Title : WSN based Monitoring, Cellular Modeling and Simulations for Environment

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Abstract:

Wireless Sensor Networks (WSN) are a key technology for environmental and physical monitoring in a green smart city[1]. Advances in technology make WSNs an attractive and cost effective proposition.

A WSN regularly measures values representing the state of a physical system (water levels for floods monitoring). The collected data combined with external knowledge and data (rainfall data) are then used to monitor, model and simulate the system.

Our research focuses on cellular models to study both a physical phenomenon and the measures taken from a WSN on the same geographical area. The location of sensors has both an effect on the effectiveness of the monitoring (correct positions giving adequate measurements) and the cost (number of sensor nodes necessary for coverage). In a WSN, we have to ensure that sensors can communicate with their neighbors. Parameters like the coverage area, the communication technology (LoRa, ZigBee, ...) and the ground contour are important in that regard.

UBO/LABSTICC has developed NetGen/PickCell [2,3,4,5], for cellular modeling and simulation of geographically distributed phenomena and WSN deployments. The tools use an algorithm to optimize sensor locations (line of sight) taking into account the elevation. Experiments using LoRa nodes have shown good matches between the tools results for sensor positions and experimental results.
Additional simulations have covered the modeling and simulation of the geographical dispersion of insects.

A collaboration with BPPT and Diponegoro University Indonesia has provided results on experiments with sensors monitoring waterways and communicating via zigbee; integration with NetGen/PickCell is next to model, simulate and forecast flooding in urban areas.

Such a technique has a lot of potential for modeling physical phenomena (flooding, pollutions, ...) and planing cost-effective WSN deployments in other contexts; as such we are open to cooperation with universities/research centers and state actors facing similar issues in Asia.

References:
[1] OECD, Smart Sensor Networks: Technologies and Applications for Green Growth, Report, December 2009
[2] Lam, Bao Hoai and Hiep Xuan, Huynh and Bernard Pottier, Synchronous networks for bio-environmental surveillance based on cellular automata, Journal EAI Endorsed Transactions on Context-aware Systems and Applications, vol 16, no 8, March 2016
[3] Hoang Van Tran and Hiep Xuan Huynh and Vinh Cong Phan and Bernard Pottier, A federation of simulations based on cellular automata in cyber-physical systems, Journal EAI Endorsed Transactions on Context-aware Systems and Applications, vol 16, no 7, Feb 2016
[4] Iqbal, Adnan and Pottier, Bernard, Meta-simulation of large WSN on multi-core computers, SpringSim '10 Proceedings of the 2010 Spring Simulation Multiconference, SCS, ACM, Orlando, United States, June 2010
[5] Pottier, Bernard and Dutta, Hritam and Thibault, Failler and Melot, Nicolas and Stinckwich, Serge, An execution flow for dynamic concurrent systems: simulation of WSN on a Smalltalk/CUDA environment, SIMPAR'10, Darmstadt, Germany, Emanuele Menegatti, ISBN 978-3-00-032-863, Nov 2010

Area of Interest (AOI):
Green Smart Cities

Speakers:

Onil Nazra Persada Goubier represents SAMES STIC-Asia Project 'Modeling for Environment and Simulation" and is actively involved in this project . She is a co-founder and the president of a french NGO named Cirela, to help people in disaster prone-areas to be more resilient using communication and information technology. Graduated as a telecommunication engineer from Institute of Technology Bandung (ITB) Indonesia in 1984 and got her PhD from Université de Rennes I France in 1995 for her work on load balancing on parallel and distributed systems using reconfigurable architectures, as well as two Msc (DEA). From 1996 until 2006, she has worked on parallel, distributed and real time systems in academic institutions as researcher and a lecturer in Diponegoro University Indonesia and as a senior lecturer at Curtin University Sarawak Campus Malaysia. From 2007 to 2010 she joined french institutions, ENSIETA Brest and CEA as research engineer to work on modeling of distributed and real time systems. Then she worked for HPC Project/Silkan in the area of parallel and real time systems from 2010 to 2013. She is now focused on Wireless Sensor Networks (WSN) to monitor natural and environmental disasters, combining her technical knowledge to the societal aspect of such networks.

Hiep Xuan Huynh represents SAMES STIC-Asia Project 'Modeling for Environment and Simulation" and is active as researcher in this project. Associate professor in computer science (informatics) at Cantho University (CTU). Vice dean for research affaires of College of Information and Communication Technology (CICT-CTU) and head of the DREAM team (Decision-support Research for Environmental and Application Models). Research activities are data mining, modeling decison, statistical implicative analysis and wireless sensor network.

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*SAMES stands for Stic Asia Models for Environment and Simulation it groups (Bernard Pottier (UBO/Lab-STICC France), Vincent Rodin (UBO/Lab-STICC France), Laurent Esclade (UBO/ESIAB France), Blaise Nsom (UBO/LBMS/IRDL France), Bao Hoai Lam (Cantho University Vietnam / Lab-STICC France), Hafidz Muslim (BPPT Indonesia), Udrekh (BPPT Indonesia), Serge Stinckwich (UMI UMMISCO, IRD/UMPC France), Raonirivo N Rakoroarijaona (UBO/Lab-STICC France)). SAMES objectives are to develop software tools to ease wireless distributed sensing and data integration in relation with critical physical processes.