SIMULTECH 2012
Final Program and Book of Abstracts

2nd International Conference on Simulation and Modeling
Methodologies, Technologies and Applications

Rome, Italy
28 – 31 July, 2012

Sponsored by
INSTICC – Institute for Systems and Technologies of Information, Control and Communication

Technically Co-sponsored by
SCS – The Society for Modeling & Simulation International
GDR-I3 – Information-Interaction-Intelligence
Liophant Simulation
Simulation Team
IFIP – International Federation for Information Processing

In Cooperation with
AIS SIGMAS – AIS Special Interest Group on Modeling and Simulation
MIMOS – Movimento Italiano Modellazione e Simulazione

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Foreword

This book contains the abstracts of the 2012 International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH 2012), which was sponsored by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC) and held in Rome, Italy. SIMULTECH 2012 was technically co-sponsored by the Society for Modeling & Simulation International (SCS), GDR I3, Lionphant Simulation, Simulation Team and IFIP and held in cooperation with AIS Special Interest Group of Modeling and Simulation (AIS SIGMAS) and the Movimento Italiano Modellazione e Simulazione (MIMOS).

This conference brings together researchers, engineers and practitioners interested in methodologies and applications of modeling and simulation. The main topics covered in the papers accepted in the conference are: Methodologies and Technologies, and Applications and Tools of modelling and simulation. We believe the accepted papers demonstrate new and innovative solutions. They also highlight technical issues and challenges in this field.

The high quality of the SIMULTECH 2012 program is enhanced by the four keynote lectures, delivered by distinguished speakers who are renowned experts in their fields: David M. Nicol (University of Illinois, Urbana-Champaign, United States), Tuncer Ören (University of Ottawa, Canada), Simon Taylor (Brunel University, U.K.) and Anthony John Jakeman (Australian National University, Australia).

The technical program features three special sessions: Computationally Efficient Simulation-Driven Engineering Design Optimization andModeling (SDDOM), Applications ofModeling and Simulation to Climatic Change and Environmental Sciences (MSCCEC) and Health Applications (HA). SIMULTECH 2012 received 125 paper submissions from 38 countries in all continents. A double blind paper review was performed by the International Program Committee members, all of them recognized in at least one of the main conference topic areas. After reviewing, only 38 papers were selected to be published and presented as full papers, i.e. completed work (10 pages in proceedings / 30 minutes oral presentations) and 26 papers, describing work-in-progress, were selected as short papers for 20 minutes oral presentation. Furthermore there were also 10 papers presented as posters. The full-paper acceptance ratio was thus 30%, and the total oral paper acceptance ratio was less than 44%. These ratios denote a high level of quality, which we intend to maintain in future SIMULTECH conferences.

Based on the reviewer's evaluations and the presentations, a short list of authors will be invited to submit extended versions of their papers for a book that will be published by Springer and JDMS.

Moreover, the best papers with clear contributions to discrete-event simulation will be invited to submit revised versions to the Journal of Simulation.

We hope that these Conference Proceedings, submitted for indexation by Thomson Reuters Conference Proceedings Citation Index, INSPEC, DBLP and EI, may help the Modeling and Simulation community to find interesting research work. All presented papers will soon be available at the SciTePress digital library Conferences are also meeting places where collaboration projects can emerge from social contacts amongst the participants. Therefore, in order to promote the development of research and professional networks the Conference includes in its social program a Conference Social Event & Banquet in the evening of July 30 (Monday).

Building an interesting and successful program for the conference required the dedicated effort of many people. Firstly, we must thank the authors, whose research and development efforts are recorded here. Secondly, we thank the members of the program committee and additional reviewers for their diligence and expert reviewing. We also wish to include here a word of appreciation for the excellent organization and support provided by the conference secretariat, from INSTICC, who have smoothly and efficiently prepared the most appropriate environment for a productive meeting and scientific networking. Last but not least,we thank the invited speakers for their invaluable contribution and for taking the time to synthesize and deliver their talks.

We hope that you will enjoy the program and your stay in the beautiful city of Rome. We also hope to see you again next year at SIMULTECH 2013.

Mohammad S. Obaidat, Monmouth University, U.S.A.

Nuno Pina, EST-Setúbal / IPS, Portugal

Janusz Kacprzyk, Systems Research Institute - Polish Academy of Sciences, Poland

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Panel

Saturday, 28
9:30 – 10:45
Room: Plenary

Title: *"Trends and Challenges in Modeling and Simulation"*

Panel Chair:

Mohammad S. Obaidat, Fellow of IEEE, Fellow of SCS, Immediate Past President of the Society for Modeling &Simulation International (SCS), Editor-in-Chief, Wiley International Journal of Communication Systems, and Professor in Monmouth University, U.S.A.

Panelists

Tuncer Ören, University of Ottawa, Canada
David M. Nicol, University of Illinois at Urbana/Champaign, U.S.A.
Helena Szczerbicka, University of Hannover, Germany
Simon Taylor, Brunel University, U.K.

Keynote Lectures

Saturday 28
17:00 – 18:00
Room: Plenary

Exploiting Uncertainty and Error to Accelerate Simulations

David M. Nicol
University of Illinois at Urbana-Champaign
U.S.A.

A simulation modeler constantly makes choices about abstractions, particularly in definition of entity state, and the granularity of temporal activity in the model. It is well known and highly practiced that higher levels of abstraction typically lead to less computational activity per unit simulation unit, and hence faster advancement of the simulation clock with respect to the real-time clock. Examples of this abound in physical simulation, where one has the advantage of underlying laws of physics to provide a framework against which fidelity can be assessed. Modelers of discrete systems use these same techniques, but underpinnings that serve as ground truth are scarcer. While development of mathematical frameworks within which one can rigorously assess accuracy/solution-speed trade-offs are a long-term goal, in the interim we must gather somewhat anecdotal evidence that by abstracting or neglecting certain details, significant accelerations of model executions can be achieved without significant loss in behavioral accuracy---at least not in metrics of primary concern to the modeler. We offer some examples to illustrate the points, motivate the discussion, and identify some directions for research. The examples include

Detailed Radio Channel Modeling (e.g., ray-tracing, transmission line propagation). In this example we see that a number of factors that influence model behavior (e.g., reflectivity of obstacles, size and position of antennae, actual distribution of power radiating from an antenna) are things that a modeler can at best only approximate. Still, significant behavioral dependence is observed based on whether ray-tracing includes phase angle information or not.

Wireline Network Switches. Weighted fair queueing models are commonly used in switches to fairly share limited bandwidth among competing flows. The complexity of the algorithm means that the passage of a packet through a switch may require multiple discrete events to implement. When application behavior is the point of the study, the difference in time scales between applications and switches suggests we can approximate switching latency without much impact on application performance. However the same cannot be said of packet loss, which impacts TCP and applications that use it, significantly.

Integrating Virtual Time into Emulation of Computer Programs. In order to assign some passage of virtual time to an execution burst to a program run within a virtual machine, we need to measure execution time on the host architecture, i.e., develop some measurement of how long the execution burst would actually take on the machine being modeled. There are inescapable deviations from real behavior in such systems, tied to variance in system timers and effects from virtual memory.

In each case we can identify a type of error over which we have no control, or system insensitivity that allows us to include model approximations specifically designed to accelerate the evaluation of the simulation model.

David M. Nicol is Professor of Computer and Electrical Engineering at the University of Illinois, Urbana-Champaign, and Director of the Information Trust Institute. Previously he held faculty positions at the College of William and Mary, and Dartmouth College. His research interests include high performance computing, simulation modeling and analysis, and security. He was elected Fellow of the IEEE, and Fellow of the ACM for his contributions in these areas. He is co-author of the widely used textbook "Discrete-Event Systems Simulation", and was the inaugural awardee of the ACM Special Interest Group on Simulation's Distinguished Contributions Award, for his contributions in research, teaching, and service in the field of simulation.

Sunday 29
12:00 – 13:00
Room: Plenary

The Richness of Modeling and Simulation and Its Body of Knowledge

Tucer Ören
University of Ottawa, School of Electrical Engineering and Computer Science
Canada

The increasing importance of modeling and simulation (M&S) is emphasized. Richness and stakeholders of M&S are documented. Three aspects of professionalism of M&S are clarified. Based o this clarification, work being done by the author on M&S body of knowledge is outlined. Several other BoK and M&S BoK studies are referred to. The conclusions section terminates with the fact that wide-spread application and ever increasing importance of modelling and simulation necessitate the preservation of the integrityof the M&S discipline.

