Best Paper Awards for SpringSim'11

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Introduction:

Earlier this year, I had the privilege of serving as the Vice General Chair of the 2011 Spring Simulation Multiconference (SpringSim'11). SpringSim'11 was held in historic Boston, Massachusetts, USA, April 4-7, 2011. This international multiconference is sponsored by the Society for Modeling and Simulation (SCS), in collaboration with ACM SIGSIM. It brings together scientists and scholars from a variety of disciplines to exchange ideas and collaborate. Featuring members of industry, academia, military, and government from all over the world, SpringSim continues its mission to offer a unique setting for the discussion and advancement of all aspects of modeling and simulation.

SpringSim'11 featured 218 papers organized into nine symposiums:

- Agent Directed Simulation Symposium (ADS)
- Annual Simulation Symposium (ANSS)
- Communications and Networking Simulation Symposium (CNS)
- Symposium on Theory of Modeling and Simulation – DEVS Integrative M&S Symposium (TMS/DEVS)
- Emerging Applications of M&S in Industry and Academia Symposium (EAIA)
- High Performance Computing Symposium (HPC)
- Military Modeling and Simulation Symposium (MMS)
- Symposium on Simulation for Architecture and Urban Design (SimAUD)
- Poster & Work-In-Progress Track

Seven of these symposia have provided a best paper award. In addition, there were two overall conference awards that were chosen from among the best papers of the seven symposia. In this article, we summarize these six papers and discuss their contribution to the modeling and simulation field. We start with the overall conference best paper winner, followed by the runner up and then the four other best papers in no particular order.

Overall Best Paper:

The penetrability of rocks to fluid flow is of great significance to enhanced oil recovery procedures. If these experiments were performed numerically, unlike traditionally by using rock samples, substantial cost and time savings would result. Leonardi et al. [1], winners of Springsim'11 and HPC best paper awards, designed a generalized framework that could be used with any explicit numerical method such as the smoothed particle hydrodynamics (SPH) or the lattice Boltzmann methods (LBM), or discrete element, finite element or finite difference methods. Although the framework is general enough to be used with any explicit time integration scheme, in this paper the authors focus on the former two methods; SPH and LBM.

Leonardi et al. tested the performance of their multi-core, shared memory numerical framework for SPH and LBM on a 24-core Dell Server. The simulation was distributed by using spatial hashing that assigns particles to bins based on their Cartesian coordinates. Two important performance metrics were used to show the scalability of their framework, namely speed-up and efficiency. The results show the almost linear increasing speed-up of the SPH and LBM solvers with increasing cores with efficiency up to 92% and 95%, respectively. The authors plan to extend their testing on 64 and 256 core servers.

Runner up:

Kang et al. [2], runner up for Springsim'11 and CNS best paper award winners, present an excellent tool suite, dubbed HMNToolSuite, for the emulation and simulation of mobile devices in heterogeneous mobile networks. Unlike previous network simulators, HMNToolSuite focus on handover decisions on the application layer. The authors used a Model-View-Controller (MVC) software design and developed the suite in java 6. They used java's swing package to develop a graphical user interface and java's chart library; jFreeChart, to display graphs. The simulator has many useful features. It allows users to create, modify, and delete multiple kinds of mobile networks, mobile nodes, and network servers, choose network traffic for each application, implement handover decision algorithms, use context information, run simulations with a large number of nodes in a reasonable amount of time, specify relevant simulation parameters, policies, network statuses, and services in a human readable configuration file or a GUI-based configuration manager, reuse simulation code for real network applications in order to validate simulation results, collect statistical data and generate graphs. The paper uses a case study to demonstrate the new simulator. For this case study, the authors implemented six handover decision algorithms and compared their performance.

Best papers from Symposia:

Xing et at [3], winners of ANSS best paper award, proposed a solution to the limited power problem on multi-hop wireless networks. They developed an algorithm that selects the optimal channel coding rate on each data forwarding link on the expense of some minor quality degradation. However, their approach still meets the multimedia Quality of Service (QoS) requirement. Simulation was used to evaluate the proposed scheme which showed significant improvement of their energy balancing technique over the traditional approach.

