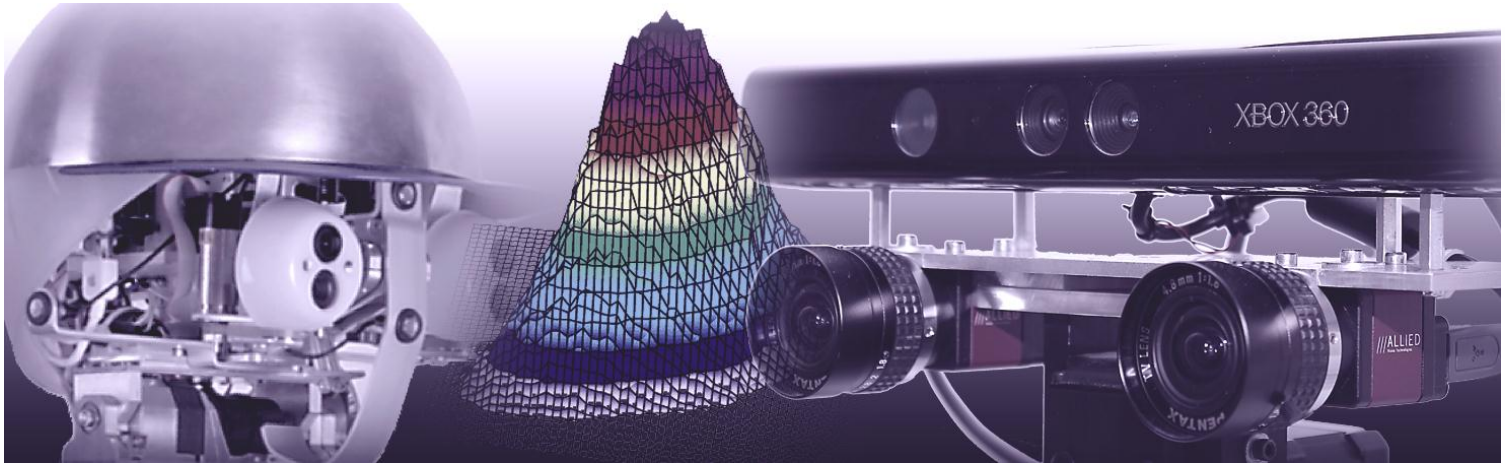
Karlsruhe Institute of Technology

Robotics III: Sensors

Chapter 12: H2T Lab Tour

Tamim Asfour

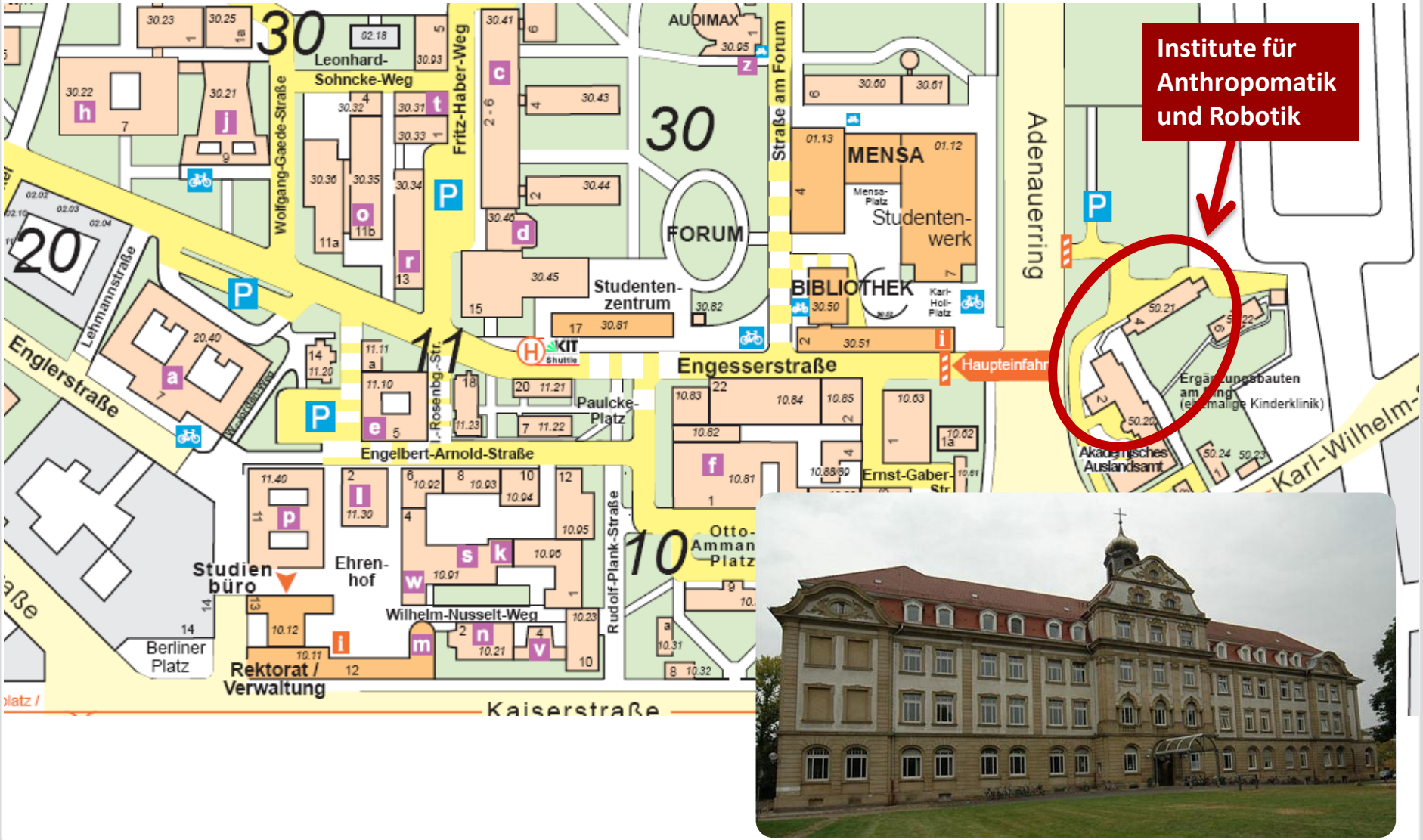
Department of Informatics, Institute for Anthropomatics and Robotics (IAR)
High Performance Humanoid Technologies Lab (H^2T)



