**Research Seminar by IEEE Communications Society Distinguished Lecturer**

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**Topology Coordinate Systems: A Novel Domain for Self-Organizing   
 Large-Scale 2D and 3D Sensor Networks**

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The emerging Internet of Things will rely on massive sensor/actuator networks deployed in complex 2D and 3D spaces to form the interface between physical and digital worlds. After an introduction to sensor networks, we will focus on coordinate systems used in such networks. Physical coordinate system requires analog measurements such as RSSI and time-delay that are unreliable, error prone, expensive, and in some cases infeasible. Techniques based on geographical coordinates do not scale well to 3D either. We present a novel localization-free coordinate system, the Topology Coordinates (TC). TCs are derived from a Virtual Coordinate System (VCS) that characterizes each node by its hop distances to a small subset of nodes. We demonstrate two techniques for obtaining Topology-Preserving Maps (TPMs) of 2-D and 3-D networks, in which even the geographic voids and shapes are preserved. The availability of geographic features together with connectivity allows the TC based schemes to outperform their counterparts in logical and physical coordinate domains. A Directional Virtual Coordinate (DVC) transformation facilitates the concepts of virtual directions and angles in complex networks. Ability to specify virtual cardinal directions and angles is a radical change from the traditional VC approaches. A self-learning algorithm is presented for individual nodes to achieve network awareness. This, we argue, is a key step toward evolving sensor networks that gradually get better and smarter at what they do.

**Anura Jayasumana** is a Professor of Electrical and Computer Engineering at Colorado State University, where he also holds a joint appointment in Computer Science. He is the Associate Director of Information Sciences & Technology Center at Colorado State. He is a Distinguished Lecturer of the IEEE Communications Society. His research interests span high-speed networking to wireless sensor networking, and anomaly detection to DDoS defense. He has served extensively as a consultant to industry ranging from startups to Fortune 100 companies. He received the B.Sc.Eng. degree from the University of Moratuwa, Sri Lanka and M.S. and Ph.D. degrees in Electrical Engineering from the Michigan State University. Prof. Jayasumana has supervised 20 PhD and more than 50 MS students, holds two patents, and is the co-author of over 250 papers.