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Native – Creating a database of grasps

Introduction

Native stands for natural two-handed interaction for virtual environments. The objective of Native is to enable users to intuitively grasp and manipulate virtual objects in virtual environments with their bare hands and without intermediate hand-held devices. In order to gain a deeper understanding of the underlying concepts of human object grasping, a database of (mainly) prehensile movements (i.e. seizing and holding real objects) is created. This database will establish a data basis for classification and retrieval of one- and two-handed grasp motions.

Data acquisition

For data acquisition an 18-sensor CyberGlove dataglove is used (see figure 1, left). The set of objects to grasp has been chosen to reflect 25 out of 33 grasp types compiled by Thomas Feix et al. in [FPS+09].

Methods

The database recording is systematically split into three setups:

1. Uncontrolled transport: Move objects from one point to another. No further explanation is provided, each object is presented five times.
2. Explicit use: Use objects the way they are designed to be used. Task and object to perform the task with are specified. When appropriate, tasks are performed left-handed and right-handed.
3. Controlled transport: Move objects from one point to another. A picture illustrates how each object has to be grasped, each specific grasp is perfomed five consecutive times.

Instead of reducing the captured motion sequences to single data points representing a distinct finger and hand configuration for holding a certain object, the whole sequence of hand and finger motions are kept. A sequence consists of moving the hand to the object, seizing it, executing the task specified, releasing it and moving the hand away from the object.

Expected results

Ideally, the captured motions will exhibit a distinct pattern when grasping and holding a specific object or type of object. This can be used to derive object-type-based "comfortable" hand and finger configurations for grasping and holding objects and hence reduce the search space for classification.

Acknowledgements

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Reference

[FPS+09] T. Feix, R. Pawlik, H. Schmiedmayer, J. Romero, and D. Kragic, A comprehensive grasp taxonomy, in Robotics, Science and Systems: Workshop on Understanding the Human Hand for Advancing Robotic Manipulation, June 2009. [Online]. Available: http://grasp.xief.net

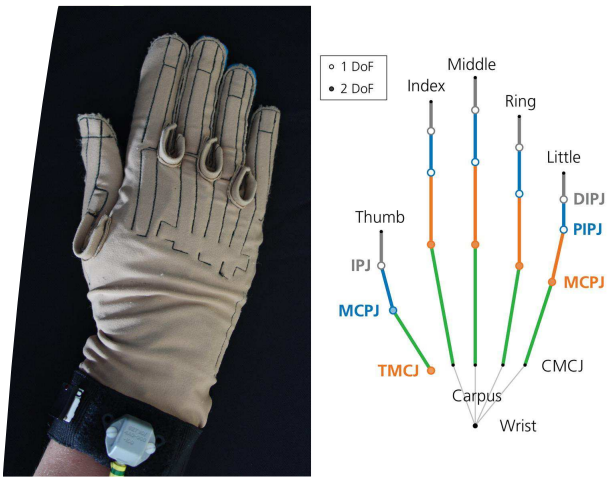

Figure 1: Dataglove used for recording joint angles (left, CyberGlove Systems LLC right hand CyberGlove) and schematic kinematic chain of a human hand (right). The abbreviations used for joints in the kinematic chain stand for (proximal, distal) interphalangeal joints (PIPJ, DIPJ, IPJ), metacarpophalangeal joint (MCPJ), carpometacarpal joint (CMCJ) and trapeziometacarpal joint (TMCJ). Filled circles represent joints with two degrees of freedom (DoF) in that joint, unfilled circles represent joints with one DoF.

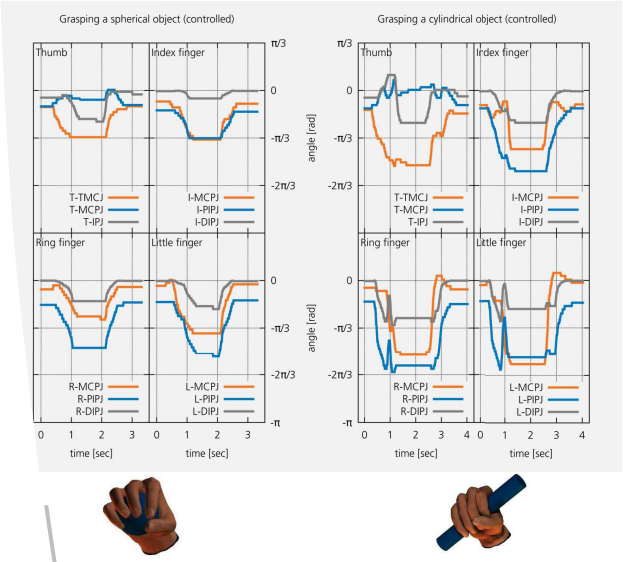

Figure 2: Exemplary angle trajectories of thumb, index finger, ring finger and little finger joints when grasping a spherical object (left) and a cylindrical object (right). How the grasp was performed is shown below the respective group of graphs. Pictures of grasps are taken from the grasp list accompanying [FPS+09].

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