"Don’t shoot until you see the whites of their eyes"

Combat Policies for Unmanned Systems

British troops given sunglasses before battle. This confuses colonial troops who do not see the “whites of their eyes”. UAV does nothing.

In the Revolutionary War, this combat policy (“Don’t shoot until you see the whites of their eyes”) may have provided sufficient guidance to the colonial forces in the Battle of Breed’s Hill (adjacent to Bunker Hill). However, certain assumptions were probably made regarding the person who was given the directive:

- they had a loaded weapon
- they knew how to fire the weapon at a target
- there was an enemy who exposed “the whites of their eyes”
- they understood that the particular white eyes belonged to an enemy combatant
- they knew that they would not encounter any higher priority tasks
- they knew they could handle other peripheral tasks at the same time (such as breathing...)
- they had loaded their musket before attempting to fire
- they understood what they were supposed to do after firing
- they understood who the enemy was with the loose description of “their eyes”
- they knew that “fire” referred to a weapon

...
Humans vs. Machines

When policies are created for humans, policy makers “assume” that the targets of the policies have a common understanding that has been accumulated through training and education. They also “assume” some services provided by the autonomic functions of the human nervous system do not need guidance. A machine, however, isn’t quite as sophisticated, at least yet. Machines must be given explicit programs to control their behavior. But, for unmanned systems to satisfy their potential, they must be able to demonstrate some of the problem solving skills that have been historically relegated to humans. And at the same time, one might (hopefully) want to maintain human control of that behavior.

Policies for Humans

Policies and regulations are created for humans to guide their behavior. Military guidelines, foreign policy guidelines, driving rules of the road, banking regulations, etc. are all intended to guide human decisions and actions. Regulations are often created to correct past behavior. When humans misbehave the legal system is there to review (and possibly isolate) the offending humans. Sometimes the legislative system is there to modify the policies.

Humans might be called evolutionary machines. They are creative. For some humans, rules and regulations block some of their desired activities. In this way humans are like water; they attempt to find new ways to go down hill. Humans continue to search for new and “easier” approaches that allow them to profit and evolve.

Controlling Machines

Humans created machines to amplify their capabilities (not to evolve on their own): speed, strength, accuracy, and more recently to go into areas where humans cannot or do not want to go, and do things that humans cannot or do not want to do.

Conventional industrial / consumer machines (beyond pure mechanical machines) are “programmed” to perform explicit tasks. IF | THEN |ELSE “sequential logic” has satisfied the requirements for the last 100 years for most of the tasks. Humans were in (almost) complete control.

If, however, one stepped back and personified machines, those machines might exhibit some human-like behaviors. They fail / break at the most inopportune times as if they had minds of their own; causing human-created “systems” to fail: Airplanes crash, nuclear power plants melt-down, machines fail. In some cases humans “program” what will happen if sub-assemblies fail or if sensors indicate wear and tear on a part. Humans create “safety systems” to monitor and protect human operators from inappropriate behavior. But these solutions are often “added on” to basic machine functionality. Software “interrupts” break into the sequential processes influencing the system behavior.

This conventional approach may not be sufficient to meet the objectives of next generation machines.

Machines that Behave
The term “behavior” might be used to describe “complex” systems. Behavior indicates an operational mode where a “system” simultaneously addresses multiple, sometimes conflicting, goals. Humans are complex systems that have an almost unlimited set of goals or challenges. They have immediate goals (self-maintenance: breathing, energy maintenance, rest), social goals, employment goals, short term and long term goals... They are constantly balancing items that influence their behavior; deciding to do / not do things, selecting options to execute simultaneously, and allocating resources across all of their goals.

The unmanned systems of tomorrow will have some similar characteristics, but (fortunately for the machine designers) they will not need to address all of a human’s objectives.

For the foreseeable future, machines will still be in service to humans. They will need to be “adaptive” to solve the simultaneous, sometimes conflicting, goals. Some machines will benefit from the ability to “learn on their own”, but these machines will primarily be relegated to research activities. The ability to “learn on their own what is right and wrong” is contrary to the objectives of most “machines” that are dealing with safety critical decisions and actions. Most users of unmanned systems want to know what the machines will do and how they will address any particular problem.

**Policies for Machines**

So, the objective is to create solutions that tell the machines how to think (apply reason and judgment). This is somewhat different than following a set of rules. This distinction brings us back to the title of this article: “Don’t shoot until you see the whites of their eyes”. Decisions and actions are seldom black and white (binary) that can easily be addressed with conventional logic. Almost all information will be relative, at least to some aspect. Even discrete information may have an associated temporal (time and distance) characteristic that the unmanned system will need to consider.

Humans handle these complex judgmental problems in the right hemisphere of their brain: the section that processes information in parallel. Alternatives are balanced in an analog fashion to address conflicting and constantly reprioritizing goals. Stated somewhat differently, it is an “analog process” that requires information to be handled “collectively” so alternatives can be balanced. Individual pieces of information may be treated differently as information is fused to pursue conflicting goals.

Keeping these objectives in mind, one needs a way to explicitly identify the changing importance of information. This changing importance of information is critical to reprioritizing tasks / adapting behavior to changing circumstances.

The policies must also be capable of describing non-linear functional relationships in the information fusion process (non-linear interpretation of information).
# Alternative Approaches

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Summary:

There are several challenges facing the Unmanned System provider and the Unmanned System user:

1. Developing a “full” understanding of the information models needed for the Unmanned Systems. This includes “a complete life-cycle model”, not just “Don’t shoot until you see the whites of their eyes”.

2. Unmanned System “providers” need to provide a system architecture that allows the Unmanned System “user” to have the ability to create, control, install and change the policies.

3. Policy development “tools” need to support the easy (cost-effective) development of complex adaptive policies in a manner that assists the policy maker in creating, testing, packaging, and auditing the behavior of the Unmanned Systems.

4. Policy makers will have to establish explicit “values” for information items used in the decision-making process that will be used by the Unmanned System. This cannot be left to the machine and is a task that most policy makers have never been challenged with before: to assign numeric values to humans and objects. Value assignments are needed for the Unmanned Systems to make the soft decisions.

5. Policies must be 100% explainable and auditable because the unmanned systems will be applied in safety critical situations and in situations where the cost of a “mistake” is significant. The Unmanned Systems must have a way that their actions can be reviewed in detail.

At the same time, the opportunities are obvious, especially with recent situations where human error has had costly consequences, and where the investigative costs are high. A “machine” that can explain exactly why it does what it does (when addressing complex situations) will provide a great economic benefit.

References:

1 “KEEL Responds to Autonomous Technology Metrics”