



## Abstract

An autonomous environmental visual perception approach for humanoid robots is presented. The proposed framework exploits the available model information and the context acquired during global localization by establishing a vision-model coupling in order to overcome the limitations of purely data-driven approaches in object recognition and surrounding status assertion. The exploitation of the model-vision coupling through the *properceptive*<sup>1</sup> components is the key element to solve complex visual assertion-queries with proficient performance. This is achieved by the presented framework which implements the basic reasoning skills by extracting simple but compelling geometrical cues from the properception component. These cues are applied as clue-filters for the association of percepts either for tracking (by optimization of the region of interest in terms of size) or handling incomplete visual information. Experimental evaluation with the humanoid robot ARMAR-IIIa includes the recognition of furniture like door, handles, dishwashers, etc. Full papers and videos demonstrating the real-time experiments at: <http://i61www.ira.uka.de/users/asfour/HumanoidsGroup/content/vision/topic2.html>.

## Objectives

Developed a robust component for visual perception for humanoid robots operating in made-for-humans environments. The component provides the following skills:

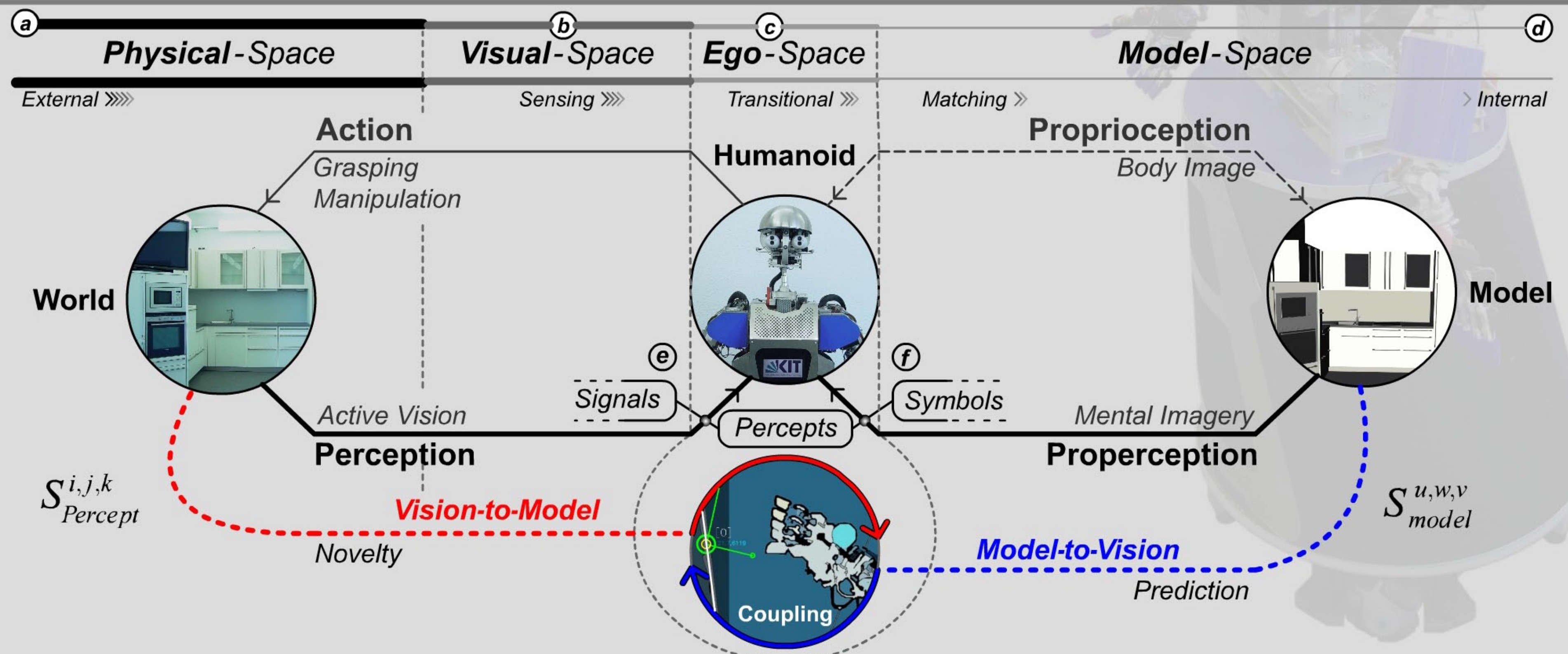
- Global 6D localization in Structured Environments
- Detection and Tracking of Surrounding Elements
- Supporting the AI-Planner through the Resolution of Visual Assertion Queries

