

Movelt! Task Constructor

A framework for planning task sequences

Robert Haschke¹, Michael Görner²

¹Center of Excellence Cognitive Interaction Technology (CITEC), Bielefeld University, Germany

²TAMS Group, Hamburg University, Germany

Universität Bielefeld



Universität Hamburg

DER FORSCHUNG | DER LEHRE | DER BILDUNG



Motivation

- manipulation + assembly tasks require a sequence of sub tasks
- interdependencies between subtasks
- symbolic task planners too complex to configure / vulnerable

- assume high-level structure of task to be known (up to alternatives)
- framework to facilitate setup of task pipelines
- efficient and complete planning

Motivation

File Panels Help

Motion Planning Tasks - Slider

Waypoint: 0 0

Motion Planning Tasks

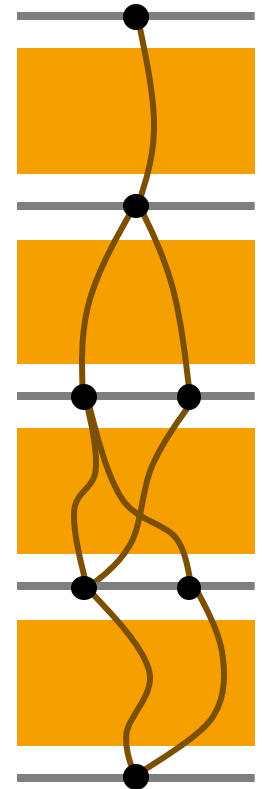
Task Tree

Name	✓	✗	#	cost
▼ Motion Planning Tasks				
▶ task pipeline			8	0

Reset 31 fps

Key Features

- high-level task structure assumed to be known
- task hierarchically represented using containers
 - SerialContainer: *sequentially* chain sub tasks
 - ParallelContainer: *alternative* sub tasks
- *stages* connect *interface states* via sub-solutions
- interface state:
 - planning scene: world & robot
 - properties for symbolic information
 - end effector selected for grasping
 - grasp type



Scheduling

- Stage types
 - generator: seed for planning
 - propagator: advance partial solutions
 - connector: connect partial solutions
- priority queues:
 - solutions by cost
 - states by #steps and costs
 - stages by type, success rate, and estimated computation time

pick-and-place with handover

↕ current state

∞ connect

↕ pick with right hand

↓ move to handover pose

∞ connect

↕ pick with left hand

↓ move to place

Available Stages

- Generators
 - fetch current Planning Scene from `move_group`
 - Cartesian pose generator / sampler
 - ComputelK
 - simple grasp generator
- Propagator: plan to joint-space or Cartesian space pose
- Connect

- SerialContainer
- ParallelContainers: Alternatives, Fallback
- Wrapper: filter / modify solutions

