IEEE Communications Society Distinguished Lectures   2014
Asia Pacific Region

Professor Anura Jayasumana
Department of Electrical & Computer Engineering
   and Department of Computer Science
Colorado State University
Fort Collins, CO 80523, USA
http://www.engr.colostate.edu/~anura

Prof. Jayasumana provided a **series of five IEEE Communications Society Distinguished Lectures in Australia and New Zealand** during the month of November 2014.   He was in Australia during Fall 2014 for his sabbatical, and therefore these lectures were arranged without incurring any international, and in some cases local, travel expenses to IEEE ComSoc.

Lecture 1:
Title: "Network Aware Nodes: A Novel Self-Organization Approach for Internet of Things,"
Sponsor: IEEE Queensland Section
Venue: Queensland University of Technology, Gardens Point Campus, Brisbane, Australia
Date: 1:00-2:00PM, Nov. 3, 2014
Contact: Prof. Dhammika Jayalath dhammika.jayalath@qut.edu.au

The lecture was attended by ~25 attendees from industry and academia. A notable feature was that there were attendees from companies working on civil infrastructure. He met with a number of faculty members and engineers from industry during this visit.

Abstract: The cost and size trends of motes, RFIDs and nano-devices point to future massive-scale networks deployed in complex 2D and 3D spaces. They will form the interface between physical and digital worlds for emerging Internet of Things. Large-scale deployments require that nodes be simple, able to harness energy and utilize any excess energy for productive use. We demonstrate how nodes, and thus the network, can evolve over time in such an environment. A novel self-learning algorithm provides individual nodes a network awareness, i.e., its own view of the network and its place in the network. The approach is based on a novel localization-free coordinate system, the Topology Coordinates (TC). Most existing techniques for self-organization, routing and tracking in sensor networks rely on distances and localization in the physical domain. Obtaining geographic coordinates is difficult, error prone, expensive, and even infeasible in some environments. Techniques based on geographical coordinates do not scale well to 3D either. TCs are derived from the hop distances to a small set of anchors. We demonstrate techniques for obtaining Topology-Preserving Maps (TPMs) of networks, in which even the geographic voids and shapes are preserved. TCs combine the advantages of geographical and virtual coordinate domains. TC based Geo-Logical Routing (GLR), for example, significantly outperforms existing logical and physical coordinate based routing schemes in both 2D and 3D networks. A Directional Virtual Coordinate (DVC) transformation is proposed to restore the directionality lost in VCS and to introduce the concept of angles between virtual directions. Ability to specify virtual

cardinal directions and angles is a radical change from traditional approaches. Achieving network awareness at individual nodes is a step toward large-scale evolving sensor networks.

Lecture 2:

Title: "Network Aware Nodes: A Localization-Free Self-Organization Approach for Internet of Things,"
Sponsor: IEEE ACT Section
Venue: RSISE Seminar Room, Bldg. 115, Australian National University, Canberra, Australia,
Date: 11:00-12:00AM Nov. 6, 2014.
URL: (http://cecs.anu.edu.au/seminars/more/SID/3591)
Contact: wen.zhang@anu.edu.au

The lecture was attended by ~35 researchers including graduate students, and some from industry. He met with a number of researchers working in related areas, and had interesting and fruitful discussions. Prof. Wen Zhang from Australian National University organized the lecture.

Abstract: The cost and size trends of motes, RFIDs and nano-devices point to future massive-scale networks deployed in 2D and complex 3D spaces to form an Internet of Things. Most techniques for self-organization, routing and tracking in such networks rely on distances and localization in the physical domain. However, obtaining geographic coordinates depend on analog measurements such as signal strength and time-delay that are unreliable, error prone and expensive. Techniques based on geographical coordinates do not scale well to 3D either. We present a novel localization-free coordinate system, the Topology Coordinates (TC), for these networks. TCs are derived from the hop distances from a node to a small subset of anchor nodes. We demonstrate techniques for obtaining Topology-Preserving Maps (TPMs) of 2-D and 3-D networks, in which even the geographic voids and shapes are preserved. This novel topological domain combines the advantages of geographical and virtual coordinate domains. TC based Geo-Logical Routing (GLR), for example, significantly outperforms existing logical and physical coordinate based routing schemes in both 2D and 3D networks. A Directional Virtual Coordinate (DVC) transformation is proposed to restore the directionality lost in VCS and to introduce the concept of angles between virtual directions. Ability to specify virtual cardinal directions and angles is a radical change from the traditional approaches. A novel self-learning algorithm is presented to provide network awareness to individual nodes, a step toward large-scale evolving sensor networks.

Lecture 3: Distinguished Lecture of the IEEE Communications Society, "Network Aware Nodes: A Localization-Free Self-Organization Approach for Internet of Things,"

6:00-7:00PM Telstra Conference Centre, 242 Exhibition St, Melbourne, Australia, Nov. 11, 2014.

