Chapter VII

Model-Based Simulation to Examine Command and Control Issues with Remotely Operated Vehicles

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Abstract

With increased interest in the overall employment of pilotless vehicles functioning in the ground, air, and marine domains for both defense and commercial applications, the need for high-fidelity simulation models for testing and validating the operational concepts associated with these systems is very high. This chapter presents a model-based approach that we adopted for investigating the critical issues in the command and control of remotely operated vehicles (ROVs) through an interactive model-based architecture. The domain of ROVs is highly dynamic and complex in nature. Hence, a proper understanding of the simulation tools, underlying system algorithms, and user needs is critical to realize advanced simulation.
system concepts. Our resulting simulation architecture integrates proven design concepts such as the model-view-controller paradigm, distributed computing, Web-based simulations, cognitive model-based high-fidelity interfaces and object-based modeling methods.

Introduction

Advances in technology, software algorithms, and operations research methods provide new opportunities for effectively building interactive models to support the study and analysis of human-computer issues in the operation and control of remotely operated vehicles (ROVs). The domain of ROVs is highly dynamic and complex in nature. Hence, a proper understanding of the simulation tools, underlying system algorithms, and user needs is critical to realize advanced simulation system concepts. With the increased interest in the overall use of pilotless vehicles in the ground, air, and marine domains for both defense and commercial applications, the need for the development of high-fidelity simulation models for testing and validating the operational concepts of these systems is very high.

ROVs are mobile systems controlled by human operators from a remote location. The utility and subsequent exploitation of ROVs have developed and diversified over the years. ROVs have been and continue to be used in a variety of ways, such as: decoys against enemy action or as friendly targets, scouts, reconnaissance and surveillance platforms, highly maneuverable bombs, and as transports (Christner, 1991). Incorporating these ROVs, such as unmanned aerial vehicles (UAVs), unmanned combat aerial vehicles (UCAVs), space maneuverable vehicles (SMVs), and unmanned emergency vehicles (UEVs), into military missions as required have been successful, although each present a real challenge for command and control station designers.

ROV operators have a wide range of responsibilities associated with multiple ROV coordination, handling multiple targets within an area and/or multiple target areas, detecting targets using a variety of sensor information, identifying targets sufficient for possible attach, planning routes given some set of targets (or locations), destroying targets in the case of armed ROVs, and the timely return of the ROVs to base. Operator responsibilities include supervisory control during normal operations, making minor flight or path adjustments when necessary, and overriding automated systems when abnormal situations occur, such as remotely versus automated landing of a UAV. Successful completion of any mission depends on an operator’s ability to perform the control task(s) as well as maintain awareness of the task(s) performed autonomously by the ROV.

The dynamic operating conditions, the complexity of the fielded systems and the overwhelming amount of data processed by the human ROV operators are making automation a critical part of the planning, decision-making, and execution process. Since automated systems are capable of performing fast, accurate calculations, they can help improve performance in high-risk, time-sensitive and/or accuracy-critical situations. Although automation often improves overall performance in dynamic and complex systems by reducing workload and human errors, the advent of automation brings new problems associated with human automation interaction (Endsley, 1996; Wiener, 1995; Parasuraman, Molloy, & Singh, 1993). Bainbridge (1983), in describing the ironies of automation, points out that automation, designed to help
The Future of Augmented Reality Gaming
www.igi-global.com/chapter/future-augmented-reality-gaming/10173?camid=4v1a