Proceedings of the 2016 Winter Simulation Conference
T. M. K. Roeder, P. I. Frazier, R. Szechtman, E. Zhou, T. Huschka, and S. E. Chick, eds.

AN APPROACH FOR SAFETY ASSESSMENT IN UAS OPERATIONS APPLYING STOCHASTIC FAST-TIME SIMULATION WITH PARAMETER VARIATION

Joao Luiz de Castro Fortes
Rafael Fraga
Kenny Martin

ISA Software LLC
11530 South Glen Road
Potomac, MD 20854, USA

ABSTRACT

This paper presents an approach for safety assessment in unmanned aerial system (UAS) operations that uses stochastic fast-time simulation and selected published ground impact fatality/casualty models to calculate fatality risk. The application of simulation allows a sensitivity analysis measuring how different aspects and phases of a UAS operation impact the risk calculations for each of the ground impact models. Specifically, this approach consists of modelling and simulating UAS operations over a defined populated region applying stochastic parameters, such as flight track dispersion, altitude, failure rate, performance variation, and latency due to situational awareness (e.g. BVLOS). Then, published ground impact models are applied to determine the risk in terms of fatalities. This process provides risk metrics in a range, where it is then left to the decision makers as to what constitutes acceptable risk in a given situation.

1 INTRODUCTION

The demand for unmanned aerial systems (UAS) with an almost unlimited range of missions has been continually growing in the last few years. Their use has been applied not only to private and recreational uses, but also to public, military and commercial users. According to a recent forecast on number of UAS vehicles published by DoT (2013), commercial users represent a large growth sector especially for mini and small UAS categories, reaching a total of 175,000 vehicles by 2035. Integrating them into the National Airspace System (NAS) and assessing the impacts of such sudden growth is a challenging and vital task.

In its omniscient origin, the International Civil Aviation Organization (ICAO) "predicted" the need for a proper regulatory framework for UAS over 72 years ago, when article 8 of 1944's Convention on International Civil Aviation (commonly known as "Chicago Convention") states that "no aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization" (ICAO, 2011). Today, ICAO (2011) defines UAS as "an aircraft and its associated elements which are operated with no pilot on board".

Lately, a great deal of effort has been done worldwide, especially in United States and Europe, in order to develop standards and recommended practices for UAS operations which cover aspects such as safety, security and liability, in order to guarantee the development of this emerging aviation segment. One of the major concerns about its integration into the NAS is assessing UAS safety, according to Melnyk et al. (2014). Since UAS is a fairly recent segment of aviation, the available data related to operations such as flight hours, number of accidents and incidents, failure rates, etc. is insufficient in order to build up reliable statistics about its level of safety as compared to airline flights and general aviation. Also, there no agreement on the most suitable methodologies to fully understand the risks and impacts of UAS operations.

978-1-5090-4486-3/16/$31.00 ©2016 IEEE