Introspection

File Panels Help

Motion Planning Tasks - Slider

Waypoint: 516 Play

Motion Planning Tasks

Task Tree

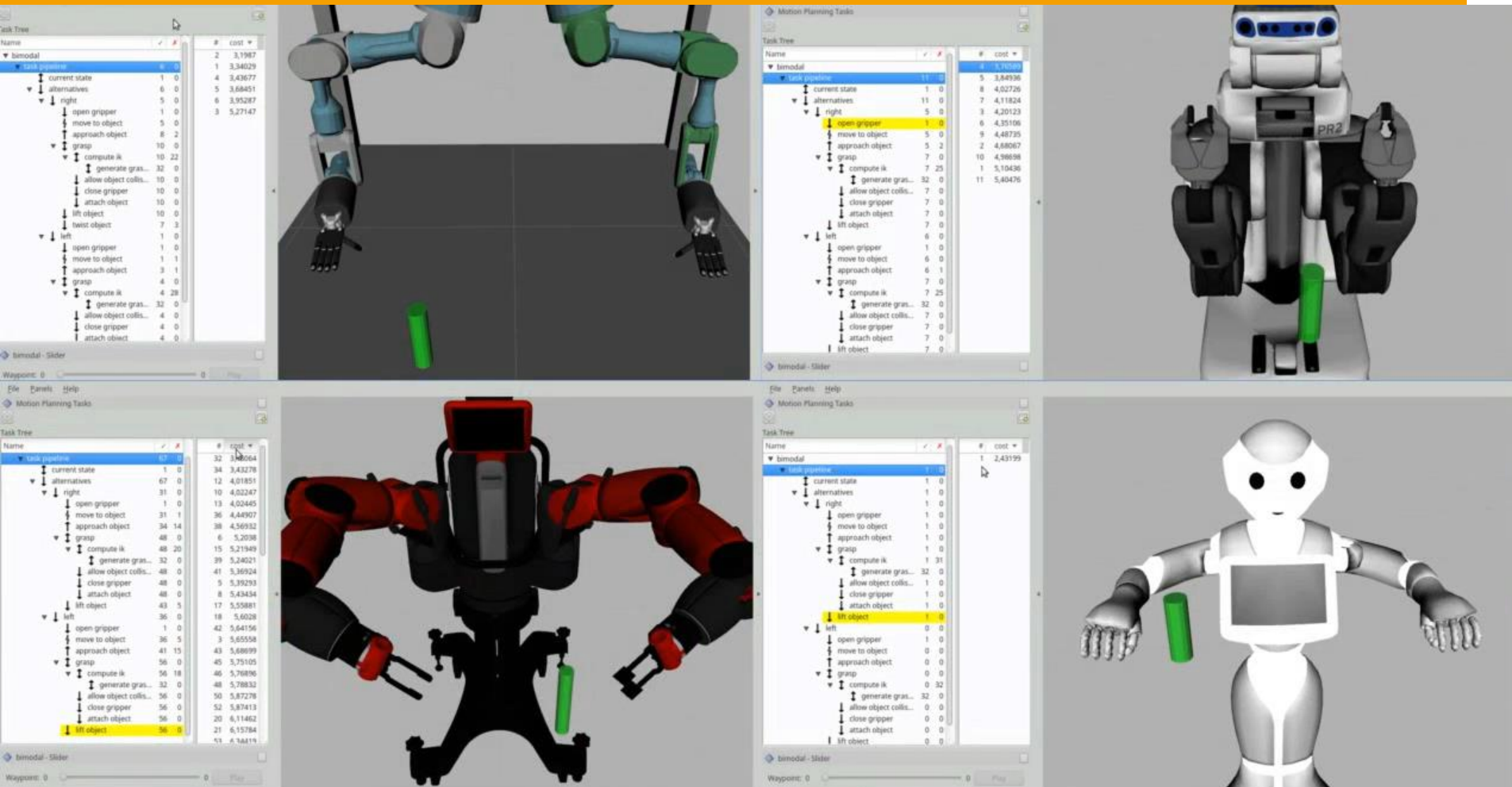
Name	✓	✗	#
↑ approach object	3	1	7
▼ ↓ grasp	5	0	8
▼ ↓ compute ik	5	27	6
↑ ↓ generate grasp p...	32	0	2
↓ allow object collision	5	0	5
↓ close gripper	5	0	9
↓ attach object	5	0	11
↓ lift object	4	1	12
↓ move to handover	3	0	10
⚡ connect	24	0	13
▼ ↓ pick with left	11	0	1
↑ approach object	11	4	3
▼ ↓ grasp	15	0	4
▼ ↓ compute ik	15	17	14
↑ ↓ generate grasp p...	32	0	15
↓ allow object collision	15	0	16
↓ close gripper	15	0	17
▼ ↓ ungrasp	15	0	18
↓ detach object	15	0	19
↓ open gripper	15	0	20
↓ forbid object colli...	15	0	21
↓ retract	15	0	22
↓ attach object	15	0	23
↓ lift object	15	0	24
↓ move to place	8	3	25
			26

Reset 31 fps

Outlook: Envisioned Features

- Interactive GUI
 - configure + validate task pipeline in rviz
 - save as YAML
 - C++ / python code generation
- Threaded Planning
- Execution Handling
 - premature execution of planned sub tasks
 - choose controllers for sub tasks (force control, servoing, ...)
 - failure handling
 - replan from current situation
 - revert to previous stage

https://github.com/ros-planning/moveit_task_constructor



Bimodal pick planner finds both, left + right hand solutions