TECHNISCHE UNIVERSITÄT MÜNCHEN
**Human-centered Assistive Robotics**
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# MASTER'S THESIS

for

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## Human Motion Retartgetting to a Humanoid and its Feedback based Improvement

Problem description:

Planning of whole body motions for humanoid robots is made complicated by the handling of a large number of degrees of freedom. The idea of using a motion capture system for copying a human's motion directly to the humanoid instead of performing complicated motion planning optimizations, therefore, has drawn the attention of many researchers in the robotics [1][2][3]. For transferring human motions to a humanoid robot, there are two necessary steps. In the first step, human's whole body motions should be captured in real-time. Then, a motion mapping algorithm from a human to a robot considering hardware limits and the differences between human's and robot's kinematics and dynamics should be developed. The focus of this project lies on development of a new mapping method to iteratively improve its mapping function. Developed algorithms should be implemented to David, DLR upper body humanoid robot and analyzed.

Tasks:

- Review of state of the art in human motion imitation techniques
- Real-time human motion retargeting algorithm for upper body and torso
- Human motion capturing using a motion capture system (inertia, vision, or strechable sensor based)
- Investigating a method for improvement of the retargetting function
  - from human's feedback (e.g. kinesthetic correction, verbal, etc)
  - by minimizing the error function after bidirectional mapping
  - from human's adjustment to the robot (e.g. in order to make robot bahavior correct)
  - machine learning approach for the mapping (e.g. which reference frame)
- General mapping method for different humanoid robots (e.g. David, Justin and TORO) (optional)
- Simulation
- Implementation to the DLR humanoid robot David

Bibliography:

[1] Christian Ott, Dongheui Lee and Yoshihiko Nakamura, Motion Capture based Human Motion Recognition and Imitation by Direct Marker Control, IEEE-RAS Int. Conf. on Humanoid Robots 2008, p.399-405.
[2] B. Dariush, M. Gienger, B. Jian, Ch. Goerick and K. Fujimura, Whole Body Humanoid Control From Human Motion Descriptors, IEEE Int. Conf. on Robotics and Automation, 2008, p. 2677-2684.
[3] S. Nakaoka, A. Nakazawa, F. Kanahiro, K. Kaneko, M. Morisawa and K. Ikeuchi, Task model of lower body motion for a biped humanoid robot to imitate human dances, IEEE/RSJ Int. Conf. on Intelligent Robots and Systems, 2005, p. 2769-2774.

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