Mobile Netw Appl (2009) 14:265–266
DOI 10.1007/s11036-009-0154-9

RoboComm Editorial

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Published online: 23 January 2009

Robotics research is inherently interdisciplinary in that a number of areas are needed to successfully deploy physically embodied, autonomous platforms, including mechanics, control theory, artificial intelligence, systems engineering, and electronics. This list constitutes what can be loosely defined as the traditional core areas in robotics research. However, due to both the tremendous growth of communication technologies, and to the increased availability of relatively cheap mobile robots, these core technologies are being complemented by a new area, namely the role of communications in multi-robot systems, which is the topic of this Special Issue in *Mobile Networks and Applications.* In fact, the area of multi-agent robotics is to a large degree performance driven since multi-robot systems offer a number of advantages and additional capabilities over their single-robot counterparts, including redundancy, increased spatial coverage and throughput, flexible reconfigurability, spatially diverse functionality, and the fusing of physically distributed sensors and actuators.

During the last two decades, we have witnessed a truly remarkable flurry of activities in the area of wireless communication technologies, with increasing attention given to sensor networks and ad-hoc networks, enlarging the possible configurations of a network. Meanwhile, building more than just one or two robots at a time has become cheaper and more common, thus opening a whole new set of applications for multi-robot systems with networking capabilities, ranging from remote and in situ, coordinated sensing to the physical manipulation of objects. The domains for such applications include land, sea, air, and space.

To capture this convergence of robotics and communications, we in October of 2007, organized *ROBOCOMM*—the First International Conference on Robot Communication and Coordination. This conference acted as a common forum for the robotics and communications research communities, explicitly aiming at the promotion of cross-pollination of these two areas, hopefully leading to growth in the capabilities of both. This Special Issue is based on seven selected papers from ROBOCOMM, chosen to present and span the state-of-the-art in mobile multi-robot systems with an emphasis on communications issues. The papers range in scope from the coordination of motion and the assignment of tasks, to the communication considerations that are critical to a successful deployment of a networks multi-robot system, and the papers are:

Information-theoretic Integration of Sensing and Communication for Active Robot Networks, by E. Frew. In this paper, an information-theoretic approach is developed that helps determine where sensors should be placed that allows for an explicit incorporation of the communication capacity into the formulation. A resulting optimization criterion is then derived that corresponds to a metric over the network in terms of both sensing geometry and communication considerations.

Maintaining Optimal Communication Chains in Robotic Sensor Networks using Mobility Control, by C. Dixon and E. Frew. This paper presents a control strategy for mobile sensor nodes that optimally generates cascaded communication chains. These chains are comprised of mobile robots, acting in an unknown and dynamic environment. In essence, the SNR field is used as the input to the control system, and the output is a controller that maximizes the capacity of the communications chain.

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Safe and Distributed Kinodynamic Replanning for Vehicular Networks, by K.E. Bekris, K.I. Tsianos, and L.E. Kavraki. In this paper, the problem of producing collision-free paths for teams of networked robots is considered. In particular, the paper focuses on how to use communications to prevent individual vehicles from reaching configurations from which collisions can no longer be avoided, and, as a consequence, safe trajectories can be planned for the entire team.

Minimal Energy Path Planning for Wireless Robots, by C.C. Ooi and C. Schindelhauer. Here a novel problem involving the optimization of the energy expended through both mobility and communications is considered as a joint problem. In particular, the paper studies the problem of having a mobile robot find the best path (in terms of both movements and communications) with respect to a base station, and algorithms for finding such paths are given.

Automatic Generation of Persistent Formations for Multi-Agent Networks Under Range Constraints, by B. Smith, M. Egerstedt, and A. Howard. In this paper, graph-based methods are presented that enables the generation of certain types of so-called minimally persistent formations. This is done while each robot has an upper bound on the effective sensing and communication range, resulting in new algorithms for assembling such parsimonious network configurations.

Distributed Estimation for Coordinated Target Tracking in a Cluttered Environment, by B.I. Triplett, D.J. Klein, and K.A. Morgansen. This paper investigates just what data different vehicles should be sharing with each, and how frequent this data should be communicated in a multi-robot network. Which information to transmit will end up depending explicitly on the available bandwidth, and the operation of the algorithm is illustrated in a target tracking scenario in a cluttered environment.

A Stochastic and Dynamic Vehcile Routing Problem with Time Windows and Customer Impatience, by M. Pavone, N. Bisnik, E. Frazzoli, and V. Isler. This work considers the problem of finding motion strategies for networked robots required to meet some spatial requests. This problem is shown to correspond to a dynamic version the Vehicle Routing Problem, and the paper presents algorithms that can deal both with customer impatience, and time windows over which the requests must be addressed.

As a final remark, it should be noted that this Special Issue (or any special issue for that matter) only represents a particular snapshot of the emerging field networked multi-robot systems. However, with a lineup of seven strong papers, we feel that the resulting snapshot is a rather successful one, and we hope this sentiment is shared by the readers also.