

IEEE TCSIM Newsletter



Issue 07 Dec 2010

Editorial Board

1. Dr. Mostafa El-Said, Editor-in-Chief
2. Dr. Kaushik Chowdhury, Editor
3. Dr. Chittabrata Ghosh, Editor

Chair's Message

By Dr. Dave Cavalcanti, Chair of TCSIM

Dear TCSIM colleagues,

Welcome to the Q4 2010 TCSIM newsletter. First, I'd like to thank the editorial team, authors and all contributors to this fourth issue of this newsletter in 2010. I'd also like to give you a brief overview of the TCSIM activities in 2010. We have set up a new **LISTSERVICE** mailing list to improve communications. We have also added new conferences (e.g. SIMUTools and ISGT) to the list of TCSIM's technically sponsored events. We continue to support student participation in events through TCSIM awards and travel grants. The following events received student awards in 2010: SECON, CGAMES, and MASS. Most importantly, with the help an enthusiastic editorial team and contributions from many members, we have increased the TCSIM newsletter publication cycle to quarterly issues. The TCSIM executive committee and the editorial team are looking forward to your contributions in the coming year in order to make this publication even more interesting. More details on the TCSIM activities in 2011 will be announce in the next issue.

This issue provides the latest updates on sponsored events and TCSIM activities and it also features an invited article on simulation of wireless underground sensor networks. Hope you enjoy the reading.

Happy 2011!

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TCSIM mailing list

In order to facilitate communication and information sharing with TC members, a new TCSIM mailing list has been created using the IEEE Listserv system.

To send a message to the new TCSIM list, just send mail to TCSIM@LISTSERV.IEEE.ORG

If you are not currently subscribed to the list please send a message to *Prof. Kaushik Chowdhury* at krc@ece.neu.edu who is currently managing all the subscriptions to the new TCSIM list. You can also search for the TCSIM list at <http://listserv.ieee.org/>

We hope you can make use of this new list to share simulation related information with the TCSIM community.

Upcoming TCSIM Sponsored Events

IEEE PES Conference on Innovative Smart Grid Technologies (ISGT 2011), January 17 – 19, 2011, Anaheim, CA
<http://www.isgt2011.com/site/>

4th International ICST Conference on Simulation Tools and Techniques (SIMUTools 2011), Barcelona, Spain - March 21-25 2011
<http://simutools.org/2011/>

TCSIM Elections Results

Our congratulations to Dr. Cavalcanti on being re-elected TCSIM Chair. The position is for three years ending 2013.

TCSIM Community Outreach

TCSIM is actively trying to outreach and diversify its efforts featuring presence, support and impactful awareness in the simulation community. Recently, TCSIM representatives Dr. Kaushik Chowdhury attended the MILCOM 2010 San Jose, Ca in Oct 31, 2010 and Dr. Mostafa El-Said attended the ISSPIT 2010 in Dec 13 in Luxor, Egypt to discuss possible collaboration with these well known conferences.

TCSIM Student Awards

"TCSIM supports students presenting ideas on exciting research frontiers through performance appreciation and travel awards."

Congratulations to the winners of TCSIM sponsored Student Best Paper awards in **CGAMES 2010**:
Jacob Schreiver (Louisville, KY)
Li Zhiqiang Nickole (Singapore)
Bhupesh Chandra (Stamford, CA)

Congratulation of the winners of **TCSIM travel grants in MASS 2010!**

For more information on the TCSIM Student Awards, please visit the TCSIM webpage (<http://tab.computer.org/tcsim>) or contact the TCSIM Chair.

A Comprehensive Simulator for Wireless Underground Sensor Networks

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Introduction

Wireless Underground Sensor Networks (WUSNs) are natural extensions of the terrestrial wireless sensor networks, where the wireless sensor nodes are buried underground and communicate wirelessly through the soil medium. The WUSNs are envisioned to provide a wide variety of novel applications, such as intelligent irrigation, smart underground power grid, border patrol and intruder detection, assisted navigation, sports field maintenance and leakage detection of underground pipelines and tanks [1].

