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

February 26, 2019

M A S T E R ' S T H E S I S
for
N.N.
Student ID XXXXXXX, Degree XX-XX

Robotic Executions of Human-like Tasks using Task Planning and Hierarchical Tasks Structures

Problem description:

The robotic execution of human-like tasks in uncontrolled environments is an open research area, actively explored by the robotics and artificial intelligence communities. This research line poses significant challenges to current approaches provided the large number of situations the robot should be able to deal with. For the successful execution of tasks, the robot should consistently evaluate the consequences of actions in all the possible situations that may arise in order to generate viable (executable) plans. On the other hand, once a plan is generated, it should consistently transform the actions in the plan into robotic movements that permits obtaining the intended effects. The main goal of this project is to combine state of the art mechanisms for task planning, which permits planning in a large number of situations using a compact representation of the consequences of actions, with mechanisms for symbol grounding using a hierarchical representation, which decomposes the actions of a plan into primitives robotic behaviours for its actual execution.

Tasks:

- Literature overview:
  - Introduction to Markov decision processes and dynamic programming (Chapter 6 in [3]).
  - Introduction to classical planning and symbolic planning (Chapter 2 in [3], Chapter 2.4 in [5]).
  - Symbolic planning for the robotic execution of human-like tasks [1, 4].
  - Symbol grounding using hierarchical tasks structures (HTS) [2, 4].
- Implementation:
  - Integration of HTS into planning operators.
  - Implementation of a robotic cognitive architecture with online plan monitoring and re-planning.
- Benchmarking:
  - Planning domain definition and experimental setup.
  - Benchmarking in real scenarios.

Bibliography:

[1] A. Agostini, C. Torras, and F. Wörgötter. Efficient interactive decision-making framework for robotic applications, in *Artificial Intelligence*, 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] M. Ghallab and D. Nau and P. Traverso. Automated Planning: theory and practice, 2004.
[4] G. Konidaris, L. Kaelbling, and T. Lozano–Perez. From Skills to Symbols: Learning Symbolic Representations for Abstract High-Level Planning, in *JAIR*, 2018.
[5] S. LaValle. Planning algorithms, 2006.