ABSTRACT

USING DISCRETE EVENT SIMULATION TO MODEL FLUID-POWERED RESCUE ROBOT OPERATOR PERFORMANCE.

Lee, Antonio D.
Major Advisor: Dr. Xiaochun Jiang
North Carolina Agricultural and Technical State University.

Rescue robots play an important role in today's urban search and rescue missions. While there are efforts to use fluid power technology to develop new generation rescue robots, some design issues need to be addressed, particularly those that might have an impact on operator performance. The use of simulation tools allows for measurement of operator performance, and can avoid costly mockups and timely revisions. This research aims to use a discrete event simulation tool, the Micro Saint, to model operator performance in a fluid powered rescue robot system. After a task analysis of the system and task networks were developed four Micro Saint Models were created based on a similar basic scenario for the empirical study. These models indicated the different tasks performed by each of the four combinations of participants (Haptic- expert, Haptic- novice, Traditional- expert, Traditional- novice). In particular, appropriate distributions were determined for each task in the model. An empirical study was conducted to evaluate the impact of different controls (haptic control and traditional control) and operator expertise (expert and novice) on operator performance. Two-way analysis of variance (ANOVA) was used to analyze the data. The results showed a significant interaction between control and expertise. To investigate the impact of the significant interaction between expertise and control type, SAS® Slicing was used. To reveal the impact of the control type, expertise was fixed at each of its two levels (expert and novice). Results indicated that there was a significant main effect of control type when expertise was fixed at expert level and there was a significant main effect of control type when the control type was fixed at novice level. Post hoc analysis revealed that novice users struggled to learn how to use haptic controls. Hence, there is a need to address usability issues in interface design of the haptic controlled rescue robots.