An Evaluation of Asymmetric Interfaces for Bimanual Virtual Assembly with Haptics

Patrick Carlson and Dr. Judy Vance

Introduction

Virtual Reality (VR) and haptic technology can help by providing a natural interface for the complex manufacturing and design process. Multimodal interfaces provide an ideal interaction for this complex process (1). A model of bimanual cooperation between hands called the Kinematic Chain Model (2) is the basis for this study. Haptic enabled devices have been shown to outperform non-haptic devices in task performance speed. Haptics refers to the inclusion of force-feedback when using the device.

Hypothesis

We predict little or no difference in task performance speed between a setup using two Phantom Omni haptic enabled devices versus the use of a single haptic Phantom device in the dominant hand coupled with a haptic disabled Phantom in the other hand.

Experimental Design

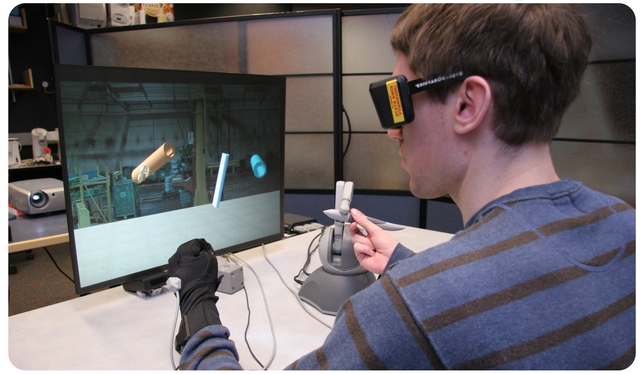
Independent Variables 5x2

Interface Configuration
Five configurations: see figure at bottom

Task
Simple or complex

Dependent Variables x1

Performance (time taken for task)



Hardware Used

Phantom Omni, by Sensable

Data Glove, by 5DT

Study Protocol

- Pre-study questionnaire
- 2 minutes to practice with hardware
- Randomly assign participant to task type
- Randomly assign order of device configurations
- Record time for each of the 5 device configurations twice to obtain average
- Post-study questionnaire

	Dual Haptic Phantoms	Dual Phantoms, One Without Haptics		Glove and Haptic Phantom	
Dominant Hand	Phantom, With Haptics	Phantom, With Haptics	Phantom, Without Haptics	Phantom, With Haptics	Glove
Non-Dominant Hand	Phantom, With Haptics	Phantom, Without Haptics	Phantom, With Haptics	Glove	Phantom, With Haptics

(1) Vyawahare, V. S., Vance, J. M. (2009). Human centered multimodal 3d user interface for desktop vr assembly. In Proceedings of the emerging technologies conference 2009. ETC.
(2) Guiard, Y. (1987). Asymmetric division of labor in human skilled bimanual action: The kinematic chain as a model. Journal of Motor Behavior, 19 (4), 486–517.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

This work is funded by the National Science Foundation under CMMI-0928774