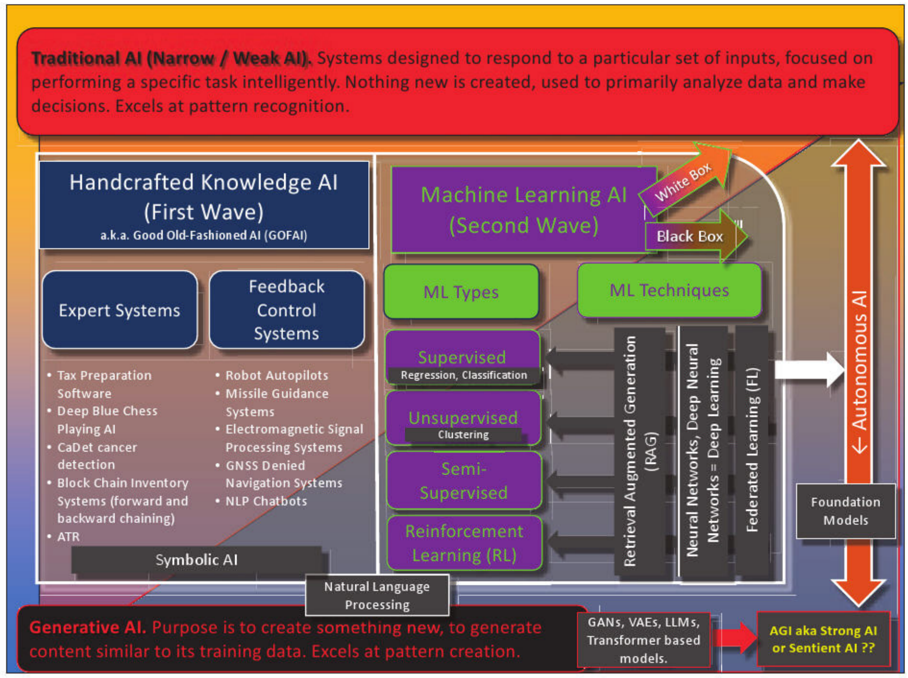

Figure 1. Artificial Intelligence Summary. Hackett, 2025. *(Figure created by author.)*

applications are concerned. Self-aware robots controlled by sentient AI would make their non-deterministic decisions based on and relative to their own self-aware state and relative assessment of conditions, thus removing the human element completely from the control process. Such robots would essentially exercise a form of free will since the human element would be completely removed from the control process, which is a morally and ethically unacceptable condition. Robots cannot be allowed to make non-deterministic decisions based on how they feel or on their perception of self and their individual desires.

Alternatively, Merriam-Webster defines "sentient" as "responsive to or conscious of sense impressions; aware." The distinction in this definition is that it differentiates the condition of *awareness* from that of *self-awareness*. Sentient robots (versus robots that employ sentient AI) are *aware* without being *self-aware*. Sentient robots rely on deterministic AI (versus sentient AI) to make decisions based on specified rules, preset conditions, and well-defined limitations, thereby maintaining attribution and responsibility, which ultimately must always reside with the human beings exercising employment authority. The importance of human responsibility and attribution cannot be extricated from the moral operation and employment of autonomous and intelligent robots; the two are intertwined.

Thus, the key differentiator between sentient AI and sentience as applied to tactical robots is the concepts of feeling and perception, which are both uniquely human and intangible conditions tied to self-awareness, versus sense impressions and awareness, which are state-based conditions relative to external factors. There is a significant gray area within academic circles where the terms "sentient AI" and "sentient robot" are often used interchangeably. For tactical applications in general and LAWS applications in particular, the term *sentient AI* cannot be confused with the term *sentient robot*. The two terms are in no way equivalent or interchangeable. Sentient AI is a subjective condition-based term used to describe self-awareness. By contrast, a sentient robot is an objective function-based term used to define situational awareness of the physical environment. This difference is more than nuance—it is a vital and clear line that has both practical application and far-ranging policy, moral, ethical, and operational implications and ramifications. The sentient robot uses in totality all its collective onboard instrumentality, processing capability, and intelligence to sense and make sense of its surrounding physical environment, enabling it to effectively interact with, integrate into, and operate within that environment.