http://www.humanoids.kit.edu

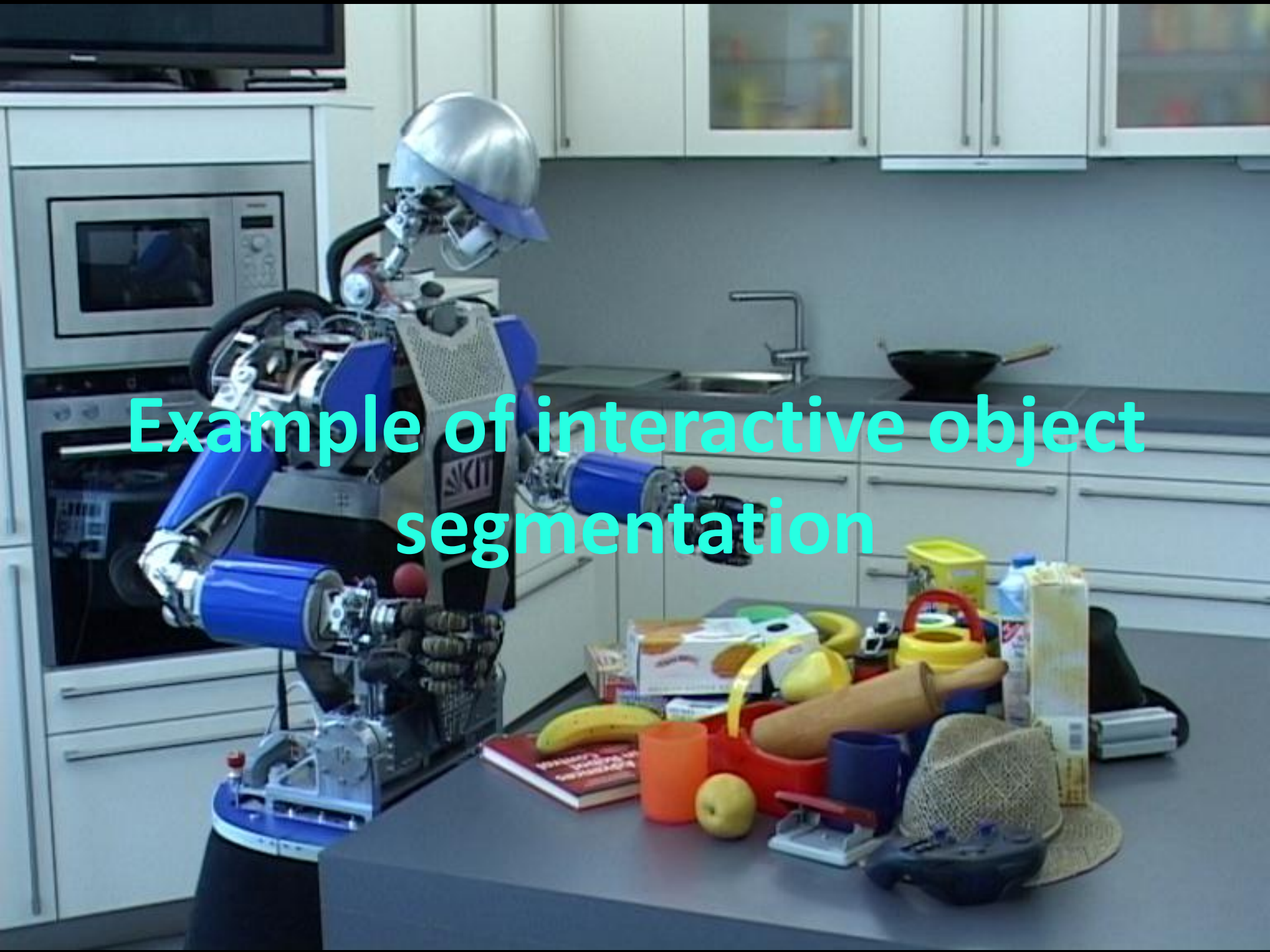
http://h2t.anthropomatik.kit.edu

Lab Tour @ H²T: Geb. 50.20



Interactive Object Segmentation

D. Schiebener, A. Ude and T. Asfour, *Physical Interaction for Segmentation of Unknown Textured and Non-textured Rigid Objects*, IEEE International Conference on Robotics and Automation (ICRA), 2014


Example of interactive object segmentation


Left robot camera image
Nesquik
Advances in Robot Control

Initial object hypotheses


Left camera
Initial hypotheses
x2
Outside view
Planned push through the center of the object hypothesis

