Unmanned Vehicle Safety: 10 Commandments to Live By

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Abstract

Unmanned vehicles appear to be everywhere: undersea, at airports, overhead, in space, on Mars, and in Iraq. It seems everyone is getting unmanned vehicles: NASA, Military, police departments, and civilians. The world is changing as technology changes, which is rapidly. Technology exists today that allows smart machines to replace human activity in dangerous situations. Robotic systems are used for surveillance, minesweeping, boarder control, port authority, just to name a few. Although removing ourselves from these dangerous activities is good, we must ensure that different "just as dangerous" activities have not been created. For example, has the probability for friendly fire causalities increased? Has the interface with humans become uncontrollable? Can the Robotic system go out of control? Does the Robotic have self-defense capability that could go haywire? Has testing/validation of the Robotic system introduced dangerous situations for the tester/observer? While we cannot answer all these questions, it is our duty to provide some safety guidance to the new and improved theme of the technical world.

The intent of this paper is to provide a set of guidelines, 10 Commandments, for use by any system that contemplates incorporation of autonomous functions intended to replace human intervention/control. This paper will investigate unmanned systems and their impact on system safety analyses. Specifically, we want to address the situations where the operator has been taken out of the loop but others have potentially and unknowingly been put in harms way (i.e., real time testing in the field, real time testing in wartime, accidents/crashes in civilian territory, etc.). The 10 Commandments of Unmanned Vehicle Safety will be presented in this paper such that the reader can apply them to their unmanned system. Lessons learned will be provided where applicable and specific examples will be used to illustrate the commandments. These 10 Commandments are intended to be a minimum set of guidelines to which other commandments will be added. As always, one must tailor these guidelines and other guidelines and requirements as justified by a particular system.

Every "reg-toting" safety engineer knows the safety requirements applicable to their system. Safety engineers help the system team tailor the core safety requirements to fit the boundaries of the project. Our 10 Commandments are intended to provide safety engineers with additional measures to ensure that safety is incorporated into the system architecture for the entire life cycle. The safety engineer should ask routinely, "Is this system adhering to the 10 Commandments of Unmanned Vehicle Safety or is this project headed for that dark gloomy place where no one wants to go?"

Introduction

The development of robotic systems is definitely on the rise. The Army currently employs unmanned vehicles for aviation and ground systems. While the authors agree this type of technology is warranted by the Army strategic planning, it still poses some safety concerns. Our experience has shown that while automation and robotics "replaces" man in one form, it could still pose hazardous conditions to man and/or the environment in another form if not properly analyzed. Specific concerns arise from the use of tactical weapons, the inability for the human to shut down the system if needed, and robotics that contain self-defense features (ref. 1). Therefore, we developed the 10 Commandments for use by system and safety engineers when evaluating and analyzing unmanned vehicles. Our set of 10 Commandments are as follows:

Commandment 1: Lessons Learned

Thou shalt use lessons learned from similar systems. This is by far the most important commandment to follow when designing or re-designing a system. Don't make the same mistake that someone else has made. Conduct research, ask questions, and contact other facilities, agencies and/or organizations. One lesson learned that the Army has come to recognize with unmanned ground vehicles is the implementation of "engine killing" for

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