TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
UNIV.-PROF. DR.-ING. DONGHEUI LEE

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B A C H E L O R T H E S I S
for
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Human-Assisted Model Identification of Articulated Objects

Problem description:

A kinematic model of articulated objects in the robot's surrounding can improve the robot's confidence when interacting with the environment during complex manipulation tasks. Many works have been conducted that enable autonomous execution of predefined tasks using models of articulated objects [1]. Identifying the kinematic structure of the robot's environment typically requires expert knowledge and consumes a lot of time. Except for a few approaches [2], the problem of automatically identifying kinematic models of articulated objects has not been investigated in depth in current literature.The number of joint parameter combinations grows exponentially with the length of the kinematic chain, which is a major difficulty for efficiently and reliably identifying a kinematic model. This work therefore focuses on employing non-expert human operators to reduce the search space for semi-automatic model identification for articulated objects by manual exploration of the environment. The human should be able to intuitively collect data and to share his intuition about the manipulated objects. Therefore the following tasks have to be conducted:

Tasks:

- Literature research on model identification of articulated objects
- Development and implementation of a prototypical handheld device that allows an operator to record data while interacting with the objects in the environment
- Development of a GUI that allows an operator to share additional insights about the objects during data acquisition
- Implementation of a signal processing strategy for noise reduction and sensor fusion
- Implementation of a model fitting algorithm based on collected sensor data from simulation
- Evaluation of the semi-automatic model identification on real hardware

Bibliography:

[1] Adrian Röfer, Georg Bartels, and Michael Beetz. Kineverse: A symbolic articulation model framework for model-generic software for mobile manipulation. *arXiv preprint arXiv:2012.05362*, 2020.
[2] Jürgen Sturm. *Approaches to Probabilistic Model Learning for Mobile Manipulation Robots*. PhD thesis, PhD thesis, University of Freiburg, Germany, 2011.

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