Non-deterministic AI models are pervasive in today's technology spheres. Because of their accessibility and relatively low cost (some open-source models are free), non-deterministic AI models often represent the "easy button" for immediate AI insertion into a given robotic application. Further muddying the application waters, it would seem on the surface that to be considered truly autonomous, robots would require the application of non-deterministic sentient AI, which is often associated (incorrectly) with creativity, to make real-time decisions in real-world scenarios. This is the moral equivalent of "pressing the button to see what happens." It is a *fait accompli* that covered nations will attempt to employ small tactical robots with nondeterministic sentient AI because they are not bound by ethical or moral barriers, and this approach is easier up front than the rigorous creation, development, and testing that highly evolved deterministic AI requires. This is the dividing line between covered countries and free nations, and must be preserved, regardless of perceived tactical advantages. Ultimately nondeterministic, sentient AI is a double-edged sword because one cannot guarantee or reproduce outcomes based on identical sets of input. With nondeterministic sentient AI, there will always be potential for fratricide or recidivistic behavior.

The United States and our allies and partners must maintain the moral high ground by insisting that intelligent autonomous systems, while sentient, must also be deterministic. This flies directly in the face of current trends, which classify deterministic AI as "traditional" or "narrow/weak AI," while nondeterministic AI (generative machine learning) is viewed as a baseline for fully autonomous AI. Recall from Figure 1 that while AGI is high on the autonomy scale, traditional hand-crafted AI is not excluded from autonomy. Figure 1 also shows us that some machine learning AI falls neatly into the traditional AI corner of the spectrum with high transparency, traceability, explainability, and interpretability. My extensive research indicates the future of tactical AI is not a clean generative model but is a hybrid between traditional and generative AI that uses highly traceable and explainable algorithms to achieve near-instantaneous and deterministic interaction with and in reaction to real-world events.[11] This "hybridization" is in part achieved by setting specific conditions on the types and levels of autonomy and intelligence integrated into various layers of a robotic system's technology stacks using objective metrics (that do not yet exist) to characterize and classify the type of AI incorporated into a system, thus ensuring that the robotic system is safe and trustworthy.

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Thus far, this article has made a clear distinction between sentient AI versus sentient robots and shown the importance of that distinction as applied to LAWS. Further, this article has demonstrated a gap in the DOW's ability to classify and characterize AI as safe and trustworthy under the tenets of responsible AI policy. This article will not address solutions to that gap, saving that problem for another day. This article has made the case for driving robotic technology development toward sentience and will close with a summary of the characteristics that can be used to define a sentient robot:[12]

1. *Intelligence.* Sentient robots must be capable of making real-time decisions in real-world environments. Sentient robots are aware of their environment. Reaction must flow from awareness. Reaction requires decisions, and decision making requires intelligence. Tactical robotic intelligence must be deterministic and trustworthy, favoring the types of AI described on the upper right portion of Figure 1.

2. *Autonomy.* The purpose of AI-based autonomy is to enable tactical robots to conduct fully independent actions across the range of military operations. Independence cannot exist without autonomy. Fully autonomous robots need not be sentient, but fully sentient robots will be the most effective and survivable robots on the modern battlefield.

3. *Aware of Surroundings.* Sentient robots must be able to achieve and maintain situational awareness. Situational awareness in space and in time is achieved by combining multi-layered multi-domain sensing with accurate and assured position, navigation, and timing. The sentient robot must be able to continuously sense its physical surroundings while correlating and understanding its relationship to those surroundings both spatially and temporally. Physical surroundings must include the environment in its entirety, not just static features. When the average human being walks down a street (assuming he or she is not staring at their smart phone) they are aware of: the three-dimensional static topography of their surroundings as interpreted using binocular vision; hearing, smell, and feel, which includes the ground underneath; air currents; temperature gradients and changes in air pressure; and other moving entities to include people, automobiles, and animals, using the same sensing organs that perceive the static topography. Human beings are constantly processing the massive amounts of data coming in from all their available sensory organs and making decisions, both voluntary and involuntary, on how to interact with their surroundings.

Voluntary actions are conscious choices (e.g., stop for a donut or keep walking) while involuntary actions are driven by instinct (e.g., flinching at a loud noise or jumping back out of the way of a speeding taxi). In the same way, sentient robots must possess the appropriate type and range of sensors with adequate coverage to collect data on the static and moving elements of their physical environment to allow them to interact with appropriate voluntary or involuntary reactions in a timely and appropriate manner. "Appropriate sensors" is a broad brushstroke of a statement. Sentient robots are capable of much greater perception than humans given the large selection of sensing instrumentality available to them including multi-band electro-optical sensors to "see," acoustic sensors to "hear," air/water quality sensors to perceive the quality and composition of the physical medium through which they are moving, sonar/lidar/radar to judge distance and closure rates, temperature sensors, RF detectors that at a minimum are sensitive to bands that can affect the robot, and an array of assured positioning, navigation, and timing capability (e.g., micro-electro-mechanical systems inertial measurement units) to maintain their spatial awareness and awareness of time. They can bring to bear sensors like intervalometers, air flow or water sensors, and pitot static systems to estimate and track state.