Old camera image

New camera image

Changed image regions

Confirmed object hypotheses

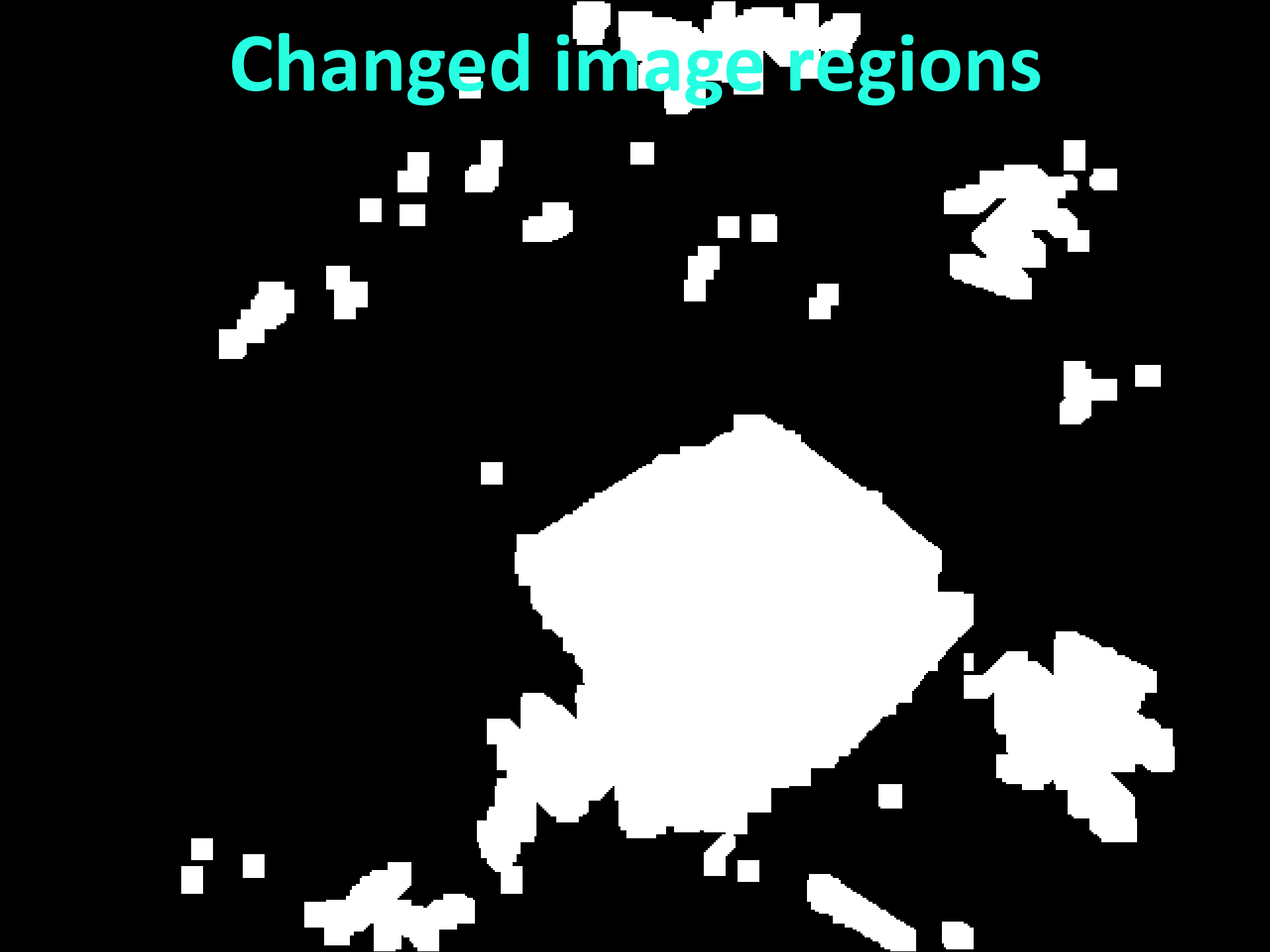
Crosses are confirmed points, dots newly added candidates


Left camera
New hypotheses
x2
Outside view
Old hypotheses
Nesquik
Advances in Robot Control
Popcorn

Old camera image


New camera image
Nesquik
Advances in Robot Control

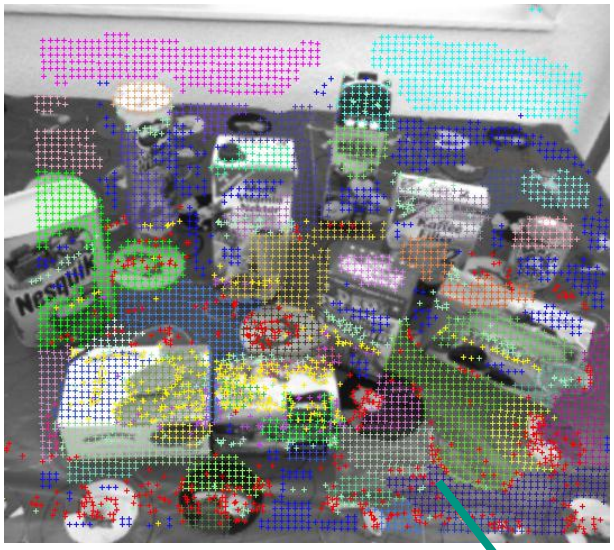
Changed image regions



Confirmed object hypothesis

Crosses are confirmed points, dots newly added candidates

Object segmentation example



Action Segmentation & Imitation

M. Wächter and T. Asfour, *Hierarchical Segmentation of Manipulation Actions based on Object Relations and Motion Characteristics*, International Conference on Advanced Robotics (ICAR), pp. 549 - 556, July, 2015 (Best paper award candidate)

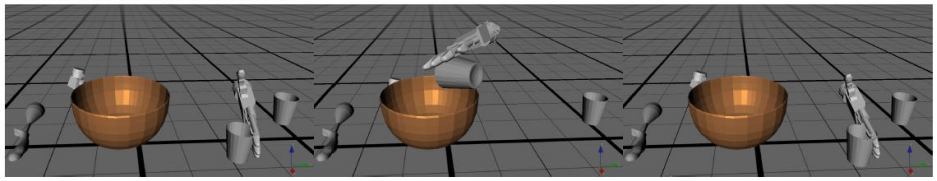
E. E. Aksoy, Y. Zhou, M. Wächter and T. Asfour, *Enriched Manipulation Action Semantics for Robot Execution of Time Constrained Tasks*, IEEE/RAS International Conference on Humanoid Robots (Humanoids), pp. 109 - 116, 2016 (Best Oral Paper Award Finalist)

