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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Simplify the Symbolic Representation of Structured Tasks by Merging Sequential Behaviors

Problem description:

A structured task, like preparing a certain recipe, can be hierarchically decomposed in different subtasks involving multiple primitive actions and manipulated objects. Actions have to be performed in a coherent manner, meaning that the actions have to be executed on certain objects with a particular order. For example, in order to pour water in a cup, the robot has to take the bottle, reach the cup, and then pour the liquid. In order to make a robot able to learn and execute structured tasks, an approach has been proposed in [1, 2] which integrates attentional supervision and kinesthetic teaching. The result is a symbolic representation of the structured with associated motion primitives.
The focus of this Bachelor Thesis work is to reduce the number of actions (leaves of the tree-based structure) generated by the segmentation algorithm in [2], by clustering together subsets of actions. The student has to define a proper clustering criteria given the learned task structure. The developed clustering strategy will also affect the learned motion primitives, which have to be adapted accordingly to generate smooth motor commands [3].

Tasks:

- Literature research on symbolic task representation and planning
- Development of a clustering algorithm to reduce the number of actions in the learned task structure
- Automatic classification of the intermediate end positions as goal (stop) or via point (pass through) - Optional
- Comparison with the approach in [2]

Bibliography:

[1] R. Caccavale, M. Saveriano, G. A. Fontanelli, F. Ficuciello, D. Lee, and A. Finzi, Learning and Attentional Supervision of Dual-Arm Structured Tasks, in *International Conference on Development and Learning and on Epigenetic Robotics*, 2017.
[2] R. Caccavale, M. Saveriano, A. Finzi, and D. Lee, Kinesthetic Teaching and Attentional Supervision of Structured Tasks in Human-Robot Interaction, in *Autonomous Robots*, 2018.
[3] S. Manschitz, J. Kober, M. Gienger, and J. Peters, Learning Movement Primitive Attractor Goals and Sequential Skills from Kinesthetic Demonstrations, in *Robotics and Autonomous Systems*, vol. 74, pp. 97–107, 2015.

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