Tucer Ören is a professor emeritus of computer science at the University of Ottawa, Canada. He has been involved with simulation since 1965. His research interests include: (1) advanced methodologies; (2) agent-directed simulation; (3) agents for cognitive and emotive simulations especially for conflict management training (including representations of human personality, emotions, and emotional intelligence (understanding and misunderstanding)); (4) reliability, QA, failure avoidance, and ethics; as well as (5) body of knowledge and (6) terminology of simulation. He has over 450 publications, has contributed to over 400 conferences and seminars held in over 30 countries and has delivered almost 200 invited talks/presentations. Dr. Ören has been recognized, by IBM Canada, as a pioneer of computing in Canada. He is a distinguished lecturer of SCS (Society for Modeling and Simulation International), received Information Age Award from the Turkish Ministry of Culture, and was inducted to SCS Modeling and Simulation Hall of Fame (Lifetime Achievement Award).

Sunday 29
16:45 – 17:45
Room: Plenary

Advances in e-Science and e-Research - *e-Infrastructures for Modelling and Simulation*

Simon Taylor
Brunel University
U.K.

Scientists today are exploiting exciting new developments in Information and Communication Technology such as high speed networks, high performance computing and distributed collaborative environments. These cyberinfastructures or e-Infrastructures are facilitating e-Science and e-Research and the formation of global virtual research communities capable of addressing challenging large scale problems with a critical mass of expertise. What does this mean for academic and industrial Modelling and Simulation? This presentation discusses how e-Infrastructure advances can be used to the benefit of modelling and simulation researchers and practitioners. The presentation asks if the development e-Infrastructures for Modelling and Simulation is really necessary or critical to making an urgently needed step-change in the field.

Simon J. E. Taylor is a Reader in Computing in the Department of Information Systems and Computing at Brunel University and leader of the ICT Innovation Group. He is Chair of the COTS Simulation Package Interoperability Standards Group under SISO and the co-Editor-in-Chief of the Journal of Simulation and. He leads the Tools and Training Theme of the Multidisciplinary Assessment of Technology Centre for Healthcare (MATCH) at Brunel. He was Chair of ACM's SIGSIM (2005-2008). He regularly consults with industry and has published widely in simulation modelling. His recent work has focused on the knowledge transfer of advanced ICT techniques into simulation modeling and the impact of advanced research infrastructures in Europe and Africa.

Monday 30
16:00 – 17:00
Room: Plenary

Modelling for the Complex Issue of Groundwater Management

Anthony Jakeman
Australian National University
Australia

Groundwater management is a complex issue that in many instances has all the features of messy or wicked problems. These are defined by there being multiple stakeholders and decision makers with competing and conflicting goals, and where the systems of interest are complex - being social, economic, and ecological - and are subject to a range of uncertainties caused by limited data, information and knowledge. Modellers can nevertheless play a key role in resolving and providing support for framing the issues of concern, clarifying decision options for managing environmental issues, and appropriately engaging with identified stakeholders. A key policy issue in Australia is how to deal with the over-allocation of groundwater in many catchments. In this paper we present the elements of an integrated approach to support the ongoing resolution of the over-allocation problem. With a collaborative multi-disciplinary research team we have developed an integrated model to identify the social, economic and environmental trade-offs in the Namoi catchment in Australia under various water policy decisions and climate variations. The model allows the exploration of adaptation mechanisms, identified by our social science team, that water users are likely to accept in order to minimise the impacts of climate change and reductions in their water allocation.

Tony Jakeman is Professor, Fenner School of Environment and Society, and Director of the Integrated Catchment Assessment and Management Centre, The Australian National University. He has been an Environmental Scientist and Modeller for 35 years and has over 300 reviewed publications in the open literature. His early career background is in applied mathematical modelling and hydrology. Interests include integrated assessment methods and decision support systems for water and associated land resource problems, including modelling and management of water supply and quality problems in relation to climate, land use and policy changes and their effects on biophysical and socioeconomic outcomes. Jakeman has undertaken research projects and consultancies for AusAID, the Murray-Darling Basin Commission/Authority, many Australian federal, state and local government agencies, and Catchment Management Authorities, often working as project leader. For example he is leader of the integration program in the recently established National Centre for Groundwater Research and Training (groundwater.com.au). He has held visiting positions at Stanford, Cambridge and Lancaster Universities, CSIRO, IRSTEA in France, the US Geological Survey; and is Adjunct Professor at the University of Western Australia. Scientific and organisational activities include: Editor-in-Chief, Environmental Modelling and Software (Elsevier) since 1996 – a 2009 Impact Factor of 3.058; Foundation President, International Environmental Modelling and Software Society (2000-2006) and elected Fellow (2004); President and Fellow (2009), Modelling and Simulation Society of Australia and New Zealand, Inc.; Vice-President, International Association for Mathematics and Computers in Simulation (2009 -); International Advisory Board of the C.T. de Wit Graduate School for Production Ecology and Resource Conservation, Wageningen University (2008 -); and regularly a member of scientific advisory committees of international conferences.

Special Sessions

Saturday 28
11:00 – 16:30
Room: Dali

Special Session on Computationally Efficient Simulation-driven Engineering Design Optimization and Modeling - SDDOM 2012

Co-chairs
Slawomir Koziel, Reykjavik University, Iceland
Leifur Leifsson, Reykjavik University, Iceland

SCOPE AND TOPICS

The use of computer simulations is ubiquitous in contemporary engineering design. High-fidelity numerical models are very accurate but, at the same time, computationally expensive and inherently noisy. Depending on the structure complexity and required accuracy level, evaluation time for a single design can take hours, days or even weeks. Therefore, direct use of high-fidelity simulations in the optimization loop may be prohibitive. On the other hand, in many cases, simulation-driven design is the only option due to complexity of the structure under consideration and the lack of analytical models and/or systematic design procedures. In such instances, computationally efficient design can be performed using surrogate-based optimization (SBO), where the high-fidelity model is replaced by its computationally cheap but still reasonably accurate representation, a surrogate. The surrogate model can be created using various approximation schemes. The surrogate can also be knowledge-based, i.e., constructed from the low-fidelity model that enjoys the same physics as the high-fidelity one. One of the important goals of SBO procedures is to reduce the number of high-fidelity model evaluations, and, consequently, to lower the overall optimization cost. The special session will focus on reviewing state-of-the-art and promoting new directions of surrogate-based and knowledge-based design optimization and modeling methodologies exploiting computer simulations as well as their applications in various fields of science and engineering.
This is the second edition of the SDDOM. The first edition, SDDOM 2011, took place during SIMULTECH 2011 and attracted a large number of high-quality speakers.

Topics of Interest

Topics of interest include, but are not limited to:

- Computationally Efficient Optimization of Expensive Objective Functions
- Simulation-driven Design
- Function-approximation-based and Physics-based Surrogate Models
- Surrogate-based Modeling and Optimization
- Multi-fidelity and Variable-resolution Analysis and Optimization
- Knowledge-based Methods
- Response Surface Approximation, Space Mapping, and Response Correction Techniques
- Multidisciplinary Design and Optimization
- Adjoint Sensitivities in Simulation-driven Design
- Software Architectures for Optimization-oriented Design
- Application Case Studies

SDDOM Program Committee

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Xin-She Yang, National Physical Lab, U.K.

Saturday 28
14:30 – 16:30
Room: Madrid

Special Session on Applications of Modeling and Simulation to Climatic Change and Environmental Sciences - MSCCEC 2012

Co-chairs
Carlos Gay, UNAM, Mexico
Francisco Mugica, UPC, Spain

SCOPE AND TOPICS

The main objective of the session is to provide a forum to disseminate and discuss recent and significant research efforts in climate change and atmospheric sciences applications in modeling and simulation based on Computational Intelligence which have significant impact to society.
New, unusual and hybrid approaches used to deal with such applications are particularly encouraged. The session is therefore open to high quality submissions from researchers who should present original research and applications including innovative results.

Topics of Interest

Such applications could utilize the following topic areas of computational intelligence (but are not limited to):
- Genetic Computational Intelligence Systems including adaptive, hierarchical, evolutionary, neural and nature-inspired systems
- Hybrid systems of computational intelligence techniques
- Fuzzy optimization and design, decision analysis and support
- Fuzzy data analysis - clustering and classifiers, pattern recognition, bio-informatics
- Knowledge discovery, learning, reasoning, agents, knowledge representation
- Neural network theory & models
- Learning and adaptation Pattern recognition
- Neural control Hybrid systems
- Evolutionary neural systems Self-aware systems
- Complex systems Data mining and intelligent systems
- Constraint and uncertainty systems and applications
- Application optimization, decision analysis, decision making, multi-criteria decision making
- Applications of data mining/knowledge discovery techniques to improve understanding of environmental science datasets

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Ivan Paz Ortiz, Programa de Investigación en Cambio Climático UNAM, Mexico

Saturday 28
14:30 – 16:30
Room: Sevilla

Special Session on Health Applications - HA 2012

Co-chairs

Angela Testi, University of Genova, Italy
Elena Tànfani, Università degli Studi di Genova, Italy

SCOPE AND TOPICS

The main difficulty of making decisions in the health care area is linked to the complexity and intrinsic uncertainty of the system itself and to its dynamic nature. Moreover, decisions in the health care field are subject to many challenges and constraints: fast change and uncertain outcomes, aging population, increasing citizen expectations, equity considerations and limited resources.
In this context simulation modelling techniques can supply the different stakeholders involved in the health care delivery process with appropriate decisions making tools.
The special session is aimed at collecting the application of simulation models to different concrete situations and problems arising in the broad field of health care delivery and evaluation.
A key feature of the session should be combining a clear explanation of methodological and theoretical concepts together with some reminds to practical applications. Each contribution should, therefore, contain both methodological and theoretical concepts as well as data collection and practical application and also the description of the impact on health care policy.