Despite the potential advantages, the hostile underground wireless channel conditions bring great research challenges in realizing the WUSNs. Due to the material absorption in soil medium, the electromagnetic (EM) waves experience very high path loss, which results in very limited communication ranges (less than 5 meters) between underground sensors [2]. Moreover, the path loss in underground channel is also determined by the operating frequency, sensor burial depth, and multiple soil properties such as soil water content and soil composition. The highly dynamic soil water content can cause dramatic changes of the underground channel conditions. Moreover, due to the unique underground channel characteristics, WUSNs have a complicated network architecture that consists of partially connected underground sensors, fixed aboveground sinks, and mobile aboveground sinks that move randomly or under control.

It is necessary to develop a comprehensive simulator for WUSNs to capture the unique underground channel properties and test the protocols and algorithms under the heterogeneous network architecture before actual deployment. The following work describes a Matlab-based simulator for WUSNs. The simulator can capture the effects of a wide range of parameters, such as underground soil properties, sensor burial depth, operating frequency, transmission power, modulation scheme, sensor node density, number and mobility of aboveground mobile sinks, and spatio-temporal correlation model of the monitored physical quantity.

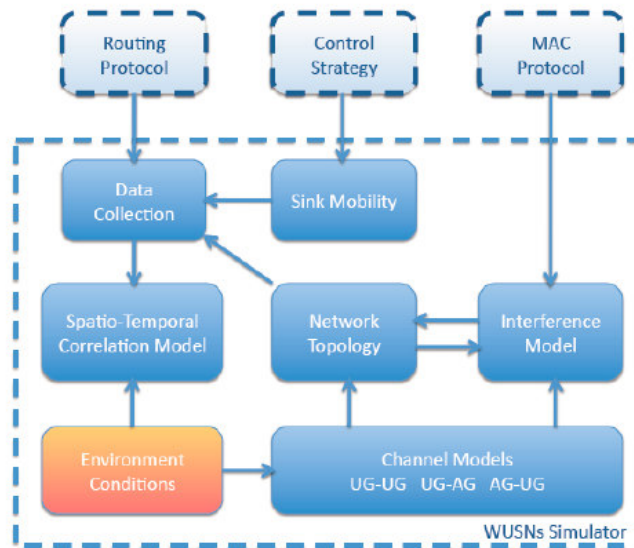


Figure 1. Block diagram for the WUSNs simulator

Figure 1 presents the block diagram for the WUSNs simulator, which composed of the following components:

- **Environment Condition Block:** The end user inputs related environmental conditions in this block, including soil composition, soil water content, and how the monitored physical quantity varies when position or time changes.
- **Channel Model Block:** This block characterizes three types of communication channels in WUSNs, including: underground-to-underground (UG-UG) channel, underground-to-aboveground (UG-AG) channel, and aboveground-to-underground (AG-UG) channel. The path losses and communication ranges of the three types of channels are determined according to the sensor burial depth, transmission power, operating frequency, channel's required bandwidth and capacity, and modulation scheme that are provided by the end user.

- **Interference Model Block:** The interferences among underground sensors and aboveground sinks are characterized in this block based on the adopted MAC protocols and the results generated in the channel model block.
- **Network Topology Block:** In this block, the network topology of the WUSN is determined according to the information provided by the channel model block and the interference model block.
- **Sink Mobility Block:** The behaviors of the multiple aboveground mobile sinks are characterized in this block according to the sink control algorithm.
- **Data Collection Block:** Based on the network topology, the sink mobility, and the adopted routing protocol, this block characterizes how the sensing data is collected. The spatial and temporal sampling rates of the WUSNs are determined.
- **Spatio-Temporal Correlation Model Block:** Not all the data of every sensor at every time stamp is collected due to the partially connected underground sensors and the limited number and moving velocity of the mobile sinks. The unavailable data is estimated by using the spatio-temporal correlations between the monitored physical quantities. The overall monitoring error can be determined in this block.

Our simulator is best used in designing deployment and topology control strategy, MAC and routing protocols, and cooperative mobile sink control algorithm in WUSNs [3]. A typical example of the outputs of the simulator is shown in Figure. 2, where we show the overall monitoring error of different underground sensor density with different number and mobility model of the mobile sinks.