## Contributions

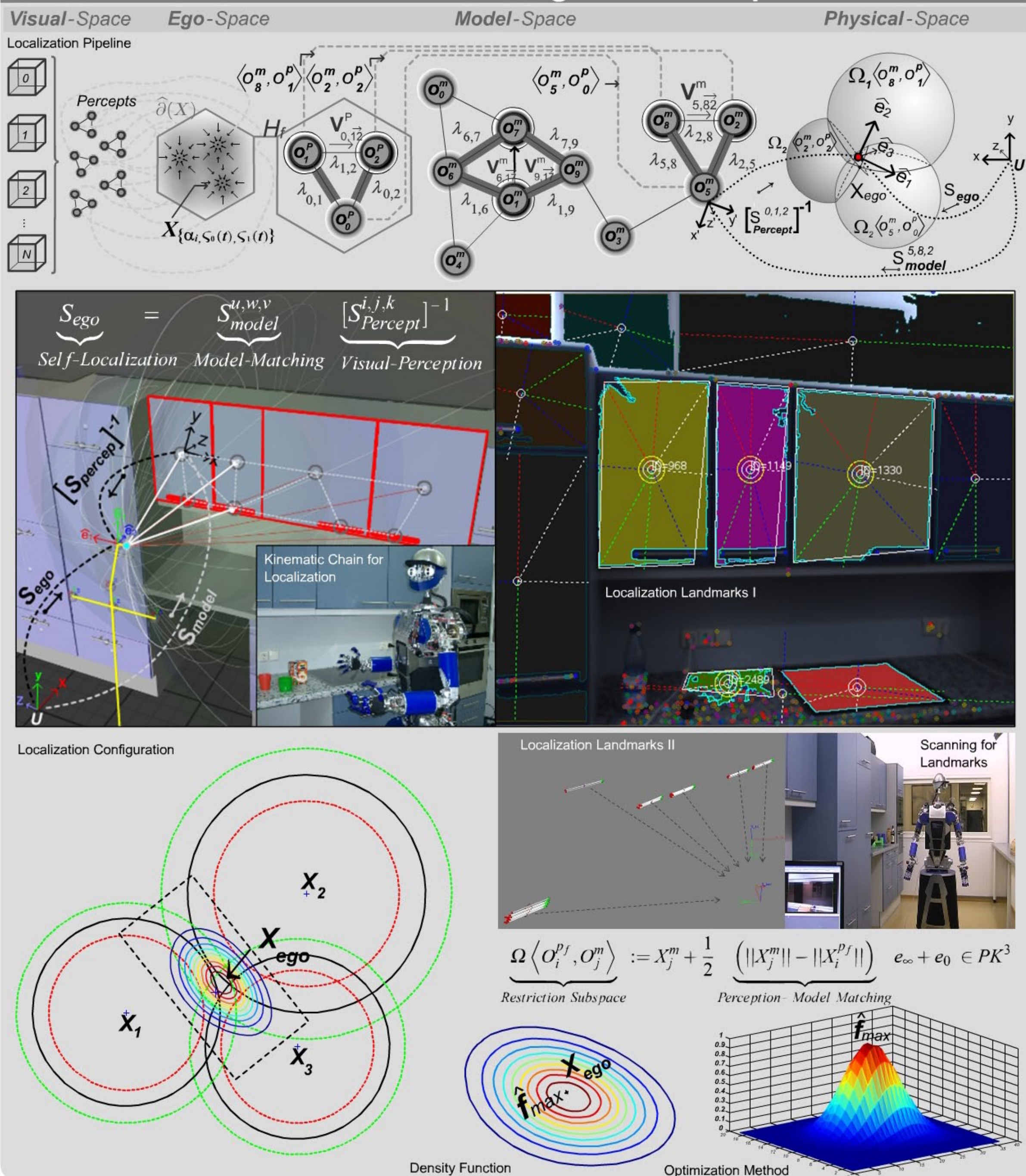
- Novel Model-Based Self-Localization Approach
- Closed-form Gaussian Spheres Intersection for Robust Self-Localization
- Introducing Mental-Imagery for Proprioceptive Recognition and Status Assertion
- Real-Time Detection / Tracking of Complex and Partially Occluded Environmental Objects during Task Execution