Topics of Interest

The main topics include but are not limited to:
- Health policies issues
- Planning health services
- Epidemiology and disease modeling
- Capacity planning
- Integrated care pathways design and evaluation
- Patient Logistics and Patient flow modeling
- Health care operations planning and scheduling
- Work-force staffing and planning
- Home care modeling
- Quality and appropriateness evaluation

HA Program Committee

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Awards

Best Paper Awards

A "Best Paper Award" and a "Best Student Paper Award" will be conferred to the author(s) of a full paper presented at the conference, selected by the Program/Conference Chairs based on the best combined marks of paper reviewing, assessed by the Program Committee, and paper presentation quality, assessed by session chairs at the conference venue.
The "Best Student Paper Award" will be given to a paper in which the first author is a registered MSc or PhD student.

The awards will be announced and bestowed at the conference closing session.

Selected Papers Book

A number of selected papers presented at SIMULTECH 2012 will be published by Springer-Verlag in a AISC Series book. This selection will be done by the Conference Chair and Program Co-chairs, among the papers actually presented at the conference, based on a rigorous review by the SIMULTECH 2012 Program Committee members.

Social Event and Banquet

Venue: Bus Tour in Rome followed by a Dinner at the "Il Borgo di Tragliata"
Date: Monday 30, 18:15 - 23:30

Located at the entrance to Rome, "IL borgo di Tragliata," rises above an impressive tufa buttress. Archeological sources provide evidence that this area has been inhabited since ancient times. The discovery of the famous, "Oinochoe of Tagliatella" vase confirms the existence of human settlements since the Etruscan era within an area subject to control by either Ceri or Veio. The place name "Tragliata" takes note of the place names, Talianum Tagliata or Terlata, during medieval times and appears to be derived from "Tagliata, (meaning, "cut"), which is the word given to the paths dug into the tufa by the Etruscans.

The presence of several tombs dug into the tufa along the East slope of the hill on which the village sits, along with several clay artifacts found in the area, are evidence which suggest the presence of a small agricultural settlement. In addition, other documentation reports the findings of the remains of a Roman villa on Tragliata property. It is also known that the two marble memorial stones found in this area have inscriptions dating back to the third century AD.

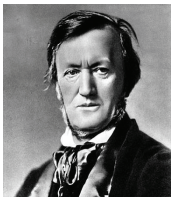
Midway through the eighth century, this area of the Roman countryside saw a period of repopulation thanks to the intelligence and will of Pope San Zaccaria (741-752) and Pope Adriano I (772-793). Encouraged by political and religious motives, these two Pontiffs presented an energetic revival and control of the territory.

During ninth and tenth centuries the historical scene began to change, the Roman countryside, with less support for the Papacy by the Carolugian empire, was made subject to continual and bloody raids by the Saracen pirates. The system of the “Domuscultae” entered into definite crisis, superceded by a strong defense system of towers and small castles; several coastal light towers were constructed to be used as bright defense signals to alert the inland region upon the pirates’ approach.

The construction of Tragliata’s small castle and tower date back to the ninth century, according to sources at the nearby Boccea castle.

The estate still belongs to the Vatican Basilica, even if time after time it was more or less controlled directly by others. In 1201, for example, it was ruled by a certain Jocobus de Traliata who occupied it, possibly as a lord. Several years later Tragliata, together with nearby “castium” Loterni, became subject to the interests of the turbulent Normanni family.

In 1885, the Chapter granted the Tragliata estate to Mr. Nicola Santovetti as the perpetual leaseholder. Consequently, Santovetti sold the lease to Mr. Domenico Lanza in 1917, (the great grand father of the present proprietor, Andrea de Gallo di Roccagiovane) who then took over as a tenant to finally gain possession of the estate in the following years.



General Information

Welcome Desk/On-site Registration
Friday 27 – Open from 15:00 to 17:30
Saturday 28 – Open from 8:45 to 18:00
Sunday 29 – Open from 9:00 to 17:45
Monday 30 – Open from 9:00 to 17:15

Opening Session
Saturday 28, at 9:15 in the Plenary room.

Welcome Drink
Saturday 28, at 18:00 in the Picasso Foyer.

Closing Session
Monday 30, at 17:00 in the Plenary room.

Meals
Coffee-breaks will be served in the Picasso Foyer next to the conference rooms to all registered participants.
Lunches will be served in the Murillo room from 13:00 to 14:30 to all registered participants.

Communications
Wireless access will be provided free of charge to all registered participants, during the conference business hours.

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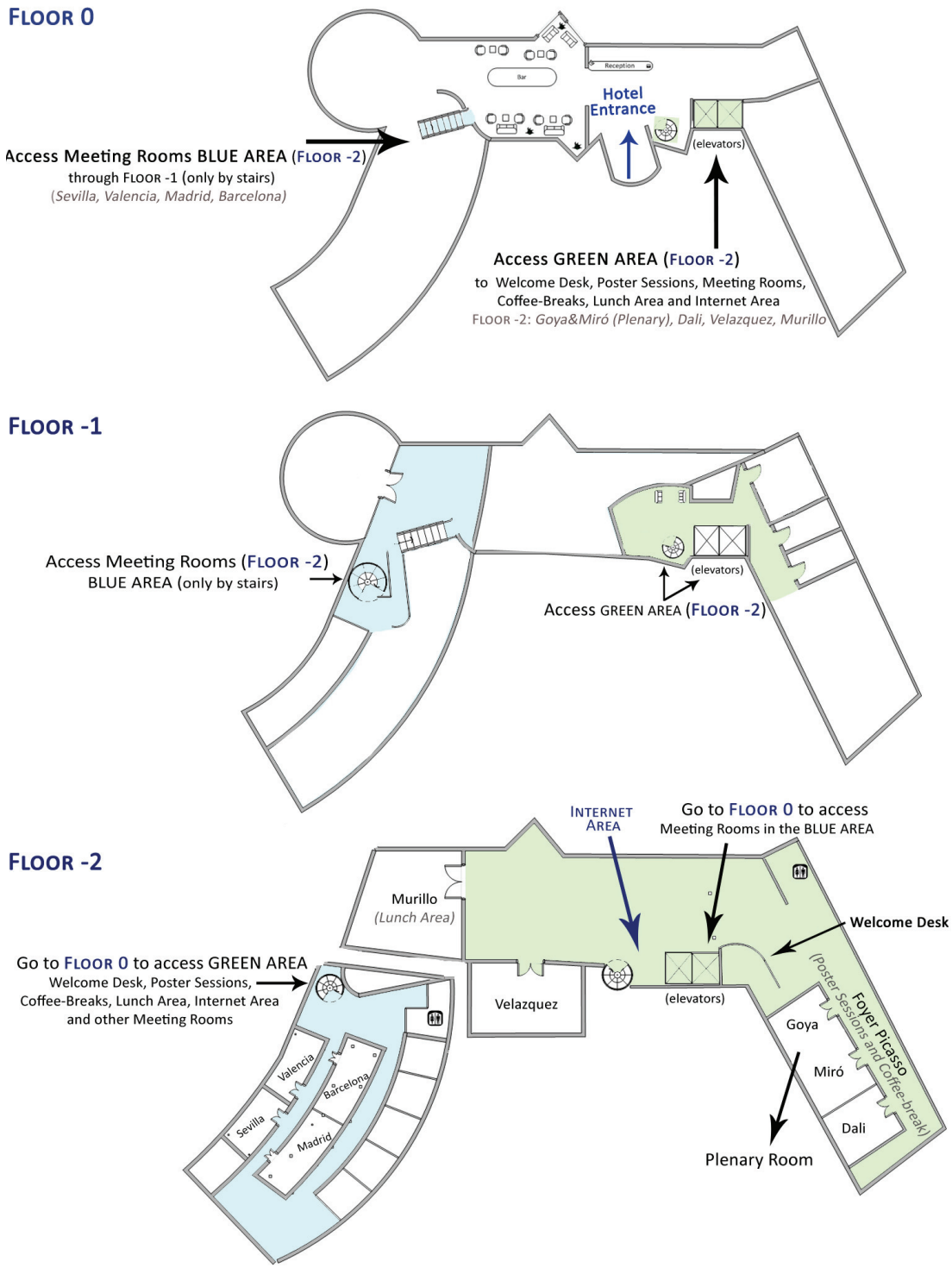
Rooms Layout



Program Layout

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Saturday Sessions

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Panel SIMULTECH
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"Trends and Challenges in Modeling and Simulation"

Paper 32
11:00 - 13:00 Room Velazquez
Parallel Session 1 - Application Domains, Formal Methods and Simulation Tools and Platforms

Hybrid Simulation Approach for Prospective Assessment of Mobile Stroke Units

Anatoli Djanatliev[1], Peter Kolominsky-Rabas[1], Bernd M. Hofmann[2], Axel Aisenbrey[2] and Reinhard German[1]

[1] *Universität Erlangen-Nürnberg, Erlangen-Nürnberg, Germany*

[2] *Siemens AG, Erlangen, Germany*

Keywords: Healthcare, Simulation, Hybrid Simulation, System Dynamics, Agent-based Simulation, Prospective Health Technology Assessment, Ischemic Stroke.