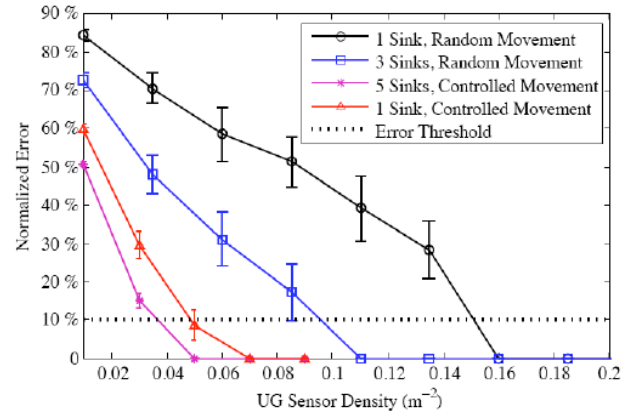


Figure 2. Simulation of overall monitoring error for different underground sensor density and sink mobility model

In this simulation, the underground sensor nodes are randomly deployed in a 100*100 m² square area according to a Poisson point process with different spatial densities. The network topology is determined by the sensor communication range, which is governed by the soil property and the sensor burial depth. Different numbers of aboveground mobile sinks move either according to the random way point model or along a predefined loop route. A contention-free MAC protocol and a broadcast-based routing protocol are adopted. The overall average monitoring error throughout the whole WUSN is calculated based on the granularity of the collected data in both space and time domains. The simulation results indicate that, to achieve a certain level of monitoring accuracy, the required underground sensor density can be greatly reduced by carefully design the control strategy of the aboveground mobile sinks.

References

- [1] I. F. Akyildiz and E. P. Stuntebeck, "Wireless Underground Sensor Networks: Research Challenges," *Ad Hoc Networks Journal (Elsevier)*, vol. 4, pp. 669-686, July 2006.
- [2] I. F. Akyildiz, Z. Sun and M. C. Vuran, "Signal Propagation Techniques for Wireless Underground Communication Networks," *Physical Communication Journal (Elsevier)*, Vol. 2, No. 3, pp. 167-183, September 2009.
- [3] Z. Sun and I. F. Akyildiz, "Connectivity in Wireless Underground Sensor Networks," in *Proc. IEEE SECON '10*, Boston, USA, June 2010.

Call for Papers – IEEE TCSIM Newsletter

The IEEE TCSIM Newsletters will publish short technical papers. The submissions should emphasize modeling, design, and analysis of computational methods for simulations and its applications in various areas, including, but not limited to, computer science, engineering, communications, and simulation applications. The submissions are invited covering, but not limited to, the following topics:

- Simulation architecture modeling and prototyping
- Simulation algorithm design, implementation, and analysis
- Simulation complexity in computing
- Parallel and distributed simulation
- Design and usage of simulation tools
- Real-time simulation monitoring
- Simulation tools for communications and networks
- Simulation of computer systems and applications
- Agent-based simulation tools focus on the use of agents in engineering, human and social dynamics, military applications
- Systems and process simulation
- Simulation of ubiquitous networking and computing
- Simulation of transportation systems
- Automotive simulation applications
- Building and energy management simulations
- Machine learning
- Virtual reality systems

- Knowledge and data systems
- Systems optimization
- Web-based simulation and applications
- Department of Defense Architecture Framework (DoDAF)-based network simulations
- DoDAF-based vulnerability assessment

Submission

All papers must be submitted to elsaidm@gvsu.edu in four pages or fewer, including all figures, tables, and references. A manuscript submitted for publication should be original work that should not have been previously published and should not be under consideration for publication elsewhere. If an author uses charts, photographs, or other graphics from previously printed material, he/she is responsible for obtaining written permission from the publisher to use the material in his/her manuscript. The maximal number of figures and tables are five, and the number of reference is limited to ten.

Please submit electronically in DOC/PDF file, and ensure that the submitted file can be viewed in Acrobat Reader 9.0. A standard IEEE copyright release will also be required before full acceptance.

Article submissions are encouraged throughout the year, though the deadline for the next quarterly newsletter is four weeks from its publication date. Submitted articles go through a quick peer review, and authors are notified of the result within three weeks.

In the event that a particular cycle has large number of submissions, the editors reserve the right to schedule their publication in the subsequent editions of the newsletter.

All papers must include the authors' affiliation and e-mail addresses of all authors. All papers will be fully refereed for accuracy, technical content, and relevance. Contact Dr. El-Said at elsaidm@gvsu.edu with any questions concerning the paper submission and review process, or questions regarding the relevance of a paper to the IEEE TCSIM Newsletters.

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