In hard real time systems outputs should be produced before specific deadlines, however it might not be possible to meet these deadlines, especially during system overloads. Imprecise Computation technique [4] separate mandatory and optional computations, and discards the latter in times of overloads. Moallemi and Wainer [5], winners of DEVS/TMS best paper award, propose a solution to over-running in hard real time systems by adopting the imprecise computation approach. They introduce Imprecise Discrete Event System Specification (I-DEVS), a model driven approach to develop real time applications. They implemented I-DEVS using E-CD++ on Xenomai, a real time framework for Linux which lies between the hardware and the Linux kernel. They tested the proposed model using a computation intensive scenario which represents a synthetic robot that instructs electrical motors based on the inputs it receives from sonar sensors. They used several important performance metrics like processor utilization and average response time. The tests included the number of discarded transitions versus processor utilization and response time versus execution time for heavy loads and medium loads. Their results show that the I-DEVS can achieve maximum throughput.

Johnson and Rosenberg-Kima [6], winners of MMS best paper award, developed a training effects (TE) algorithm that could be used as a plug-in to the Improved Performance Research Integration Tool (IMPRINT), a tool that has been used successfully by the U.S. Army to model human performance. The TE algorithm is "designed to predict the efficacy of alternative training effects that include delivery media, learner characteristics, and instructional approaches for technical tasks such as those carried out by Air Force maintenance personnel within the cognitive, perceptual, motor, and communication domains."

In their paper, Niemasz et al. [7], winners of SimAUD best paper award, mentions that "The Solar Envelope is a three dimensional envelope on a site which ensures adjacent neighbors a specified minimum direct solar access time per day throughout the year. The solar envelope was developed as a tool to give buildings in an urban setting the mutual opportunity to employ passive and active solar design strategies. Parametric computer-aided-design (CAD) environments significantly ease the construction and visualization of solar envelopes across whole neighborhoods, facilitating its wider use as a prescriptive zoning tool. This study investigates the implications of a solar envelope zoning approach for the most common building type in the United States (US) with respect to energy use and developable density. The results indicate that solar zoning for this building type has a limited and sometimes negative effect on energy use as well as a larger negative impact on developable density."

In 1988, Curtis, Krasner and Iscoe [8] mention that "Writing code isn't the problem, understanding the problem [business domain] is the problem". Barjis et al. [9], winners of EAIA best paper award, apply business process modeling and simulation very effectively by introducing a framework that transforms a business process model (BPM) into software application for enabling business activities. Nowadays business processes are heavily distributed, interdependent and agile, hence are difficult to understand based on static modeling. Barjis et al. introduce two modeling styles: imperative modeling and declarative modeling. The imperative model is based on explicit control flow. It is useful in well-structured repetitive processes and would help the BPM practitioner answer the "how model works?" question. The declarative model on the other hand supports non-determinism and is based on circumstantial information. It helps BPM practitioners make and validate assumptions or verify model properties. Both tools are very valuable for BPM practitioners. Barjis et al. made particular emphasis on robustness, resilience, adaptability and transformability. They defined a robust system as the one that can withstand environmental changes without losing ability to perform properly, and a resilient system as the one that can quickly recover to a stable state. They defined adaptability as "the capacity of a business process to influence overall system's robustness", while transformability as "the capacity to instantiate a fundamentally new process representation when new observations and constraints make the existing set of processes untenable". Their framework is very useful from the application and research point of views.

In the fifty years since its formal definition, the application areas for modeling and simulation are still growing. The best papers of SpringSim'11 provide evidence that modeling and simulation plays a significant role in many fields, whether it is the oil industry, mobile computing, wireless networks, real time systems, military training, urban design and energy use or software development. Simulation allows the analysis of systems without requiring the construction of or experimentation with the real system yielding a great savings in cost and time. In the last five years, inexpensive shared memory multi-core processors have emerged that will allow for simulations that traditionally has been performed on more expensive clusters of single processor machines. This will cause parallel simulation to be more attractive. This power will drive the high performance computing field and the wide adoption of simulation by all forms of industry and government.

References:

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