Hierarchical Action Segmentation

- Extension of previous semantic segmentation (Wächter et al., 2013)
- Semantic segmentation provides relevant information about key frames but actions without observable effects cannot be detected
- Segmentation of human demonstration on two levels
  - Semantic segmentation based on object relation changes
  - Motion segmentation based on trajectory characteristics

Human Demonstration

Converted Demonstration



Hierarchical Segmentation

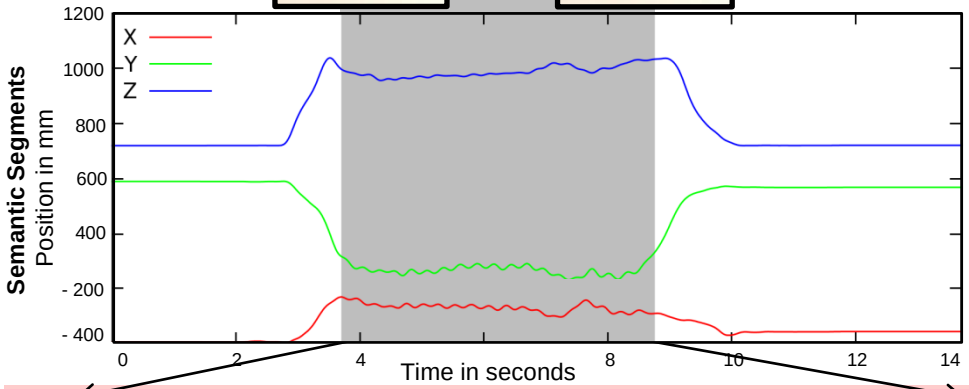
No contact	Cup in left hand			No contact
Grasp	Lift	Pour	Place	Retreat

