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# Virtual Scene Handling by 3-D Body Motion

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## 1. INTRODUCTION

In this paper, we present a virtual scene handling using 3-D body motion. In recent years, a lot of perceptual user interfaces (PUIs) have been developed [Turk 00] [Waters 98] and employed in practical use (for game consoles, interaction with lifelike characters in virtual space, and communication with humanoids). We tackle extending original PUIs to more intelligent interface which enables seamless physical-virtual interaction. In order to realize such interaction, human behaviors which are performed in the real world must be effectively converted into the corresponding events in virtual environments.

Use of 3-D human body motion sensing without physical restrictions is the most promising approach to realize seamless coupling between virtual environments and the real world [Wren 97]. As unwired approach, we adopt vision based motion capturing techniques.

In our previous works, we have developed an avatar motion control by user body postures. The method consists of the following techniques: blob based motion capturing and motion synthesis from a limited number of the blob positions.

Next, we have applied these techniques to virtual object manipulation interface with virtual camera control. The user behaviors through physical-virtual interaction can be interpreted as virtual object manipulation tasks or virtual camera control tasks in virtual scene. We assume that each virtual object affords essential information about user's action, based on simulating the idea of affordance in virtual environments. The avatar motions are automatically augmented by the afforded information so that the user tasks are effectively performed. For example, when the user grasps a virtual cup, the afforded finger motions to grasp it are augmented, and the state of the virtual object changes static into move. Such augmented motions are not acquired by real-world sensing but provided from the virtual object. The head motions, the hands motions, and the hand states of grasping are acquired as the real world information.

In previous works, we also realized the basic manipulations such as grasping and moving. In the first experiment, we realized the handling of virtual objects which are fixed in the virtual space. The examples of it are opening a virtual door and moving a lever. The user motions have to be converted into forces to change the states of such objects. The user motions are forced to the related motions with the virtual object during the handling.

In the current works, we tackle using body motions for more complex manipulations. In our approach, each complex manipulation is regarded as the combination of the basic manipulations. We assume that animated tasks in the virtual scene are strongly related to characteristic of objects. Augmentation of avatar motion is adaptively performed, referring to the following information:

- characteristic of virtual objects (what sort of functions are defined)
- user motion trajectory (how the user would manipulate)
- virtual scene context

We have applied our framework to desktop-style system, which is implemented on a PC. The system installs more than two cameras and a wide 2D display in front of the user. The system can perform real-time from vision process to virtual scene rendering. The user can only monitor the projected virtual scene with the 2D display. The upper body motions are employed as the real world input. We have tested several grasping tasks in the situation that the user would handle a tool.
Our framework treats the following functions: avatar motion control, virtual camera control by the body motion, and virtual object manipulation with/without avatar representation. The important point is that our framework aims to link virtual scene manipulation with the user motion in the real world.
The further extensions of this work would include personal adaptation such as the customization of the combination of the basic motions to realize complex manipulations. We also plan to extend our motion synthesis for the purpose of controlling autonomous agents [Kuffner 99] [Douville 96].

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