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GUEST EDITORIAL

Advanced Robotics

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The 16th International Conference on Advanced Robotics - ICAR 2013, was held on November 2013 in Montevideo, Uruguay. The conference received a total of 234 submissions; from them 156 were accepted and presented. Ten of these submissions were selected to be included in this special issue. The special issue consists of papers in various active areas of robotics research, including control of aerial flapping microrobots, relative localization of combined aerial and ground robots, human training and control of a two-wheeled wheelchair, surface reconstruction for robotic applications, quadrotor self-localization in indoor environments, a model predictive control of grasping, Simultaneous Localization and Mapping, 3D thermal modeling, robot-human bilateral interaction, and communication studies for robotics software frameworks

Joubert, Brink and Herbst present a simple and computationally tractable method for incorporating the pose uncertainty returned by a Simultaneous Localization and Mapping (SLAM) method directly into an occupancy grid map. The proposed system retains the simplicity of the traditional occupancy grid paradigm and alters only the way in which cell occupancy probabilities are updated.

Krug and Dimitrov propose a model predictive control scheme that allows generalization over multiple encoded behaviors depending on the current position in the state space, while leveraging the ability to explicitly account for state constraints to the fulfillment of additional tasks such as obstacle avoidance. The generation of grasping motions for the anthropomorphic *Shadow Robot* hand/arm platform is presented as preliminary verification of the proposed method.

Araguás, Paz, Gaydou and Perez-Paina address the self-location of a quadrotor in indoor environments, where the GPS signal is not available. They propose a new approach for visual estimation of the yaw angle based on spectral features, and a fusion algorithm using unit quaternions. The approach is based on an Inertial Measurement Unit and a downward-looking camera, rigidly attached to the quadrotor. The fusion is performed by means of an Extended Kalman Filter with a double measurement update stage. They also propose a new method to integrate the yaw angle in the measurement update of the filter, using an augmented measurement vector in order to avoid discontinuities in the filter innovation vector.

Demisse, Borrmann and Nuechter apply 3D thermal modeling for analyzing the energy efficiency of

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indoor environments. They present a sequence of algorithms for building the fundamental semantics of a 3D thermal model. These algorithms enable to differentiate between objects in a room and objects that are part of the room. The thermal information is used to construct a stochastic mathematical model of the temperature distribution of the detected image windows. The Maximum a Posteriori framework is used to further label the windows as either open, closed or damaged based upon their temperature distribution.

Leica, Toibero, Roberti and Carelli propose a switched control strategy to interpret and design a human-robot bilateral interaction when a human follows a non-holonomic mobile robot at a desired distance while the robot is already following a known path. The human-robot interaction considered in this work is said to be bilateral because the robot not only follows the desired path but also it has to interpret human intentions in order to modify its behavior during the task.

Perez-Arancibia, Duhamel, Ma, and Wood present a model-free experimental method to find a control strategy for achieving stable flight of a dual-actuator biologically inspired flapping-wing flying microrobot during hovering. The proposed design process of a stabilizing multiple-input–multiple-output controller involves sequential tuning of parameters to accomplish more complex tasks that include upright stable flight, straight vertical flight, and stable hovering with altitude and position control.

Wanasinghe, Mann, and Gosine propose a relative localization method for coordinated control of multi-robotic systems equipped with both aerial and ground vehicles. The authors propose a pseudo-linear measurement-based technique for relative localization where true nonlinear measurements are algebraically transformed into pseudo-linear measurements in order to overcome the issues of filter initialization and state bias at hard linearization in the general EKF approach.

Dinale, Hirata, Zoppi and Murakami describe a two-wheeled wheelchair system that is trained by the user by leaning forward and backward in order to increase the maneuverability of the wheelchair. The user is able to lean her/his body forward and backward to drive the wheelchair. Since the system is naturally unstable, a motion controller is used to keep the wheelchair balanced. In order to estimate the torque acting on the pitch direction, the system uses a synthesized pitch angle disturbance observer (SPADO). The system combines the SPADO with a Lyapunov controller to stabilize wheelchair control system.

Wiemann, Annuth, Lingemann, and Hertzberg present an evaluation of several surface reconstruction software packages with emphasis on usability in robotic applications, evaluating run time, accuracy and topological correctness of the generated polygon meshes.

Hammer and Bauml present a description of the communication layer for the real-time communication layer of the robotic software framework aRDx (agile robot development - next generation), including zero-copy semantics, real-time determinism and detailed control of the QoS (quality of service), while comparing its performance to other robotic frameworks, namely ROS, YARP, Orocos and aRD.