Abstract: Technology innovations in health care offer high potentials for all stakeholders (e.g., patients, healthcare providers and health industry), but the development phase of such innovations is often very expensive and the effects are hardly predictable without a systematic strategy. The new interdisciplinary approach Prospective Health Technology Assessment (ProHTA) uses simulation techniques to indicate the effects of new health technologies, early before the cost-intensive development process begins. Furthermore, ProHTA helps to detect gaps and bottlenecks in the health system to catch potentials for new innovations. The scope of ProHTA includes both a strategic aggregated level of analyses as well as an individual detailed level. This paper describes the use of hybrid simulation approaches, consisting of System Dynamics and Agent-Based Simulation, to analyze the effects of an innovative stroke technology. We discuss an example of the prospective assessment of Mobile Stroke Units within a Metropolitan Scenario. The project ProHTA is a part of the Centre of Excellence for Medical Technology - Medical Valley EMN - and is supported by the German Federal Ministry of Education and Research (BMBF), project grant No. 01EX1013B.

Paper 45
11:00 - 13:00 Room Velazquez
Parallel Session 1 - Application Domains, Formal Methods and Simulation Tools and Platforms

A Simulation Study of Learning a Structure Mike's Bike Commuting

Mamoru Kaneko[1], Jeffrey J. Kline[2], Eizo Akiyama[1] and Ryuichiro Ishikawa[1]

[1] *University of Tsukuba, Tsukuba, Japan*

[2] *University of Queensland, Brisbane, Australia*

Keywords: Inductive Game Theory, Social Simulation, Learning, Short-term Memory, Long-term Memory, Preferences.

Abstract: This paper undertakes a simulation study of a player's learning about the structure of a game situation. In a simple 1-person example called Mike's Bike Commuting, we simulate the process in which Mike experiences and accumulates memories about the structure of Mike's town. It is the basic requirement that to keep an experience as a long-term memory, Mike needs enough repetitions of that experience. By the choice of our simple and casual example, we can discuss relevant time spans for learning. The limit case of Mike's learning as time tends to infinity is of little relevance to the problem of learning. We find that the concept of "marking" introduced by Kaneko-Kline is important for obtaining sufficient structural knowledge in a reasonable time span. Our study shows that Mike's learning can change drastically with the concept. We also consider Mike's learning about his preferences from his experiences, where we meet various new conceptual problems.

Paper 51
11:00 - 13:00 Room Velazquez
Parallel Session 1 - Application Domains, Formal Methods and Simulation Tools and Platforms

A Really Simple Explanation of Policy Punctuations? Interdependence, Complexity, and Policy Punctuations

Florian Prange

GORDIS GmbH, Hamburg, Germany

Søren Serritzlew

University of Aarhus, Aarhus C., Denmark

Keywords: Theory of Budgeting, Policy Punctuations, Agent based Modeling, Complexity, Non-Equilibrium Games.

Abstract: We know for a fact that changes in budgets follow a leptokurtic or power law distribution. We have

solid evidence that the degree of leptokurtosis can be explained by factors such as special features of policy areas, information processing, decision costs, and differences in the institutional setting (Jones & Baumgartner, 2005a; 2005b, Breunig, 2007; Jones, Sulkin and Larsen, 2003; Breunig and Koski, 2006). However, we do not know why leptokurtosis is omnipresent. In this paper we conjecture that leptokurtosis can be explained by four simple observations which must be true of any budgeting process: (1) that several actors request and spend budgets, (2) several actors allocate funding, (3) that actors which do not receive sufficient funding will eventually close down, and (4) that available funding is limited and often smaller than requested funding. We first review the literature on policy punctuations and leptokurtosis, and identify the four simple observations. We then discuss how a simulation can be useful in investigating the implications of these four observations, and introduce a simulation of the interaction of beggars and philanthropists in a budget game. We show that the four observations can account for the omnipresence of leptokurtosis at the sub system level. They cannot, however, explain the magnitude of leptokurtosis found in empirical distributions of budget changes.

Paper 54
11:00 - 13:00 Room Velazquez
Parallel Session 1 - Application Domains, Formal Methods and Simulation Tools and Platforms

Modelling Passengers Flow at Airport Terminals Individual Agent Decision Model for Stochastic Passenger Behaviour

Wenbo Ma, Clinton Fookes, Tristan Kleinschmidt and Prasad Yarlagadda

Queensland University of Technology, Brisbane, Australia

Keywords: Agent-based Models, Bayesian Networks.

Abstract: Airport system is complex. Passenger dynamics within it appear to be complicate as well. Passenger behaviours outside standard processes are regarded more significant in terms of public hazard and service rate issues. In this paper, we devised an individual agent decision model to simulate stochastic passenger behaviour in airport departure terminal. Bayesian networks are implemented into the decision making model to infer the probabilities that passengers choose to use any in-airport facilities. We aim to understand dynamics of the discretionary activities of passengers.

Paper 86
11:00 - 13:00 Room Velazquez
Parallel Session 1 - Application Domains, Formal Methods and Simulation Tools and Platforms

Enhancing the Performances of D-MASON A Motivating Example

Michele Carillo[1], Gennaro Cordasco[2], Rosario De Chiara[1], Francesco Raia[1], Vittorio Scarano[1] and Flavio Serrapica[1]

[1] *Università degli Studi di Salerno, Salerno, Italy*

[2] *Seconda Università degli Studi di Napoli, Caserta, Italy*

Keywords: Agent-based Simulation, Load-balancing, Visualization of Distributed Models, Performance Evaluation.

Abstract: Agent-based simulation models are an increasingly popular tool for research and management in many, different and diverse fields. In executing such simulations the “speed” is one of the most general and important issues and the traditional answer to this issue is to invest resources in deploying a dedicated installation of dedicated computers, with highly specialized parallel applications, devoted to the purpose of achieving extreme computational performances.
In this paper we present our experience with a distributed framework, D-MASON, that is a distributed version of MASON, a well-known and popular library for writing and running Agent-based simulations. D-MASON introduces the parallelization at framework level so that scientists that use the framework (domain expert but with limited knowledge of distributed programming) can be only minimally aware of such distribution.
The framework allowed only a static decomposition of the work among workers, and was not able to cope with load unbalance among them, therefore incurring in serious performance degradation where, for example, many of the agents were concentrate on one specific part of the space. We elaborated two strategies for ameliorate the balancing and enhance the synchronization among workers. We present their design principles and the experimental tests that validate our approach.

Paper 4
11:00 - 13:00 Room Dali
Special Session on Computationally Efficient Simulation-Driven Engineering Design Optimization and Modeling - SDDOM 2012

X-FEM based Topological Optimization Method

Meisam Abdi, Ian Ashcroft and Ricky Wildman
Loughborough University, Loughborough, U.K.

Keywords: Topology Optimization, Isoline, X-FEM, Eso.

Abstract: This study presents a new algorithm for structural topological optimization by combining the Extended Finite Element Method (X-FEM) with an evolutionary optimization algorithm. Taking advantage of an isoline design approach for boundary representation in a fixed grid domain, X-FEM can be implemented to obtain more accurate results on the boundary during the optimization process. This approach can produce topologies with clear and smooth boundaries without using a remeshing or a moving mesh algorithm. Also, reanalysing the converged solutions in NASTRAN confirms the high accuracy of the proposed method.

Paper 3
11:00 - 13:00 Room Dali
Special Session on Computationally Efficient Simulation-Driven Engineering Design Optimization and Modeling - SDDOM 2012

Managing Model Fidelity for Efficient Optimization of Antennas using Variable-resolution Electromagnetic Simulations

Slawomir Koziel, Stanislav Ogurtsov and Leifur Leifsson
Reykjavik University, Reykjavik, Iceland

Keywords: Computer-aided Design (CAD), Simulation-driven Design, Antenna Design, Electromagnetic Simulation, Surrogate Modelling.

