

MeisterGRIP: Cylindrical Interface for Intuitive Robot Manipulation

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1 Introduction

In recent times, robot manipulations have been used to perform operations in extreme environments, communicate with people in remote locations, and realize entertainment systems that control virtual robots. In all these activities, an interface for robotic hand and arm manipulations is important to interact with the external environment [Bar-Cohen, 2000]. Conventional interfaces consist of a few levers and switches; unfortunately, such interfaces are difficult to control, and the users must have prior experience as far as the operation of these interfaces is concerned. The other type of interfaces reflects the postures of the user's hand and arm directly in the robotic hand and arm so that the robots are capable of intuitive manipulation. However, these devices have a trouble of wearing and restrict the hand size of the user.

We believe that an interface for robotic hand manipulations should be developed in such a manner that anyone can use it intuitively and easily. Therefore, we developed a novel interface called "MeisterGRIP." This device measures the user's grasping conditions and reflects this information in the robotic hand and arm control. The user is simply required to grasp the device; therefore, the complexity of the setup is reduced and there are fewer restrictions on the user. Furthermore, by reflecting the grasping force of the user directly in the robotic hand and arm, intuitive manipulation is possible. MeisterGRIP allows robot manipulations to be easily conducted, and it can be widely used in general households. In the future, it will be possible to travel and interact with objects at remote locations by using our proposed device, even if the user is sitting on a sofa in his/her living room.

2 Principle

In order to measure the user's grasping conditions, the force vector distribution caused by the user's grasping is used. When a user grasps our proposed device, the device recognizes the five fingers and the palm of the user as six input positions from the pattern of the force vector distribution. Then, the three-axis force vectors are measured at each input point and relayed to each finger and wrist of the robotic hand. The input points could be set at any position on the device surface; this allows the user to grasp the device at any position in any posture. The individual differences among the hand sizes are also cleared by this feature.

In order to measure the force vector distribution, we applied our vision-based tactile-sensing technology [Kamiyama, et al., 2004]. The force vector distribution is calculated by capturing the movement of colored markers on the surface of an elastic body with a camera. MeisterGRIP has a cylindrical shape to support any grasping posture, as shown in Figure 1. Two CCD cameras and two spherical mirrors are attached at the end and the center of the cylindrical body, respectively. The mirrors enable us to capture

all the markers on the inner surface of the cylindrical body using a few cameras.

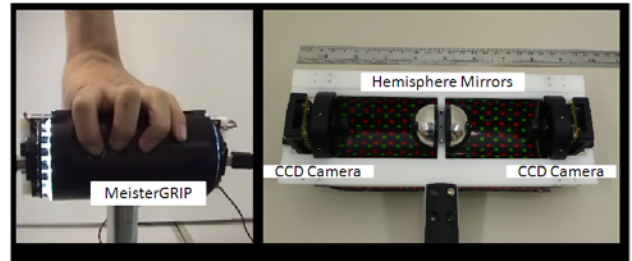


Figure 1: The figure on the left represents MeisterGRIP grasped by a hand. The figure on the right represents the inner configuration of the device.

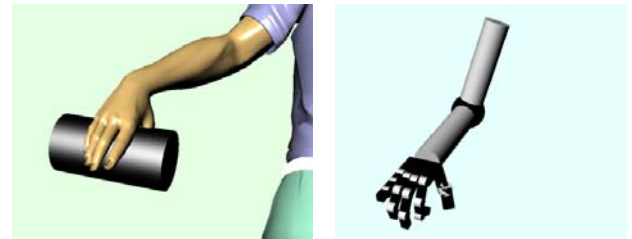


Figure 2: Manipulation of a robot system using MeisterGRIP.

3 Summary and Application

We propose a novel cylindrical interface called MeisterGRIP that treats the force vector distribution. This elastic device allows institutional and dexterous robot manipulation based on vision-based tactile-sensing technology. Furthermore, it provides universal manipulation that can tolerate the personal differences in hand sizes and grasping postures of the users.

This device is proposed for use in a cockpit to manipulate a robot in both real and virtual environments (Figure 2). We attached a stick to the device and fixed it to the ground. By using the force information measured from MeisterGRIP, the user can manipulate not just the robotic hand, but the robotic arm. To manipulate the robotic arm, we use the six-axis force information calculated from force vector distribution. Using this device, the users would feel as if they become a robot in remote environment by only the information of user's grasping.

References

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