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Editorial

A special issue of Ad Hoc Networks on "Theory, algorithms and applications of wireless networked robotics"

Communications, control, mobility, and cooperation are the main keywords of future Wireless Networked Robotics. This new research field brings together the physical control of mobile sensors and actuators of robotic systems along with their communication and motion capabilities. The aim is to foster cooperation and information sharing among the devices and the robots, and to permit that mission objectives and task division are performed in closed loop operations with communications and networking. Issues, concepts and challenges of Wireless Networked Robotics reside at the intersection between the ad hoc networking and the robotics research fields. A large body of research, addressing a variety of different issues, have been produced by both communities, mainly aiming to achieve self-organized cooperation and coordination of multiple heterogeneous devices toward the realization of target-oriented missions. However, the convergence of objectives and methodologies between the two communities still needs further and significant research efforts. As a matter of fact, important core challenges remain open.

Addressing these aspects, this special issue presents the research contributions on theory, algorithms and applications of Wireless Networked Robotics. It also aims at giving a contribution towards the realization of the convergence between the domains of ad hoc networking and robotics.

The special issue consists of eight papers. Each submission underwent three rounds of review with at least two reviewers per round. The selected papers cover different fields of application in relation to the synergies between robotics and networking. The special issue has been therefore organized along the following application areas: network maintenance, area coverage, exploration and navigation, localization and deployment, precision agriculture.

The first two papers of the issue focus on utilizing robotic systems for network maintenance, as communication relays and data mules. In the article entitled "Ad Hoc Self-Healing of OFDMA Networks using UAV-Based Relays", Rohde et al. utilize aerial relays to compensate cell outage and cell overloads LTE-Advanced networks. Using an exact analytical model for Signal to Interference and Noise Ratio to compute expected gain, the authors propose an algorithm for Interference-aware Positioning of Aerial Relays that minimizes inter-cell interference between aerial nodes and surrounding macro cell base stations and maximizes user throughput.

In the article entitled "Coverage Strategy for Periodic Readings in Robotic-Assisted Monitoring Systems", Viana et al. consider the sensor coverage problem, where mobile robots are used to collect readings at a minimum frequency from sensors distributed in a large area and deliver the readings to a base station within a bounded delay, taking into account constraints such as number of robots, continuous trajectories for the robots, and data aggregation needs.

In "Spatially Constrained Coordinated Navigation for a Multi-Robot System", Bruggemann et al. tackle the issue of coordinated multi-robot navigation. The authors address the scenario in which the robots need to navigate towards assigned target locations while obeying spatial constraints, such as communication ones. The proposed solution is based on the combined use of a movement graph and on a constraint graph to plan robots' trajectories. A solution based on purely local information is also presented. The coordination algorithms are studied in extensive simulation experiments and are validated in an outdoor real world experiment with 6 ground robots.

Cooperative exploration in multi-robot system is the topic of paper "The effects of exploration strategies and communication models on the performance of cooperative exploration", by Tuna et al. Three different classes of exploration approaches, namely frontier-base, market-driven, and role-based, are considered and extensively studied in simulation in terms of exploration performance vs. use of computational resources. The effect of different communication models to let the robots cooperate, as well as of the number of robots is also thoroughly investigated and analyzed.

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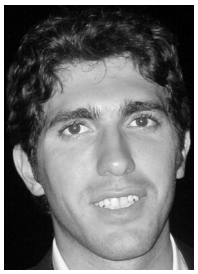
Localization and deployment are the focal points of the two papers titled "An Algorithm for Fast Rendezvous Seeking of Wireless Networked Robotic Systems", and "Randomized Carrier-Based Sensor Relocation in Wireless Sensor and Robot Networks". In the first paper, Manfredi evaluates a cooperative algorithm for rendezvous seeking in a robot network through simulation based experiments, and also provides a rigorous discussion of its design and analysis. The paper especially focuses on the performance of the algorithm under realistic communication conditions. In the second work, Li et al., through a number of simulations, present robot-assisted sensor relocation algorithms to cover a sensing area of interest. The algorithms detect and eliminate sensing holes and also minimize the coverage redundancies.

One of the classical applications for teams of networked robots is search and rescue. This is the application scenario of the paper "An Autonomous Wireless Networked Robotics System for Backbone Deployment in Highly-Obstructed Environments". Specifically, Vieira et al. study the problem of deploying and positioning mobile robots in order to offer connectivity to all clients and provide all network links with a minimum guaranteed rate.

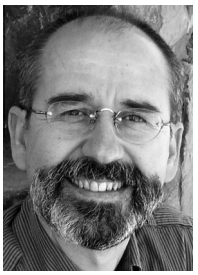
In the study presented in the article "Autonomous Precision Agriculture through Integration of Wireless Underground Sensor Networks with Center Pivot Irrigation Systems", Dong et al. propose the development of an autonomous precision irrigation system with Wireless Underground Sensor Networks for precision agriculture. The authors validate the feasibility of their proposal, based on soil-air communications, by field experiments with a hydraulic drive and continuous move center pivot irrigation system.

Guest Editors
Enrico Natalizio
Gianni Di Caro
Ahmet Sekercioglu
Evsen Yanmaz



Dr. **Enrico Natalizio** is an Assistant Professor at the Université de Technologie de Compiègne, in the Network&Optimization group within the Heudiasyc Lab. He obtained his Ph.D. from the Università della Calabria, Italy and he was a visiting researcher at the BWN (Broadband Wireless Networking) Lab at Georgia Tech in Atlanta, GA, USA. From December 2005 until September 2010, he worked as a research fellow and a contract professor at the Università della Calabria, Italy. From October 2010 to August 2012 he worked with the FUN Team at INRIA Lille – Nord Europe as a postdoctoral researcher. His current research interests include group communication in wireless robot and sensor networks and coordination and cooperation among swarm networked devices.

Dr. **Gianni Di Caro** received a degree in Physics from the University of Bologna (Italy), and a Ph.D. in Applied Sciences from the Universite' Libre de Bruxelles (ULB), in Belgium. Currently he is senior researcher at the Dalle Molle Institute for Artificial Intelligence (IDSIA), in Lugano, Switzerland. He has a co-authored more than 100 peer-reviewed works covering multiple different domains, focusing in particular on networking, optimization, bio-inspired algorithms, and distributed robotics.



Dr. **Ahmet Sekercioglu** is a member of the academic staff at the Department of Electrical and Computer Systems Engineering of Monash University, Melbourne, Australia. He has established the Monash Wireless Sensor and Robot Networks Laboratory, and currently serves as its director. He completed his PhD degree at Swinburne University of Technology, BSc and MSc degrees (all in Electrical and Electronics Engineering) at Middle East Technical University, Ankara, Turkey. He has published over 100 papers in various forums. He leads a number of research projects on distributed algorithms for self-organization in mobile visual sensor and ad hoc networks, and networked robotics.

Dr. **Evsen Yanmaz** received the B.S. degree in electrical and electronics engineering from Bogazici University, Istanbul in 2000; the M.S. degree in electrical engineering from SUNY Buffalo in 2002; and the Ph. D. degree in electrical and computer engineering at Carnegie Mellon University in 2005. From November 2006 to October 2008, she held a Postdoctoral Fellowship in CCS Division at the Los Alamos National Laboratory of Department of Energy, where she worked on the design and development of self-organizing wireless networks with a focus on the impact of mobility and topology changes on the network performance. Since October 2008, she is with the Mobile Systems Group in the Networked and Embedded Systems Institute of University of Klagenfurt as a senior researcher. Her current research interests include design and analysis of cooperative networks, self-organization, and aerial networks.