Abstract: Electromagnetic (EM) simulation has become an important tool in the design of contemporary antenna structures. However, accurate simulations of realistic antenna models are expensive and therefore design automation by employing EM solver within an optimization loop may be prohibitive because of its high computational cost. Efficient EM-driven antenna design can be performed using surrogate-based optimization (SBO). A generic approach to construct surrogate models of antennas involves the use of coarse-discretization EM simulations (low-fidelity models). A proper selection of the surrogate model fidelity is a key factor that influences both the performance of the design optimization process and its computational cost. Despite its importance, this issue has not yet been investigated in the literature. Here, we focus on a problem of proper surrogate model management. More specifically, we carry out a numerical study that aims at finding a trade-off between the design cost and reliability of the SBO algorithms. Our considerations are illustrated using several antenna design cases. Furthermore, we demonstrate that the use of multiple models of different fidelity may be beneficial to reduce the design cost while maintaining the robustness of the optimization process.

Paper 6
11:00 - 13:00 Room Dali
Special Session on Computationally Efficient Simulation-Driven Engineering Design Optimization and Modeling - SDDOM 2012

Trawl-door Performance Analysis and Design Optimization with CFD

Eirikur Jonsson, Leifur Leifsson and Slawomir Koziel
Reykjavik University, Reykjavik, Iceland

Keywords: Trawl-doors, CFD, Design Optimization, Space Mapping, Surrogate-based Optimization, Variable-resolution Modeling, Simulation-driven Design.

Abstract: Rising fuel prices and inefficient fishing gear are hampering the fishing industry. In this paper, we present a computational fluid dynamic (CFD) model to analyse the hydrodynamic performance of trawl-doors, which are a major contributor to the high fuel consumption of fishing vessels. Furthermore, we couple the CFD model with an efficient design optimization technique and demonstrate how to redesign the trawl-door shapes for minimum drag at a given lift. The optimization techinique is surrogate-based and employs a coarse discritization CFD model with relaxed convergence criteria. The surrogate model is constructed using the physics based low-fidelity model and space mapping. The CFD model is applied to the analysis of current trawl-door shapes and reveals that they are operated at low efficiency (with lift-to-drag ratios lower than 1), mainly due to massively separated flow. An example design optimization case study reveals that the angle of attack can be reduced significantly by re-positioning and tilting the leading-edge slats. The performance can be improved by as much as 24 times (attaining lift-ro-drag ratios around 24).

Paper 19
14:30 - 16:30 Room Velazquez
Parallel Session 2 - Application Domains, Formal Methods and Simulation Tools and Platforms

Elastomeric Seismic Isolators Behavior at Different Pads Thickness

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Federico Milani
Chem.Co Consultant, Occhiobello (RO), Italy

Keywords: Elastomeric Isolators, Hardness/Young's Modulus, Elastic Modulus/Thickness, Stretch-stress and Shear Behavior under Large Deformations, Numerical Simulations, Finite Element Method.

Abstract: A seismic isolator has the main function to be extremely deformable for horizontal forces, but at same time sufficiently stiff when loaded with vertical actions. These properties may be strongly influenced by both the isolator geometry (i.e. overall dimensions, number and thickness of rubber pads and steel laminas) and the mechanical properties of rubber pads. Mechanical properties of the pads, especially Young modulus, may be evaluated as a function of hardness, by means of consolidated empirical formulas. In this work, the influence of rubber pads thickness and hardness on both vertical and horizontal stiffness of realistic seismic isolators is discussed. Three full 3D Finite Element models referred to three different seismic isolators having different slenderness are analysed in detail in both vertical compression (elastic analysis) and simple shear in large deformations. Uniaxial and shear response of the seismic devices obtained numerically are finally critically compared, with the aim of evaluating the best compound to be used in practice.

Paper 30
14:30 - 16:30 Room Velazquez
Parallel Session 2 - Application Domains, Formal Methods and Simulation Tools and Platforms

Sigmapoint Approach for Robust Optimization of Nonlinear Dynamic Systems

Sebastian Recker
RWTH Aachen University, Aachen, Germany

Peter Kühl
BASF SE, Ludwigshafen, Germany

Moritz Diehl
KU Leuven, Leuven, Belgium

Hans Georg Bock
University of Heidelberg, Heidelberg, Germany

Keywords: Parametric Uncertainty, Optimal Control, Batch Process, Unscented Transformation.

Abstract: Mathematical models describing dynamic processes contain parametric uncertainties. Robust model-based optimization thus becomes a challenging task in process engineering. Current approaches either require high computational effort or they make use of oversimplified approximations that do not capture changes in the solution structure due to nonlinear effects of the uncertain parameters on the states of the process. In this paper we propose an improved optimization approach that uses sigmapoints to characterize the space of uncertain parameters. Propagating sigmapoints through the process model and directly using them in the optimization problem allows to capture relevant nonlinearities for the uncertain parameters. Main advantages of this simple yet elegant approach are the relatively low computational burden and the independence from the optimizer, as no further derivatives are needed. The approach is applied to two examples from process engineering, a batch distillation and a semibatch reactor.

Paper 61
14:30 - 16:30 Room Velazquez
Parallel Session 2 - Application Domains, Formal Methods and Simulation Tools and Platforms

Plant Level Framework for Material Flow in a Nuclear Reprocessing Facility

Hyo Jik Lee, Won Il Ko and Han Soo Lee
Korea Atomic Energy Research Institute, Daejeon, Korea, Republic of

Keywords: Plant Level Framework, Spent Nuclear Fuel Reprocessing, Pyroprocess, Mass Balance, Discrete Event Dynamic System.

Abstract: A plant level framework has been developed for a nuclear recycling facility. A plant level model generally consists of multi-tiered models. The bottommost tier is a unit process model regarding electro-chemical phenomenon. The middle tier is an operation model regarding mechanical handling of the process equipment. The topmost tier is a systemic integration in the level of the plant. Even though a unit process model is fundamental to build higher tier models it takes time to make a model with high fidelity. Therefore, a different strategy for a plant level model building is suggested in this study. One of the important issues that nuclear recycling process must consider is dynamic material flow, which could be done with the help of a unit process model. However, from plant level aspect, it can be simply obtained from mass balance sheet rather than understanding of electro-chemical behavior during process time. A plant level framework was suggested to be able to include dynamic material flow even without a unit process model. Thus, a more reliable unit process model can be added later selectively. The characteristic of the current framework was addressed and evaluated for further improvement. The current version of the plant-level-framework could provide many unforeseeable results which are difficult to obtain by intuition. Nevertheless, the next version will include more function to provide various analyses linked with other nuclear related codes.

Paper 23
14:30 - 16:30 Room Velazquez
Parallel Session 2 - Application Domains, Formal Methods and Simulation Tools and Platforms

Simulation and Multi-Objective Optimization of Vaccuum Ethanol Fermentation

Jules Thibault
University of Ottawa, Ottawa, Canada

Rubens Maciel Filho
Universidade Estadual de Campinas, Campinas, Brazil

Marina O. S. Dias, Tassia L. Junqueira, Otavio Cavalett, Charles D. F. Jesus, Carlos E. V. Rossell, Antonio Bonomi
Laboratório Nacional de Ciência e Tecnologia do Bioetanol - CTBE/CNPEM, Campinas, Brazil

Keywords: Ethanol Fermentation, in Situ Recovery, Vacuum Fermentation, Simulation, Optimization.

Abstract: With the overall objective of optimizing an integrated first and second generation bioethanol production plant, a simple illustrative example is first used to examine the advantages and challenges of using a combination of VBA and UniSim Design for multi-objective optimization. In this paper, the simulation and optimization of a vacuum fermentation system using glucose and xylose as substrates is performed. The simulation of the fermentation system and the optimization are performed in the VBA environment, while UniSim Design is used to provide thermodynamic data necessary to perform calculations and used to simulate the downstream portion of the fermentation vacuum system. The Pareto domain of the system was circumscribed based on three decision variables (starting time of vacuum, rate of broth removal by vacuum and condenser temperature) and four objective functions (minimum ethanol loss, maximum productivity, minimum residual sugars and minimum compression energy). The procedure developed has allowed to easily circumscribe the Pareto domain of this system and to observe clearly the compromises that are required when all objective functions are optimized simultaneously. Some challenges to overcome are the time required for exchanging information between VBA and UniSim Design and the risk of non-converging for complex problems. For this procedure to be implemented effectively for the integrated ethanol plant, some innovative measures need to be developed.

Paper 69
14:30 - 16:30 Room Valencia
Parallel Session 2 - Complex Systems Modeling and Simulation

Airflow and Particle Deposition in a Dry Powder Inhaler
A CFD Simulation

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CPERI, CERTH, Thermi, Greece

C. Kiparissides
Aristotle University of Thessaloniki, Thessaloniki, Greece

Keywords: Dry Powder Inhaler, Turbuhaler, CFD, Particle, Deposition.

