

Final report of the cooperation project

Project no.: 72p5

Topic: Improvements of change detection in point cloud data and visualization

of these changes by incorporating semantic information.

Austrian partner: Markus Vincze, Ao.Univ.Prof. Dipl.-Ing. Dr.techn.
Vision4Robotics group
Automation and Control Institute
Technische Universität Wien (TUW)

Czech partner: Michal Španěl, Ing. Ph.D.
Robo@FIT group
Department of Computer Graphics and Multimedia
Brno University of Technology (BUT)

Involved persons:

Name	Occupancy	Home University	Length and location of visit
Martin Veřas	student /scientist	BUT	5 weeks + 2 days at TUW
Daniel Wolf	scientist	TUW	1 week at BUT
Thomas Fäulhammer	scientist	TUW	1 week at BUT
Michal Španěl	scientist	BUT	4 days at TUW
Markus Vincze	scientist	TUW	2 days at BUT
Vítězslav Beran	scientist	BUT	2 days at TUW

Activities description (by person)

Martin Veřas

Main objectives planned in the project proposal were realized during Martin's 4 visits to TUW (5 weeks in total):

- 3.8.2015 - 14.8.2015
- 24.8.2015 - 28.8.2015
- 30.8.2015 - 3.9.2015
- 2.11.2015 - 5.11.2015

Originally planned visits were split and rescheduled due to acceptance of AKTION individual 2 months scholarship for September and October 2015 what further extended this cooperation project.

During the visits, a system of semantic change detection and visualization has been developed. This was done by implementing several change detection modules for point cloud data and integrating the modules into existing object detection modules provided by Vision4Robotics group to improve performance of the object detector in changing environments.

The new modules implement interfaces of ROS (Robotic Operating System) what makes them easily reusable. Moreover, novel plugins for semantic changes visualization and presentation for the ROS/RViz toolbox have been prepared (see Figure 1). The source code of the modules is publicly available via GitHub service:

- <https://github.com/martin-velas/v4r> (change detection and recognition modules)
- https://github.com/martin-velas/v4r_ros_wrappers (ROS interface and RViz plugin).

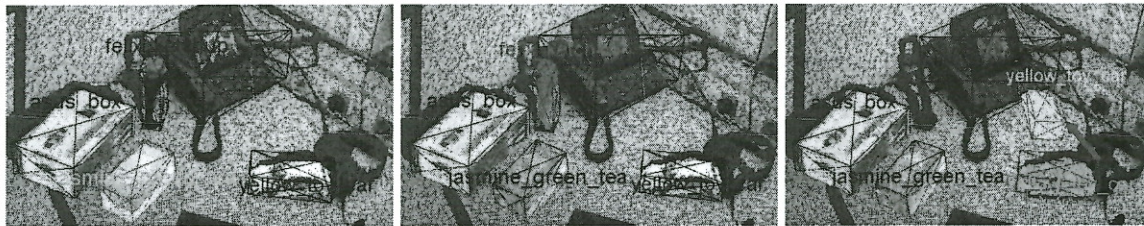


Figure 1. Visualization of detected changes in the scene. Color coding: green (new objects), blue (preserved objects), red (removed objects), orange (object moved to new location). Note the red arrow (image on right) which visualizes detected change in the position of car model.

The presentation of the project outcomes at International Conference on Intelligent Robots and Systems (IROS 2016) has been discussed during the last visit of TUW on 9.12.2015 - 10.12.2015. This visit has been originally planned for Dr. Beran. The amend has been convenient since Martin Vefas will be the corresponding author of prepared article.

Daniel Wolf

The visit to BUT has been shortened for 1 week and rescheduled on 23.11.2015 - 27.11.2015 because of unexpected duties of TUW.

During the visit to BUT Daniel Wolf presented the results of his work in the field of semantic segmentation. Moreover, the benefits of using Deep Convolutional Neural Networks for this task have been discussed and the experiments have been proposed.

Thomas Fäulhammer

This visit to BUT has not been originally scheduled in project proposal and replaces the second visit of Daniel Wolf.

The main goal of this visit has been preparation and execution of the experiments for proposed publication, which has been fulfilled. Thomas Fäulhammer also presented his work in multi-view object detection and discovery.

Michal Španěl

Michal Španěl visited TUW two times (9.-10.12.2015 and 3.-4.9.2015). During the visits Michal helped to coordinate Martin's visit to TUW and discussed his ongoing work and exact orientation of the work to perfectly fit needs of both the research groups. Michal Španel also presented research activities of Robo@FIT group and discussed potential topics for further cooperation between the groups.

Markus Vincze

Professor Vincze visited BUT on 26.11.2015 - 27.11.2015. During the stay, the presentation of the work and results of Robo@FIT group have been presented to visitors. The meeting regarding mutual conference publication and future European projects also took place.

Vítězslav Beran

During the stay at TUW from 3.9.2015 to 4.9.2015, Vita presented activities of the Robo@FIT research group in the field of Human-Robot Interaction and discussed experiences of researchers from the Vision4Robotics group in design and preparation of user tests for practical evaluations of robotic systems.

Outcomes and impact of the cooperation

The outcomes of the AKTION cooperation under project no. 72p5 can be summarized as follows:

1. Developed several publicly available **software modules for semantic change detection** and visualization.
2. Joint effort in **implementation of improvements to TUW's multi-view object detection** by integrating the change detection modules which improves the precision of the detector in changing environments.
3. **Joint publication proposal** for IROS 2016 conference.
4. **Encouragement of relationships between both the research teams** from TUW and BUT which will be beneficial for future cooperation and preparation of European projects.

Signature:

prof. Markus Vincze

Date:

27.1.2016

Signature:

Michal Španel

Date:

27.1.2016