



Title:

Haptic Interface Technique in Large-Scale Virtual Environment

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Introduction:

Haptic interface uses an electro-mechanical feedback device which enables a user to touch, feel, and manipulate virtual objects. Incorporating haptic interface into the CAD modeling system provides the user with more realistic experience. The authors have developed a freeform modeling system, which integrates haptic interface with large-scale PowerWall Virtual Environment (VE).

The haptic device has very limited physical workspace. For example, the PHANToM Omni used as haptic device in the system has the workspace of 6.4 W x 4.8 H x 2.8 D in. The PowerWall is a single, flat, large-scale stereoscopic screen with the size of 10 ft by 7.5 ft. There is a mismatch between the workspace of the haptic device and the large size of PowerWall virtual environment. Some solutions have been developed to address this issue, such as the scaling technique developed by Fischer and Vance [1], the clutching technique proposed by Johnsen and Corliss [2], and the Bubble technique proposed by Dominjon et al. [3]. The haptic workspace moving algorithm was developed to solve the workspace mismatch problem.

The technical contribution of our work lies in the following. Compared to the methods abovementioned, our method is easy to operate and has high efficiency. In our method, the user can move the haptic workspace by two convenient ways. The user can drag the haptic workspace to the desired location by holding the stylus button on haptic device. The user can also keep pressing then releasing the button, so the haptic workspace will “jump” to the destination. Our method provides fine and precise control to reach and touch the virtual object in virtual environment.

Main idea:

In the haptic workspace moving algorithm, the haptic workspace can be moved within the Virtual Environment as shown in Fig. 1. The VE workspace and haptic workspace are represented as boxes. The detailed step by step procedures are described below: (I) In the beginning (Step One), the user can move the virtual tool inside the haptic workspace. When the user reaches the boundary of the haptic workspace, he/she presses the stylus button on PHANToM. The center of the transparent box coincides with the virtual tool (Step Two). When the user releases the button, the haptic workspace coincides with the transparent box. The haptic workspace is moved. The virtual tool is now free to move inside the haptic workspace; (II) When the user keeps pressing then releasing the stylus button, the haptic workspace jumps in the direction of movement of virtual tool. The user can also drag haptic workspace while keeping holding the stylus button to reach any position (Step Three); (III) Once the haptic workspace reaches the destination (Step Four), the user will stop pressing the button. The haptic workspace will stop moving. The user will start editing the virtual object.

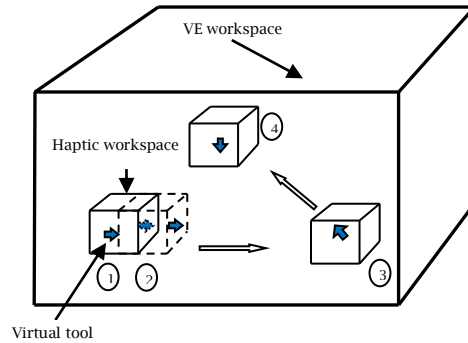


Fig. 1: Haptic workspace moving algorithm.

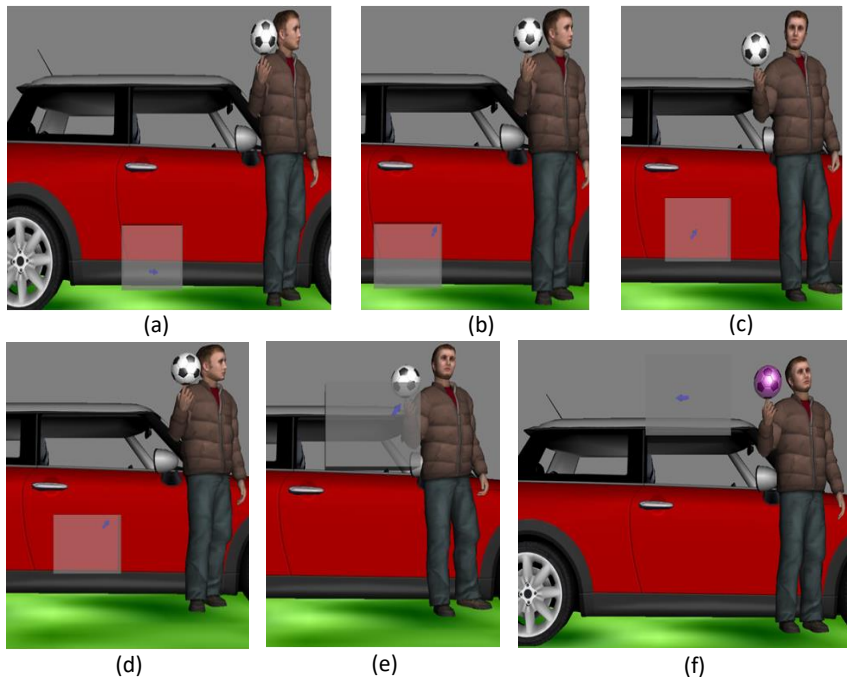


Fig. 2: An example of haptic workspace moving process.

Results:

The algorithm is implemented in Vizard. The results are shown in Fig. 2. The haptic workspace (represented by a transparent box) moves along with the virtual tool (represented by the marker). In the beginning, the virtual tool is free to move inside the haptic workspace. When the user moves stylus at six degrees of freedom the virtual tool moves with it. The Fig. 2(a) shows the initial position of the haptic workspace. The user brings the virtual tool at the boundary of the haptic workspace as shown in Fig. 2(b). Here the user wants to modify the color of the soccer ball. The user presses the stylus button and the center of the transparent box coincides with the virtual tool as shown in Fig. 2(c). When the user releases the stylus button, the haptic workspace coincides with the transparent box. As a result, the haptic workspace moves with the virtual tool as shown in the Fig. 2(d). The user can drag the haptic workspace while pressing the button or keep on press/release the stylus button to reach the destination as shown in Fig. 2(e). The virtual tool touches the soccer ball and the color of the ball is changed as shown in Fig. 2(f).

Conclusions:

This paper presents the implementation of a haptic workspace moving algorithm, which provides fine and precise control to reach and touch the virtual object in large-scale virtual environment.

Acknowledgements:

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