Séminaire ISIR

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Campus Jussieu, 4 place Jussieu, Paris

Salle de réunion H20

Resilient Perception for Robots in Challenging Environments: day and night, in smoke, dust clouds or inside a knee.

Abstract : Long-term autonomy in robotics requires perception systems that are resilient to unusual but realistic conditions that will eventually occur during extended missions. For example, unmanned ground vehicles (UGVs) need to be capable of operating safely in adverse and low-visibility conditions, such as at night or in the presence of smoke, in the presence of deformable terrain or in vegetated environments. A key to a resilient UGV perception system lies in the intelligent combination of multiple sensor modalities, e.g. operating at different frequencies of the electromagnetic spectrum, to compensate for the limitations of a single sensor type. For example, we show that by augmenting LIDAR-based traversability maps with ultra-wideband (UWB) RADAR data we can enhance obstacle detection in vegetated environments, where vegetation is often mistakenly interpreted as an obstacle by state-of-the-art obstacle detection techniques.

However, since distinct sensing modalities may react differently to certain materials or environmental conditions, they may detect different targets even though they are spatially aligned. This can lead to catastrophic fusion, where the outcome of standard Bayesian data fusion may actually be of lower quality than the individual representations obtained using a single source of information. Therefore, we propose a new method to reliably fuse data acquired by distinct sensing modalities, e.g. a LIDAR and a RADAR, including in situations where they detect different targets, thereby providing ”conflicting data”. The method automatically identifies conflicting data and produces accurate continuous representations of objects in the environment, with uncertainty, using a machine learning technique called Gaussian Process Implicit Surfaces.

If that is of interest, we may also discuss recent developments in our research on experimental learning for traversability estimation and stochastic motion planning for a UGV. This research comprises of two main components: 1) a near-to-far learning approach for estimating terrain traversability in the presence of occlusions and deformable terrain, 2) a method to learn stochastic mobility prediction models for planning with control uncertainty on unstructured terrain.

Short bio : Dr. Thierry Peynot is a Lecturer in Robotics and Autonomous Systems at Queensland University of Technology (QUT), Brisbane, Australia, where he was appointed in February 2014. He is also a research affiliate of the Australian Centre for Robotic Vision (ACRV). Between Dec. 2007 and Feb. 2014 he was a Research Fellow at the Australian Centre for Field Robotics (ACFR), The University of Sydney. Thierry received his PhD from the University of Toulouse (INPT), France, in 2006, with a thesis prepared at LAAS-CNRS. From 2005 to 2007 he was also an Associate Lecturer at the University of Toulouse. In 2005 he visited the NASA Ames Research Centre in California. Thierry regularly serves as an Associate Editor for the IROS and ICRA conferences, and was Guest Editor of the Journal of Field Robotics for a special issue on Alternative Sensing Techniques for Robot Perception. His current research interests focus on mobile robotics and include: resilient perception, multimodal sensing, sensor data fusion, terrain traversability estimation for unmanned ground vehicles, planetary rovers, and more recently medical robotics.

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