Temporal Scaling

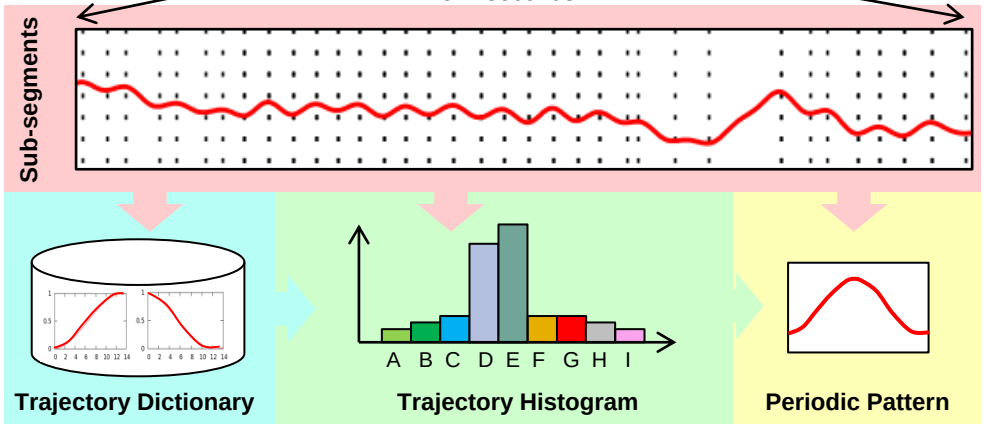
Human Demonstration

Semantic Segmentation

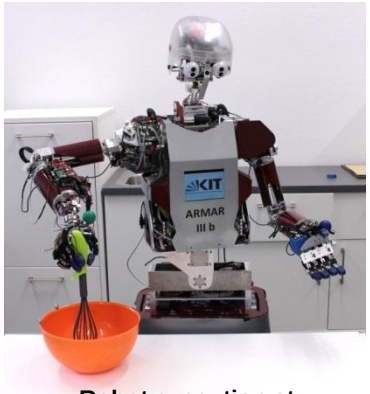
mix



Motion Segmentation



Based on the Dynamic Time Warping Distance Measure

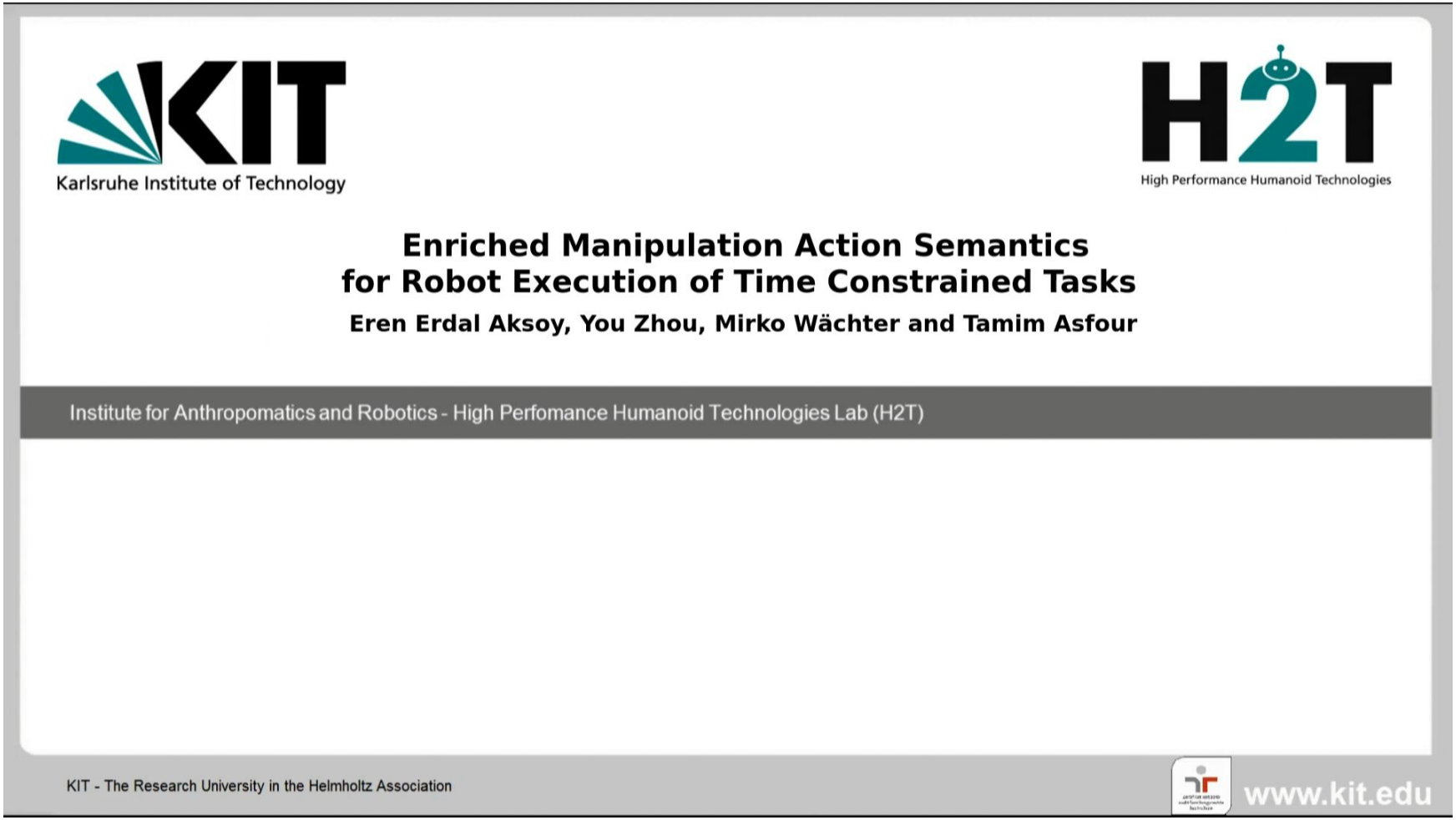


Robot execution at different temporal scales

CLASS-WISE AVERAGE PERIODICITY MEASURES

Mix	*Pick Place*	*Put In*	*Take Down*	*Put On*	*Drink*	*Pour*	*Cut*
0.67	0.0	0.0	0.0	0.0	0.0	0.0	**0.5**