4. *React and Interact with Surroundings.* Reaction to and interaction with the physical environment are core functions of sentience. Constant situational awareness sensing data (state and status) is processed by intelligent algorithms to arrive at decisions regarding reactions and interactions to the surrounding environment, with responses driven by mission and behavior rules and parameters.

Reactions are voluntary or involuntary actions resulting from immediate encounters with unplanned external stimuli and are considered singular events. For example, if a robot encounters a sudden increase in RF emissions in-band with its Global Navigation Satellite System receiver, it must react to maintain positioning, navigation, and timing. Another example might be a ground robot moving along a premapped route toward an objective when it encounters a downed tree in its path. It reacts by stopping.

Interactions are a continuous process of intertwined causes and effects and might be thought of as a series of interrelated reactions. In our previous tree example, the robot's immediate reaction was to stop. The interaction is to navigate around, under, or over the tree using all its sensing capability and built-in logic to find the best path to safely and quickly return to its primary mission. If the AI on the robot is strong enough and performs true object detection, it can recognize the obstacle as a tree and more rapidly develop a response based on that recognition—look to transit around the relatively compact base versus the broad and leafy treetop. Another example of interaction would be a maritime underwater robot with manipulators tasked with unhooking a stuck anchor line from a small craft. The underwater robot uses its on-board navigation and sensor systems to find the anchor, which it recognizes as an anchor based on multi-mode sensing and computer vision algorithms, then uses a single manipulator to grasp the anchor line and maintain station while using the other manipulator to sever the anchor line. The continuous processes of sensing and manipulating are interactions. If, while engaged in its task, the robot is attacked by a giant squid, it might react by deploying an electrical charge to scare off the squid before continuing to sever the tangled anchor line. The robot may not have recognized the squid as a squid, or as hostile, but when the squid attached itself to the robot, the robot sensed it was a living versus an inanimate object and elected to deploy the electrical charge as a response.

5. *Learn and Share.* Sentient robots must learn from their experiences and be able to share those experiences with other sentient robots in much the same way that human operators learn during operations and share their learned experiences (lessons learned in military parlance) during after-action debriefs. In the case of robots, those lessons could be called "new skills" and ideally would be shared with other like robots. Until very recently, running sophisticated AI models at the edge was not practical for tactical robots, particularly small tactical robots (e.g., drones), because of limitations in hardware processing technology. In recent years, advances in edge processors like graphics processing units, neural-processing units, and central processing units, coupled with advances in AI models, have allowed this capability to be miniaturized to the point where it is now practical to run sophisticated AI on very small tactical robots.

In summary, the distinction between sentient AI and sentient robots is not merely academic—it carries profound operational, ethical, and policy implications for the future of autonomous systems in tactical environments. Sentient AI, characterized by self-awareness and emotion, introduces non-deterministic behaviors that challenge the principles of responsible and reliable AI, especially in lethal autonomous weapon systems. In contrast, sentient robots, defined by their situational awareness and deterministic decision making, offer a path toward trustworthy, accountable, and ethically governed autonomy. As advances in hardware and AI models continue to enable greater levels of robotic sentience, development and deployment must remain anchored in transparency, traceability, and human responsibility. Only by maintaining this clear distinction and prioritizing deterministic, explainable intelligence can we ensure that autonomous systems serve both operational effectiveness and the moral imperatives of modern warfare.

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As we move forward, it is essential for policymakers, technologists, and military leaders to collaborate in establishing rigorous standards and objective metrics for AI safety and trustworthiness. By fostering interdisciplinary dialogue and prioritizing ethical development, we can guide the evolution of autonomous systems toward a future where technological advancement aligns with our highest values and responsibilities.

Notes

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11. Dr. Jon Hackett, "An Architecture for a Global Joint Multi-Domain Small Tactical Robotic Ecosystem," (PhD Dissertation, Capitol Technology University, 2025).

12. Ibid.