Paul Fitzpatrick paul.fitzpatrick@ieee.org

This lecture was attended by about 25 attendees. The lecture was held in the evening in city center of Melbourne, and thus most of the attendees were from industry. In addition, he visited Monash University and provided a second lecture and also met with many researchers and graduate students.

The cost and size trends of motes, RFIDs and nano-devices point to future massive-scale networks deployed in 2D and complex 3D spaces to form an Internet of Things. Most techniques for self-organization, routing and tracking in such networks rely on distances and localization in the physical domain. However, obtaining geographic coordinates depend on analog measurements such as signal strength and time-delay that are unreliable, error prone and expensive. Techniques based on geographical coordinates do not scale well to 3D either. We present a novel localization-free coordinate system, the Topology Coordinates (TC), for these networks. TCs are derived from the hop distances from a node to a small subset of anchor nodes. We demonstrate techniques for obtaining Topology-Preserving Maps (TPMs) of 2-D and 3-D networks, in which even the geographic voids and shapes are preserved. This novel topological domain   combines the advantages of geographical and virtual coordinate domains. TC based Geo-Logical Routing (GLR), for example,   significantly outperforms existing logical and physical coordinate based routing schemes in both 2D and 3D networks. A Directional Virtual Coordinate (DVC) transformation is proposed to restore the directionality lost in VCS and to introduce the concept of angles between virtual directions. Ability to specify virtual cardinal directions and angles is a radical change from the traditional approaches.   A novel self-learning algorithm is presented to provide network awareness to individual nodes, a step toward large-scale evolving sensor networks.

Lecture 4:   Distinguished Lecture of the IEEE Communications Society, "Topology Coordinate System: A Novel Domain for Self-Organizing Large-Scale 2D and 3D Sensor Networks," IEEE Communications Society New South Wales Chapter, and University of New South Wales, Australia, Nov. 14, 2014.

Prof. Jinhong Yuan j.yuan@unsw.edu.au

The lecture was held at the University of New South Wales. He made several additional visits to UNSW before and after this lecture to meet researchers at this institution, and also provided a second lecture on a more advanced topic.

The cost and size trends of motes, RFIDs and nano-devices point to future massive-scale sensor networks deployed in 2D and complex 3D spaces. Most techniques for self-organization, routing and tracking in sensor networks rely on distances and localization in the physical domain. However, geographic coordinates require analog measurements such as RSSI and time-delay that are unreliable, error prone and expensive. Most techniques based on geographical coordinates also do not scale well to 3D. We present strategies for self-organization and routing using 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 techniques for obtaining Topology-Preserving Maps (TPMs) of 2-D and 3-D networks, in which even the geographic voids and shapes are preserved. This new topological domain   combines the advantages of geographical and virtual coordinate domains. TC based Geo-Logical Routing (GLR), for example,   significantly outperforms existing logical and physical coordinate based routing schemes in both 2D and 3D networks. A Directional Virtual Coordinate (DVC) transformation is proposed to restore the directionality lost in VCS and to introduce the concept of angles between virtual directions. Ability to specify virtual cardinal directions and angles is a radical change from the traditional VCS approaches. Mobility tracking in TC domain will be addressed. A novel self-learning algorithm is presented to provide network awareness to individual nodes, a step toward large-scale evolving sensor networks.

Lecture 5:   Distinguished Lecture of the IEEE Communications Society, "Topology Coordinate Systems: A Novel Domain for Self-Organizing Large-Scale 2D and 3D Sensor Networks," IEEE Communications Society New Zealand, Auckland University of Technology, Auckland, New Zealand, Nov. 20, 2014.

Prof. Nurul Sarkar nurul.sarkar@aut.ac.nz

The cost and size trends of motes, RFIDs and nano-devices point to future massive-scale sensor networks deployed in 2D and complex 3D spaces. Most techniques for self-organization, routing and tracking in sensor networks rely on distances and localization in the physical domain. However, geographic coordinates require analog measurements such as RSSI and time-delay that are unreliable, error prone and expensive. Most techniques based on geographical coordinates also do not scale well to 3D. We present strategies for self-organization and routing using 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 techniques for obtaining Topology-Preserving Maps (TPMs) of 2-D and 3-D networks, in which even the geographic voids and shapes are preserved. This new topological domain   combines the advantages of geographical and virtual coordinate domains. TC based Geo-Logical Routing (GLR), for example,   significantly outperforms existing logical and physical coordinate based routing schemes in both 2D and 3D networks. A Directional Virtual Coordinate (DVC) transformation is proposed to restore the directionality lost in VCS and to introduce the concept of angles between virtual directions. Ability to specify virtual cardinal directions and angles is a radical change from the traditional VCS approaches. Mobility tracking in TC domain will be addressed. A novel self-learning algorithm is presented to provide network awareness to individual nodes, a step toward large-scale evolving sensor networks.