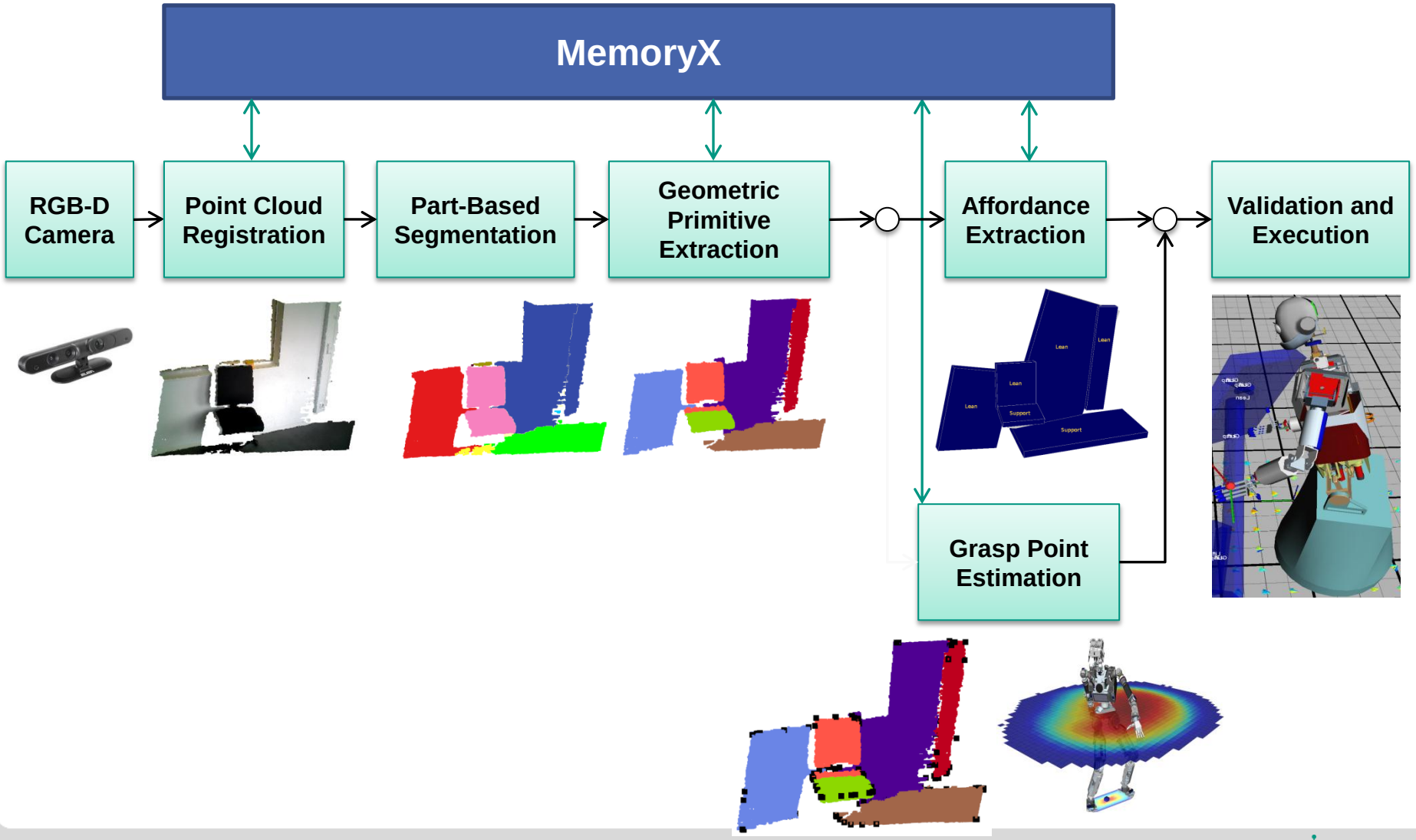
Temporal Scaling



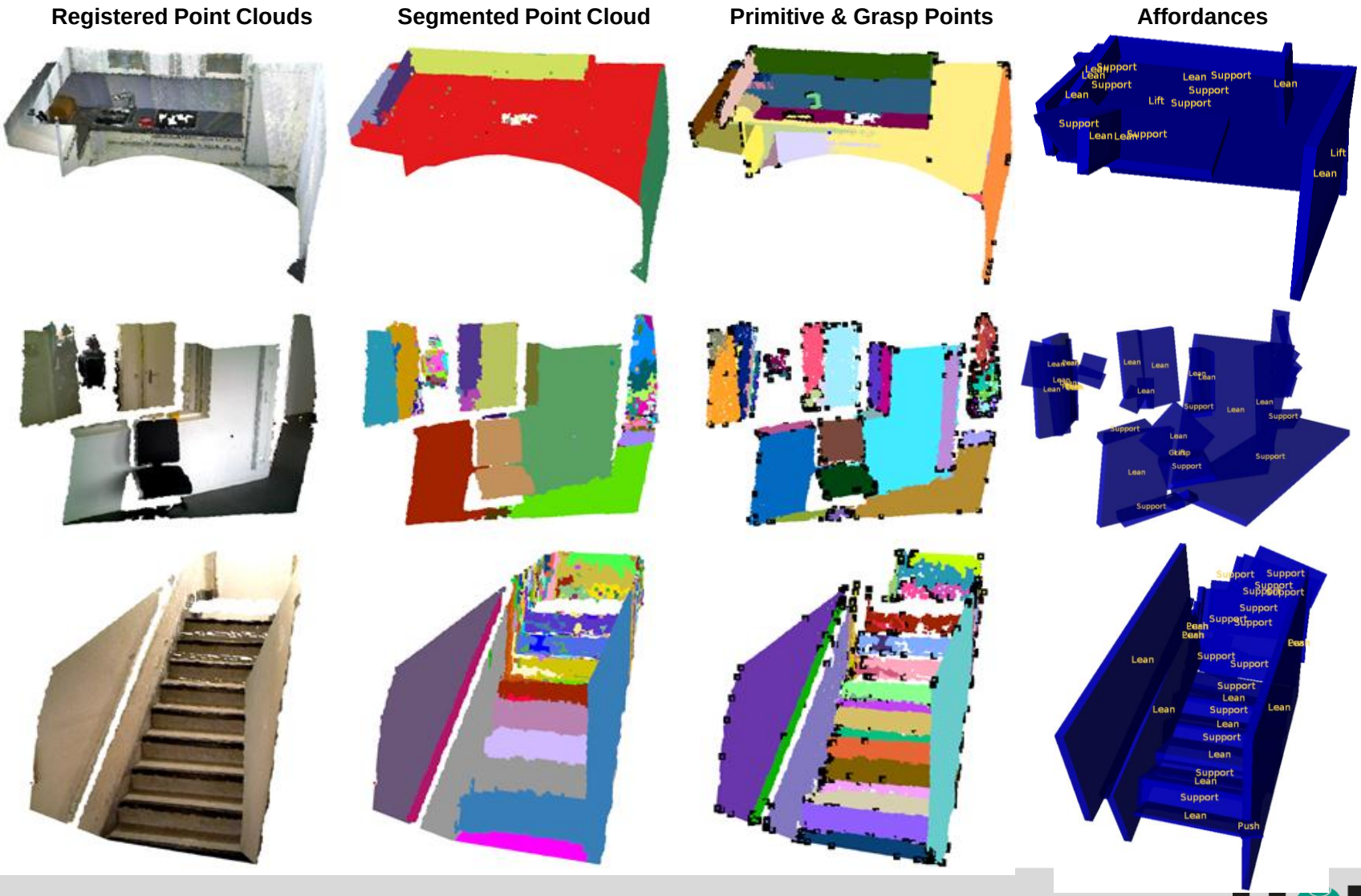
Loco-Manipulation Affordances

Kaiser P., Grotz M. Aksoy E.E., Do M. Vahrenkamp N. Asfour T.,
“Validation of Whole-Body Loco-Manipulation Affordances for Pushability and Liftability”, In IEEE-RAS International Conference on Humanoid Robots 2015.

Loco-Manipulation Affordances



Loco-Manipulation Affordances - Examples



Perception Pipeline for Affordance Extraction

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Validation of Whole-Body Loco-Manipulation Affordances for Pushability and Liftability

Peter Kaiser, Markus Grotz, Eren E. Aksoy, Martin Do, Nikolaus Vahrenkamp and Tamim Asfour

Institute for Anthropomatics and Robotics - High Perfomance Humanoid Technologies Lab (H2T)

KIT – University of the State of Baden-Wuerttemberg and National Laboratory of the Helmholtz Association

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