Editorial
ECMR'13 Special Issue

This special issue contains extended versions of the best papers from the 6th European Conference on Mobile Robots (ECMR). ECMR is a biennial European forum, internationally open, that allows roboticists throughout Europe to become acquainted with the latest research accomplishments and innovations in mobile robotics and mobile human-robot systems. ECMR covers most aspects of mobile robotics research and machine intelligence, including (but not limited to) the following topics: multi-sensor fusion, localization, map building, navigation, active perception, behaviour-based robotics, path and task planning, learning and adaptation, robot vision, human-robot interaction, cognitive robotics, experimental evaluation and benchmarking, 3D sensing, and applications for mobile robotics in land, water, air, underground, and space.

ECMR was established in 2003, merging two conferences, EUROBOT and SIRS. Previous meetings took place in Radciejowice, Poland (ECMR'03); Ancona, Italy (ECMR'05); Freiburg, Germany (ECMR'07); Mlini, Croatia (ECMR'09); and Orebro, Sweden (ECMR'11). The 6th edition of ECMR was held on September 25-27 in Barcelona, Spain. ECMR'13 received 131 paper submissions. Each paper was reviewed independently by three reviewers. Based on the reviewers recommendations, the Program Committee accepted 28 papers for oral presentation and 34 for poster presentation. The oral presentations were organized in eight lecture sessions with the following topics: micro-aerial vehicles, tracking, graph sparsification, 3D segmentation and interpretation, object and place recognition, exploration, localization and mapping, and applications. The sessions topics are an indicator of the exciting diverse themes that are current trends in mobile robotics research. Apart from the oral and poster sessions, we had invited lectures by Prof. Jamie Paik from the École Polytechnique Fédérale de Laussane with the title *Addressing soft robotics challenges with Robogamis*, and by Prof. Paul Newman from the University of Oxford with the title *Do we need SLAM? Probably not.*

Based on the paper evaluations and on the paper presentations, a number of authors were invited to submit extended and revised versions of their papers for this special issue. These submissions underwent the standard journal review process which included a new review cycle with three reviews per paper plus final recommendations from the editorial board. As a result of this process, seven articles were selected for this special issue.

Dense RGB-D SLAM techniques and high-fidelity LIDAR scanners are com-

mon trend now in todays mobile robot systems, capable of providing multi-million point datasets. These datasets quickly become difficult to process due to the sheer volume of data, typically containing significant redundant information, such as the representation of planar surfaces with millions of points. The first paper in this special issue, entitled *Incremental and batch planar simplification of dense point cloud maps* by Thomas J. Whelan, Lingni Ma, Egor Bondarev, Peter H. N. de With, and John McDonald, presents a method for real-time incremental planar segmentation of a gradually expanding point cloud map and a method for efficient triangulation and texturing of the planar surface segments. The method is capable of reducing the input data set to a tenth of its size, whilst maintaining a geometrically accurate representation with adequate visual appearance.

Lifelong mapping and localization is another required core technology of todays mobile robot systems. The paper *Superpixel-based appearance change prediction for long-term navigation across seasons* by Peer Neubert, Niko Sünderhauf, and Peter Protzel, addresses the problem of place recognition across seasons. The key insight presented by the authors is that the occurring scene changes are in part systematic, repeatable and therefore predictable. The authors present a recognition system based on a vocabulary of superpixels that is resilient to seasonal changes in outdoor imagery.

The paper *Generic NDT mapping in dynamic environments and its application for lifelong SLAM* by Erik Einhorn and Horst M. Gross, also addresses the problem of lifelong mapping and localization but from a different perspective. In contrast to the abovementioned paper in which seasonal changes are mostly in appearance, the authors are concerned here with structural changes and present a new mapping approach that combines normal distribution transform (NDT) and occupancy mapping. The approach is fully generic and suitable for 2D and 3D mapping with different sensors. In their paper, the authors also describe a method for detecting and handling dynamic objects to allow mapping in highly dynamic environments.

Mobile robots often need to detect their position without resorting to prior knowledge. The problem, known as robot kidnapping, is addressed in the next article in this special issue, entitled *Metric-Based Detection of Robot Kidnapping with and SVM Classifier* by Dylan J. Campbell and Mark A. Whitty. In the paper, the authors propose a joint classifier for kidnap detection utilising a pair of metrics. A one-versus-all multi-class support vector machine kidnap detection classifier is proposed, which improves classification accuracy at the cost of requiring a larger training dataset. This 3D point cloud-based approach is extensible to 2D, other modalities and other methods of registration, such as visual odometry.

In their paper *Consistent unscented incremental smoothing for multi-robot cooperative target tracking*, Guoquan Huang, Michael Kaess, and John J. Leonard address the problem of multi-robot cooperative localization and target tracking. The authors analyze the observability properties of the maximum a posteriori estimator of a cooperative localization and tracking system and provide an efficient, consistent, unscented incremental smoothing algorithm that achieves both

reduced linearization errors by unscented transform and correct observability.

The paper *Potential information fields for mobile robot exploration* by Joan Vallvé and Juan Andrade-Cetto addresses the problem of mobile robot exploration. The method evaluates the reduction of joint path and map entropy and uses it to compute a potential information field in robot configuration space. The exploration trajectory is generated descending on the gradient of these field. The technique uses Pose SLAM as its estimation backbone. Very efficient kernel convolution mechanisms are used to evaluate entropy reduction for each sensor ray, and for each possible robot orientation, taking frontiers and obstacles into account. This exploration strategy is shown to be computationally efficient and compares favorably with other state of the art exploration methods.

The last paper in this special issue addresses another current trend in mobile robotics research, that of pose estimation of UAVs, and in particular, of small and resource-constrained UAVs. Chiara Troiani, Agostino Martinelli, Christian Laugier, and Davide Scaramuzza show in their paper *Low computational complexity algorithms for MAVs vision-aided inertial navigation* a set of methods to estimate the motion of a resource-constrained UAV using very small sets of image point correspondences. The authors make use of IMU data to reject outlier point matches inconsistent with the motion of the vehicle, for motion along the horizontal plane using a single point feature and the IMU angular rates, and for generic 6 DOF motion using two point features. The full vehicle pose can be computed using three-point tracks and the IMU roll and pitch angles.

The next ECMR will be held in Lincoln UK in 2015 and will be chaired by Prof. Tom Duckett.

We hope to see you in Lincoln!

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