SITUATION MANAGEMENT



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Many domains, such as physical infrastructure and cyber security monitoring, battlefield operations management, disaster response and crisis management, and homeland security, are characterized by dense real-time sensing, large numbers of distributed heterogeneous information sources, and a variety of distributed, communicating, and network-enabled actors and agents. In these domains there is the need to automatically and continuously identify and act on complex, often incomplete and unpredictable dynamic situations. As a result, effective methods of situation recognition, prediction, reasoning, and control are required — operations collectively identifiable as situation management.

Situation management intersects with trends in high-level information fusion, intelligent sensing, sensing grids, complex event processing architectures, wide-area situation awareness, and context awareness. Often situations involve a large number of interdependent dynamic objects that change their states in time and space, and engage each other in fairly complex relations. From a management viewpoint it is important to understand the situations in which these objects participate, to recognize emerging trends and potential threats, and to undertake required actions. Understanding of dynamic situations requires complex cognitive modeling of situations and continuous sensing, collection, and fusion of signal and human intelligence events and reports.

The situation management research community was launched [1] at the first Workshop on Situation Management (SIMA) in 2005, the first of a series of five SIMA workshops held in association with the IEEE Communications Society Military Communications Conference (MILCOM). This growing research community has led to the new IEEE Communications Society Conference on Cognitive Situation Management (IEEE CogSIMA 2011) [2] and this feature topic. This feature topic of *IEEE Communications Magazine*, the first one in the field, presents five outstanding articles that reflect important results in situation management.

The first article, "Representation and Recognition of Situations in Sensor Networks" by Rachel Cardell-Oliver and Wei Liu, discusses the fundamental concepts of how to represent and recognize situations. The authors introduce a new language and related algorithms for describing event-based situational patterns in the streams of events in sensor networks and for automatic recognition of those patterns.

The second article, "A Context Management Architecture for Large-scale Smart Environments" by Yoosoo Oh, Jonghyun Han, and Woontack Woo, discusses a novel architecture for context awareness in smart physical environments. Their work combines elements related to distributed smart sensing, information fusion, and modeling of complex physical, social, environmental, and virtual entities. The challenge here is to understand the user experience, and model the activities of both human and machine agents.

The third article, "DistressNet: A Wireless Ad Hoc and Sensor Network Architecture for Situation Management in Disaster Response" by S. M. George, W. Zhou, H. Chenji, M. Won, Y.-Oh Lee, A. Pazarloglou, R. Stoleru, and P. Barooah, presents a number of technical problems at the sensing level that are not prevalent in conventional surveillance and monitoring applications, but are important issues for situation management at the sensing fabric. Their work in self-localization, distributed audio sensing, and multichannel negotiation represents important and interrelated steps toward deploying ad hoc and wireless sensor networks in disaster recovery.

The fourth article, "A System of Systems Approach to Disaster Management" by Sandeep Chandana and Henry Leung, investigates motivations, technologies, and models of building situation management systems applied to such large-scale applications as disaster situation management. In order to scale the approach, the authors compose complex situations from component situations, where different architectural solutions are generated and evaluated using genetic algorithm models.

The fifth article, "Enhancing Situation Awareness via Automated Situation Assessment" by Jared Holsopple, Michael Nusinov, Daniel Liu Daniel, Haitao Du, Shanchieh Jay Yang, and Moises Sudit, is on situation assessment, particularly related to the analysis of impacts on physical or cyber systems caused by attacks on physical, human, or cyber assets. The article discusses sensor data

fusion, event classification, activity recognition, impact estimation, and threat projection in the cyber security domain.

The five articles in this issue were selected after a rigorous review of 46 submitted papers. The guest editors would like to express their sincere thanks to the researchers who submitted their work to this feature topic issue, and to the reviewers for their important suggestions and comments that contributed to the outstanding quality of the articles. They would also like to express their appreciation to the Editor-in-Chief and production staff of *IEEE Communications Magazine* for their strong support.

REFERENCES

[1] G. Jakobson *et al.*, "Overview of Situation Management at SIMA 2005," *SIMA Wksp. IEEE MILCOM 2005*.
[2] IEEE Conf. Cognitive Methods in Situation Management (CogSIMA) 2011, http://www.comsoc.org/tco/cogsima2011

BIOGRAPHIES

GABRIEL JAKOBSON [SM] (jakobson@altusystems.com) is chief scientist at Altusys Corp., which is developing situation management technologies for cyber security, defense, and disaster recovery applications. During his more than 20 years tenure at Verizon (formerly GTE), he had increasing responsibilities for leading advanced database, expert systems, artificial intelligence, and telecommunication network management programs. Prior to that he was a senior researcher at the Institute of Cybernetics, Tallinn, Estonia, conducting research on knowledge-based systems. He has authored over 100 technical publications, has been awarded four U.S. patents on innovative real-time event correlation methods, and has four U.S. patents pending on situation management. He received his Ph.D. degree in Computer Science from the Institute of Cybernetics, Estonia. He holds the honorary degree of Doctor Honorius Causa from Tallinn Technical University, Estonia, and is an IEEE ComSoc Distinguished Lecturer. He is chair of the Workshop on Situation Management held in conjunction with MILCOM 2005–2009, chair of the Special Sessions on Situation Management at the International Conference of Information Fusion 2006–2008, TPC co-chair of the Symposium on Selected Areas of Communication at ICC 2009, and General Chair of the International Conference of Enterprise Networking and Services (EntNet) 2002–2007. He is Vice-Chair of the Tactical Communications and Operations Technical Committee of IEEE ComSoc, chair of the IEEE ComSoc Sub-Committee on Situation Management, an IEEE ComSoc Board member, and Director of the North America Region of ComSoc.

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