Abstract: In this work the steady-state flow in a commercial dry powder inhaler device (i.e., Turbuhaler) is described. The DPI geometry is constructed in a CAD/CAM environment (i.e., CATIA v5) and then imported into GAMBIT where the geometry is discretized into a computational grid. The Navier-Stokes equations are solved using FLUENT (v6.3) considering different flow models, i.e., laminar, k-ε, k-ε RNG, and k-ω SST. Particle motion and deposition are described using an Eulerian-fluid/Lagrangian-particle approach. Flow and particle deposition for a range of mouthpiece pressure drops (i.e., 800-8800Pa), as well as particle sizes corresponding to single particles and aggregates (i.e., 0.5-20μm) are examined. The total volumetric outflow rate, the overall particle deposition

as well as the particle deposition sites in the DPI are determined. The transitional k-ω SST model for turbulent flow was found to produce results most similar to a reference Large Eddy Simulation solution as well as experimental results for the pressure drop in the DPI. Realistic particle deposition results could only be obtained by considering a nonideal sticking coefficient corresponding to a critical capture velocity of 2.7m/s. Overall, the simulation results are found to agree well with available experimental data for volumetric flow and particle deposition.

Paper 113
14:30 - 16:30 Room Valencia
Parallel Session 2 - Complex Systems Modeling and Simulation

Simulating Vaccination Control and Herd Immunity Threshold in EcoDemics

Yasaman Majdabadi Farahani and Robin Gras
University of Windsor, Windsor, Canada

Keywords: Agent-based Epidemiology, Herd Immunity, Vaccination, Ecosystem Simulation.

Abstract: Modeling infectious diseases and exploring immunization interventions has been a major concern for the last century. Deadly pandemics transmitted from animals to humans such as SARS, rabies, H1N1 and the lack of extensive parameters in most of the epidemic simulations, imposes a great importance on simulating realistic ecosystems to study different aspects of epidemics and mitigation strategies. To this end, EcoDemics was built upon EcoSim to model epidemics in an evolutionary ecosystem simulation. Due to the high mitigation capacity and significance of the immunization intervention, we explore vaccination techniques with various time delays and population proportions. Based on the herd immunity theory, the whole population can be protected against a contagious disease by vaccination of a fraction of individuals. We investigate this principle in EcoDemics and compare our results with real epidemics data.

Paper 87
14:30 - 16:30 Room Valencia
Parallel Session 2 - Complex Systems Modeling and Simulation

Modeling Cell Populations in Development using Individual Stochastic Regulatory Networks

Paweł Bednarz and Bartek Wilczyński
University of Warsaw, Warsaw, Poland

Keywords: Stochastic Simulation, Cellular Population, Regulatory Network, GPU Computing.

Abstract: We present a new approach to high level stochastic simulations of cell populations. The proposed method employs the Stochastic Logical Network (SLN) method for simulating independent regulatory processes occurring in individual cells allowing for efficient simulations of systems consisting of thousands of cells. The stochastic logical network model is extended to account for not only regulatory control of gene expression but other related processes such as: inter-cellular signaling, cell division and programmed cell death. In the paper, we present the method and several case studies, where the proposed approach is used to provide models of biological phenomena. These examples include community effect in gene expression, the role of negative feedback in growing epithelial cell lineage and the role of asymmetric cell division in cell fate choices. We present also an efficient implementation of the method using GPU computing and show that its performance is significantly better than that using CPU.

Paper 5
14:30 - 16:30 Room Dali
Special Session on Computationally Efficient Simulation-Driven Engineering Design Optimization and Modeling - SDDOM 2012

Challenges in Applying Optimization in the Design of Continuous Processes Case: Collaborative Optimizing Design of Pulp Fractionation Process

Mika Strömman, Ilkka Seilonen and Kari Koskinen
Aalto University, Aalto, Finland

Keywords: Process Design, Continuous Process, Optimization, Modelling, Collaboration, Pulp and Paper Industry.

Abstract: In order to make pulp and paper facility design more effective, simulation and optimization could be used more comprehensively during design. The structure and the operation of the mill should be designed simultaneously, and therefore bi-level multi-objective optimization (BLMOO) is a feasible method. Applying BLMOO in pulp and paper facility design requires changes in business processes of organizations involved. In this research, projects of applying optimizing design in example cases have been followed and a multi-organizational design process is defined. The process is then evaluated by expert interviews.

Paper 8
14:30 - 16:30 Room Dali
Special Session on Computationally Efficient Simulation-Driven Engineering Design Optimization and Modeling - SDDOM 2012

Microwave Design Optimization Exploiting Adjoint Sensitivity

Slawomir Koziel, Leifur Leifsson and Stanislav Ogurtsov
Reykjavik University, Reykjavik, Iceland

Keywords: Computer-aided Design (CAD), Simulation-driven Design, Microwave Design Optimization, Electromagnetic Simulation, Adjoint Sensitivity.

Abstract: Adjustment of geometry and material parameters is an important step in the design of microwave devices and circuits. Nowadays, it is typically performed using high-fidelity electromagnetic (EM) simulations, which might be a challenging and time consuming process because accurate EM simulations are computationally expensive. In particular, design automation by employing an EM solver in an numerical optimization algorithm may be prohibitive. Recently, adjoint sensitivity techniques become available in commercial EM simulation software packages. This makes it possible to speed up the EM-driven design optimization process either by utilizing the sensitivity information in conventional, gradient-based algorithms or by combining it with surrogate-based approaches. In this paper, we review several recent methods and algorithms for microwave design optimization using adjoint sensitivity. We discuss advantages and disadvantages of these techniques and illustrate them through numerical examples.

Paper 7
14:30 - 16:30 Room Dali
Special Session on Computationally Efficient Simulation-Driven Engineering Design Optimization and Modeling - SDDOM 2012

Transonic Wing Optimization by Variable-resolution Modeling and Space Mapping

Eirikur Jonsson, Leifur Leifsson and Slawomir Koziel
Reykjavik University, Reykjavik, Iceland

Keywords: Transonic Wing Design, CFD, Surrogate-based Optimization, Variable-resolution Modeling, Space Mapping.

Abstract: This paper presents an efficient aerodynamic design optimization methodology for wings in transonic flow. The approach replaces the computationally expensive high-fidelity CFD model in an iterative optimization process with a corrected polynomial approximation model constructed by a cheap low-fidelity CFD model. The output space mapping technique is used to correct the approximation model to yield an accurate predictor of the high-fidelity one. Both CFD models employ the RANS equations with the Spalart-Allmaras turbulence model, but the low-fidelity one uses a coarse mesh resolution and relaxed convergence criteria. Our method is applied to a constrained lift maximization of a rectangular wing at transonic conditions with 3 design variables. The optimized designs are obtained by using 50 low-fidelity CFD model evaluations to set up the approximation model and 7 to 8 high-fidelity model evaluations, equivalent to around 10 high-fidelity CFD model evaluations.

Paper 1
14:30 - 16:30 Room Sevilla
Special Session on Health Applications - HA 2012

MetSim: A Simulation Decision Support Tool using Meteorological Information for Short-Term Planning of Hospital Services

Paul Harper, John Minty
Cardiff University, Cardiff, U.K.

Sujit Sahu, Bernard Baffour
University of Southampton, Southampton, U.K.

Christophe Sarran
Met Office, Exeter, U.K.

Keywords: Forecasting Demand, Hospital Capacity Management, Weather, Simulation.

Abstract: Improved short-term predictions of hospital admissions and bed occupancy offer the potential to plan resource needs more accurately and effectively. The MetSim project explores the relationship between weather and health, building novel Bayesian models that are more sensitive to fluctuations in weather. Short-term forecasts of the numbers of admissions, categorised by age, gender and medical condition, are produced. In turn, coupled with predictions on length of stay and information on current occupancy, MetSim uses hazard ratios embedded within a simulation framework to provide forecasts of short-term bed needs. MetSim is a collaboration between Cardiff University, the University of Southampton, and the Met Office. Cardiff and Vale University Health Board and Southampton University Hospitals NHS Trust have guided the development of MetSim, provided data and piloted the tool.

Paper 2
14:30 - 16:30 Room Sevilla
Special Session on Health Applications - HA 2012

Sensitivity Analysis in Bed Capacity Studies including the Medical Staff's Decision Making

Cristina Azcárate[1], Julio Barado[2] and Fermín Mallor[1]

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[2] *Hospital of Navarre, Pamplona, Spain*

Keywords: Simulation, Decision Making Modelling, Sensitivity Analysis, Intensive Care Unit, Bed Capacity.

Abstract: This paper deals with capacity planning studies in intensive care units (ICU). Our aim is to provide a framework in which the discharge policy from an ICU can be modelled and included in a simulation model. This is a very unique contribution of this research. We highlight the influence of the assumed policy in the ICU quality of service. A high quality of service means a low percentage of rejected patients and a length of stay in the ICU as long as necessary for the patient recovery. We introduce a parameterized set of rules to mathematically model the discharging decisions made by the physicians of an ICU. Then we present a sensitivity study carried out for the ICU of the Hospital of Navarra in Spain. The set of discharge policies is represented in the space of the performance measures to distinguish efficient from no efficient policies. Finally, the sensitivity analysis is extended, firstly, by considering variation in the number of beds and, then, by varying the patient arrival ratio.