## Cognitive Stratification

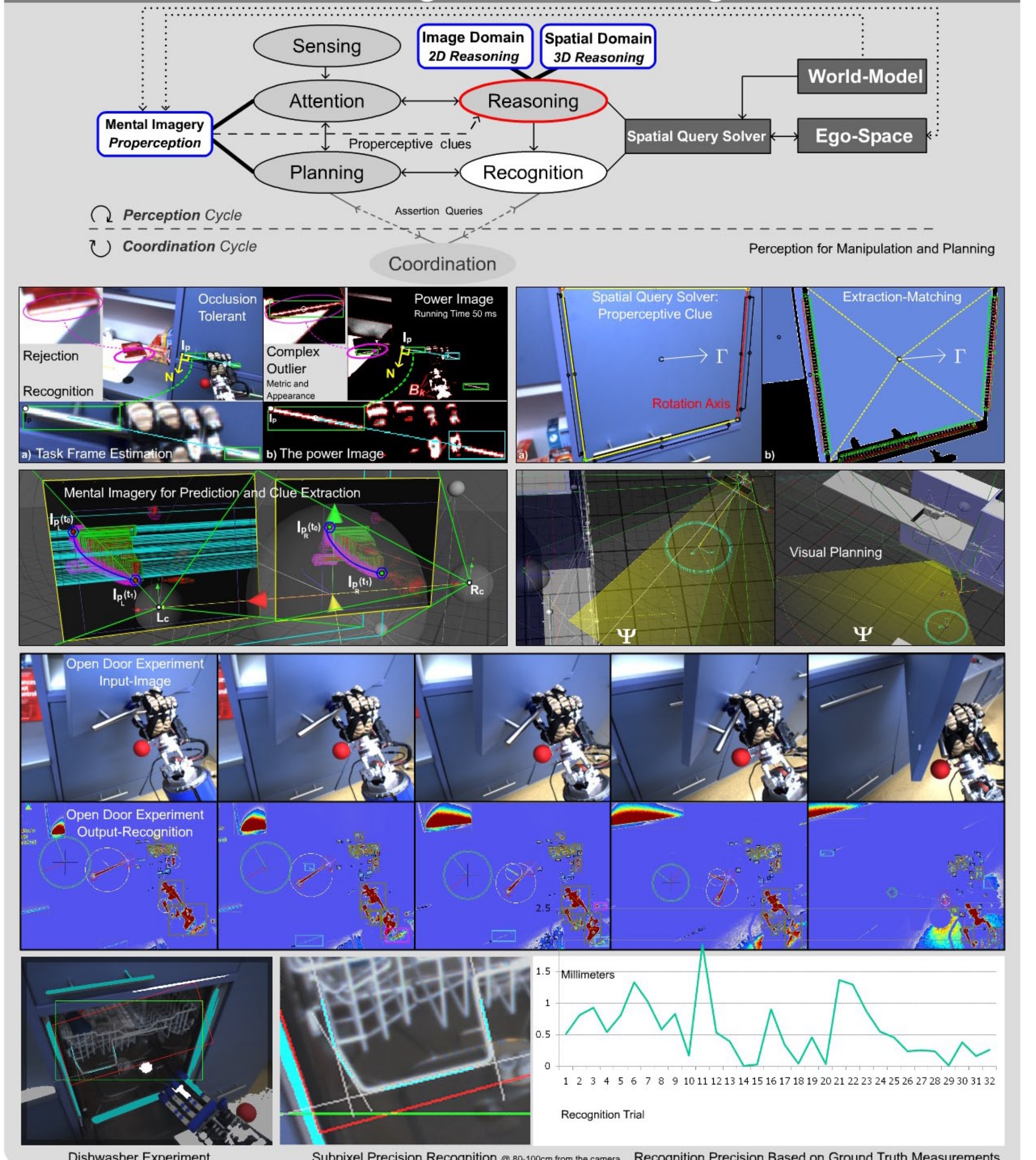
- a) The physical-space embraces the tangible reality
- b) The visual-space embodies the image projection from the reality to percepts by means of sensor devices and active recognition components
- c) The ego-space is the short term registration storage for percepts and self-localization
- d) The model-space contains the geometrical and topological description of the entities of the physical-space
- e) The signals-to-percepts is the transducer process from visual-space to ego-space
- f) The symbols-to-percepts process fuses the percepts corresponding to abstracted entity in the model-space



## Model-Based Self-Localization Using Gaussian Spheres



## Markerless Detection-Recognition and Tracking for Task Execution



## References and Acknowledgments

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