Paper 3
14:30 - 16:30 Room Sevilla
Special Session on Health Applications - HA 2012

How to Build an Agent-based Model to Assess the Impact of Co-payment for Health Services

Angela Testi, Michele Sonnessa and Elena Tànfani

University of Genova, Genova, Italy

Keywords: Agent-based Models, Economic Simulation, Health Care Financing.

Abstract: Some forms of co-payment are required in insurance markets to avoid moral hazard that in health sector entails excessive consumption and costs. Literature and empirical findings, however, do not agree about the effectiveness of co-payment in practical situations. Moreover, in health systems co-payment seems to be more aimed to help in financing than to reduce moral hazard. The final impact of co-payment is rather difficult to predict due to these conflicting aims. Assessing the impact of a co-payment policy is, however, very important, because it affects also the principles of universalistic health systems threatening equity attainment. The specific aim of this paper is to propose an Agent-based simulation model that allows both i) to take into account all these contradictory effects at the same time, ii) to compare different co-payment models. The model development is presented mixing empirical data with some stochastic assumptions the authors intend to test.

Paper 2
14:30 - 16:30 Room Madrid
Special Session on Applications of Modeling and Simulation to Climatic Change and Environmental Sciences - MSCCEC 2012

Use of Fuzzy Cognitive Maps for Climate System Stability Analysis

Carlos Gay García and Iván Paz Ortiz

Universidad Nacional Autónoma de México, Mexico City, Mexico

Keywords: Cognitive Maps, Climate System, Stability.

Abstract: In the present work we use fuzzy cognitive maps for the qualitative analysis of the earthâ€™s climate system dynamics. First of all, we identify the subsystems which determine, as a hole, the stability of the climatic system. Later we develop cognitive maps (knowledge networks) based on the documented relationships between the subsystems (nodes of the network). The relationships between the nodes can be precise (quantifiable) or fuzzy (not quantifiable). Once the map is built, we use the state vector and adjacent matrix technique to assess the response of the system (the system converges or diverges) to the changes in the input node values in order to identify the possibles feedback. Then the *Min-Max* criteria is used to evaluate the effect of the network over the nodes, according to the fuzzy weights assigned to the edges (causal relations between nodes). Finally, we discuss some possible changes in the network in order to show how the system dynamic can be modified and can lead the system into a desired equilibrium state.

Paper 3
14:30 - 16:30 Room Madrid
Special Session on Applications of Modeling and Simulation to Climatic Change and Environmental Sciences - MSCCEC 2012

Simple Fuzzy Logic Models to Estimate the Global Temperature Change Due to GHG Emissions

Carlos Gay García[1], Oscar Sánchez Meneses[1], Benjamín Martínez-López[1], Àngela Nebot[2] and Francisco Estrada[1]

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[2] *Universitat Politècnica de Catalunya, Barcelona, Spain*

Keywords: Fuzzy Inference Models, Greenhouse Gases Future Scenarios, Global Climate Change.

Abstract: Future scenarios (through 2100) developed by the Intergovernmental Panel on Climate Change (IPCC) indicate a wide range of concentrations of greenhouse gases (GHG) and aerosols, and the corresponding range of temperatures. These data, allow inferring that higher temperature increases are directly related to higher emission levels of GHG and to the increase in their atmospheric concentrations. It is evident that lower temperature increases are related to smaller amounts of emissions and, to lower GHG concentrations. In this work, simple linguistic rules are extracted from results obtained through the use of simple linear scenarios of emissions of GHG in the Magicc model. These rules describe the relations between the GHG, their concentrations, the radiative forcing associated with these concentrations, and the corresponding temperature changes. These rules are used to build a fuzzy model, which uses concentration values of GHG as input variables and gives, as output, the temperature increase projected for year 2100. A second fuzzy model is presented on the temperature increases obtained from the same model but including a second source of uncertainty: climate sensitivity. Both models are very attractive because their simplicity and capability to integrate the uncertainties to the input (emissions, sensitivity) and the output (temperature).

Paper 4
14:30 - 16:30 Room Madrid
Special Session on Applications of Modeling and Simulation to Climatic Change and Environmental Sciences - MSCCEC 2012

Prediction of PM2.5 Concentrations using Fuzzy Inductive Reasoning in Mexico City

Àngela Nebot and Francisco Mugica

Technical University of Catalonia, Barcelona, Spain

Keywords: Air Pollution Prediction, $PM_{2.5}$ Pollution, Fuzzy Inductive Reasoning (FIR), Time Series Analysis.

Abstract: The research presented in this paper is focused on the study and development of fuzzy inductive reasoning models that allow the forecasting of daily particulate matter with diameter of 2.5 micrometres or less (PM2.5). FIR offers a model-based approach to modelling and predicting either univariate or multivariate time series. In this research, predictions of $PM_{2.5}$ concentration at hour 12 of the next day, in the downtown of Mexico City Metropolitan Area, are performed. The data were registered every hour and include missing values. In this work the hourly modelling perspective is analyzed. The results are compared with the ones obtained using persistence models showing that the FIR models are able to predict $PM_{2.5}$ concentrations more accurately than persistence models.

Paper 5
14:30 - 16:30 Room Madrid
Special Session on Applications of Modeling and Simulation to Climatic Change and Environmental Sciences - MSCCEC 2012

Rings in the Gulf of Mexico and Stochastic Resonance

Benjamín Martínez-López, Jorge Zavala-Hidalgo and Carlos Gay García

National Autonomous University of Mexico, Mexico, Mexico

Keywords: Gulf of Mexico, Ring Shedding, Reduced Gravity Model, Seasonal Forcing, Stochastic Resonance.

Abstract: In this work, we used a nonlinear, reduced gravity model of the Gulf of Mexico to study the effect of a seasonal variation of the reduced gravity parameter on ring-shedding behaviour. When small amplitudes of the seasonal variation are used, the distributions of ring-shedding periods are bi-modal. When the amplitude of the seasonal variation is large enough, the ring-shedding events shift to a regime with a constant, yearly period. If the seasonal

amplitude of the reduce gravity parameter is small but a noise term is included, then a yearly regime is obtained, suggesting that stochastic resonance could play a role in the ring-shedding process taking place in the Gulf of Mexico.

17:00 - 18:00 Room Plenary
Exploiting Uncertainty and Error to Accelerate Simulations
Keynote Speaker: David M. Nicol

Exploiting Uncertainty and Error to Accelerate Simulations

David M. Nicol

University of Illinois, Urbana-Champaign, Urbana, U.S.A.

Abstract: A simulation modeler constantly makes choices about abstractions, particularly in definition of entity state, and the granularity of temporal activity in the model. It is well known and highly practiced that higher levels of abstraction typically lead to less computational activity per unit simulation unit, and hence faster advancement of the simulation clock with respect to the real-time clock. At heart, the modeler accepts more error (with respect to the physical system being simulated) to accelerate the simulation. In our recent work we've explored other ways to exploit uncertainty and/or error in a model, with the express intent of supporting faster execution times, particularly on parallel simulations. This talk covers the main concepts, and illustrates the approach through examples drawn from the modeling and simulation of computer and communication networks.

Sunday Sessions

Paper 46
09:15 - 10:45 Room Velazquez
Parallel Session 3 - Simulation Tools and Platforms

Observations of Discrete Event Models

Gauthier Quesnel, Ronan Trépos
INRA, Castanet-Tolosan, France

Éric Ramat
ULCO, Calais Cedex, France

Keywords: Simulation, Discrete Event Systems, DEVS Formalism, Observation, Methodology.

Abstract: The observation of a simulation is an important task of the modeling and simulation activity. However, this task is rarely explained in the underlying formalism or simulator. Observation consists to capture the state of the model during the simulation. Observation helps understand the behavior of the studied model and allows improving, analyzing or debugging it. In this paper, we focus on appending an observation mechanism in the *Parallel Discrete Event System Specification* (PDEVS) formalism with guarantee of the reproducible simulation with or without observation mechanism. This extension to PDEVS allows us to observe models at the end of the simulation or according to a time step. Thus, we define a formal specification of this extension and its abstract simulators algorithms. Finally, we present an implementation in the DEVS framework VLE.

Paper 57
09:15 - 10:45 Room Velazquez
Parallel Session 3 - Simulation Tools and Platforms

A Simple Efficient Technique to Adjust Time Step Size in a Stochastic Discrete Time Agent-based Simulation

Chia-Tung Kuo, Da-Wei Wang and Tsan-sheng Hsu
Academia Sinica, Taipei, Taiwan

Keywords: Simulation, Step Size, Efficiency, Granularity.

Abstract: This paper presents a conceptually simple approach on adjusting the time step size in a stochastic discrete time agent-based simulation and demonstrates how this could be done in practical implementation. The choice of time step size in such a system is often based on the nature of the phenomenon to be modelled and the tolerated simulation time. A finer time scale may be desired upon the introduction of new events which could possibly change the system state in smaller time intervals. Our approach divides each original time step into any integral number of equally spaced sub-steps based on simple assumptions, and thus allows a simulation system to incorporate such events and produce results with finer time scale. Regarding the tradeoff between finer scale and higher use of resource, our approach also highlights the implementation techniques that increase the resource usage and simulation time only marginally. We analyze the results of this refinement on a stochastic simulation model for epidemic spread and compare the results with the original system without refinement.

Paper 81
09:15 - 10:45 Room Velazquez
Parallel Session 3 - Simulation Tools and Platforms

A Model-driven Approach to Build HLA-based Distributed Simulations from SysML Models

Paolo Bocciarelli, Andrea D'Ambrogio and Gabriele Fabiani
University of Rome "Tor Vergata", Rome, Italy

Keywords: SysML, HLA, Simulation, Model-driven, QVT.

Abstract: The analysis and design of complex systems, which very often are composed of several sub-systems, takes advantages by the use of distributed simulation techniques. Unfortunately, the development of distributed simulation systems requires a significant expertise and a considerable effort for the inherent complexity of available standards, such as HLA. This paper introduces a model-driven approach to support the automated generation of HLA-based distributed simulations starting from system descriptions specified by use of SysML (Systems Modeling Language), the UML-based general purpose modeling language for systems engineering. The proposed approach is founded on the use of model transformation techniques and relies on standards introduced by the Model Driven Architecture (MDA). The method exploits several UML models that embody the details required to support two transformations that automatically map the source SysML model into a HLA-specific model and then use the latter to generate the Java/HLA source code. To this purpose, this paper also introduces two UML profiles, used to annotate UML diagrams in order both to represent HLA-based details and to support the automated generation of the HLA-based simulation code.

Paper 53
09:15 - 10:45 Room Valencia
Parallel Session 3 - Application Domains

Machine Modelling for Transient Stability Analysis in Distribution Grids
A Comparison of Synchronous and Induction Machine Models in Medium and Low Voltage Grids

Johannes Weidner and Lutz Hofmann
Leibniz University Hannover, Hannover, Germany

Keywords: Transient Stability, Distribution Grid, Machine Modelling, Distributed Generation.

Abstract: The complete models for synchronous and induction machines are compared with selected approximated models. This is to validate the approximations for the utilisation in transient stability analysis in distribution grids. The results show that they can be used to simulate stable oscillations, but they lose their accuracy approaching the area of transient instability. The main reason is the active power exchange during faults, which is not jumping to zero as it does in high voltage scenarios.

Paper 75
09:15 - 10:45 Room Valencia
Parallel Session 3 - Application Domains

Simulation of Photovoltaics for Defence Applications
Power Generation Assessment and Investigation of the Available Integration Areas of Photovoltaic Devices on a Virtual Infantryman

Ioannis Paraskevopoulos and Emmanuel Tsekleves
Brunel University, London, U.K.

Keywords: 3D Simulation, Virtual Reality, Photovoltaic, Solar Energy Harvesting, Computer Simulation, Infantry Soldier, Product Integrated Photovoltaics (PIPV), Wearable Photovoltaics.

Abstract: The use of photovoltaic (PV) technology for the harvesting of renewable energy is a reality and is widely employed today. However this is mainly focused towards house and industry energy harvesting. Recent development in thin and flexible materials mean that photovoltaic technology can be integrated into wearable computing and expanded to other commercial as well as defence applications. This paper presents work under the Solar Soldier project that aims to assess the incorporation of flexible PV technology on the modern infantry soldier through the modelling and simulation of virtual military scenarios. The scenarios consist of various military operational terrains, various lighting conditions as well as motions of the virtual infantry soldier. The scenarios are simulated in a systematic way and for numerous global positions of military interest. The results of these simulations are then organised and presented in a manner leading to the assessment of the power generation potential per scenario and investigation of the optimum integration areas of flexible PV devices on the infantryman.

Paper 111
09:15 - 10:45 Room Valencia
Parallel Session 3 - Application Domains

Optimizing Energy using Probabilistic Routing in Underwater Sensor Network

Sanjay K. Dhurandher[1], Mohammad S. Obaidat[2], Abhishek Gupta[1], Prateek Gupta[1] and Siddharth Goel[1]
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Keywords: Underwater Sensor Networks, Probabilistic Routing, Simulation Analysis, Performance Evaluation.

Abstract: As the Importance of Applications, Such as Ocean Sampling, Environmental Monitoring, Disaster Prevention, and Distributed Tactical Surveillance, Has Recently Grown, the Need for Underwater Communication Has Become More Pronounced. unlike Terrestrial Sensor Networks, Underwater Sensor Networks (Uwsns) Have Different Characteristics Such as a Long Propagation Delay, a Narrow Bandwidth and High Packet Loss.Considering the Various Challenges Posed by the Underwater Environment, a Routing Algorithm Has Been Proposed in This Paper. the Algorithm Consists of Special Features, including Three Different Types of Nodes in the Architecture Proposed, a Mathematical Formula in Order to Select the next Node to Be Used for Transmission. The Major Aim of the Algorithm Is to Select the next Node to Be Used for Successful Data Delivery, and Ensure Minimum Energy Consumption. the next Node Is Chosen With Utmost Care in Order to Increase the Probability of Successful Data Delivery. the Packet Is Transferred from the Source to the Sub-Destination by Exploiting Minimum Energy of the Nodes. the Simulation Studies for the Protocol Were Conducted using AQUA-GLOMO Network Simulator. the Protocol Was Benchmarked With DSR Routing Protocol. The Matrices That Were Considered for the Simulation Study Were Throughput, PDR, Energy Consumption and Delay and It Was Observed That Our Proposed Model Performed Better in the Underwater Environment.

Paper 99
09:15 - 10:45 Room Madrid
Parallel Session 3 - Complex Systems Modeling and Simulation

Fast Assessment of Wildfire Spatial Hazard with GPGPU

Donato D'Ambrosio, Salvatore Di Gregorio, Giuseppe Filippone, Rocco Rongo, William Spataro
University of Calabria, Rende, Italy

Giuseppe A. Trunfio
University of Sassari, Alghero, Italy

Keywords: GPGPU, Cellular Automata, Wildfire Simulation, Wildfire Susceptibility, Hazard Maps.

Abstract: In the field of wildfire risk management the so-called *burn probability maps* (BPMs) are increasingly used with the aim of estimating the probability of each point of a landscape to be burned under certain environmental conditions. Such BPMs are computed through the explicit simulation of thousands of fires using fast and accurate simulation models. However, even adopting the most optimized simulation algorithms, the building of simulation-based BPMs for large areas results in a highly intensive computational process that makes mandatory the use of high performance computing. In this paper, General-Purpose Computation with Graphics Processing Units (GPGPU) is applied, in conjunction with a specifically devised wildfire simulation model, to the process of BPM building. Using two different GPGPU devices, the paper illustrates two different implementation strategies and discusses some numerical results obtained on a real landscape.

Paper 112
09:15 - 10:45 Room Madrid
Parallel Session 3 - Complex Systems Modeling and Simulation

Agent based Modelling and Simulation using State Machines

Ilias Sakellariou
University of Macedonia, Thessaloniki, Greece

Keywords: Agent Simulation Platforms, Agent Programming Languages, Crowd Simulation.

Abstract: Although agent based modelling has drawn significant attention in the recent years, with a significant number of simulation platforms proposed, the latter target usually relatively simple reactive agents. Thus, little has been done toward enhancing the modelling capabilities of platforms with richer agent oriented programming constructs that could potentially lead to the implementation of more sophisticated models. This paper presents an extension to the TSTATES library that aims to support the implementation of state based intelligent agents and a more complex example drawn from the pedestrian simulation domain that demonstrates the potential of the library in programming complex agent systems.

Paper 34
09:15 - 10:45 Room Madrid
Parallel Session 3 - Complex Systems Modeling and Simulation

Two Modes of Scheduling in a Simple Economic Agent-Based Model

Sarah Wolf[1,2], Steffen Fürst[1,2], Sophie Knell[2], Wiebke Lass[2], Daniel Lincke[1,2], Antoine Mandel[3], Jonas Teitge[2] and Carlo Jaeger[1]
[1] *Global Climate Forum, Berlin, Germany*
[2] *Potsdam Institute for Climate Impact Research, Potsdam, Germany*
[3] *Université Paris 1 Panthéon-Sorbonne, Paris, France*

Keywords: Economic Agent-based Models, Scheduling, Climate Policy, Win-win Strategies.

Abstract: Agent-based models (ABMs), and with them simulation, are gaining importance in economics. As they allow to study coordination problems in a dynamic setting, they can be helpful tools for identifying win-win strategies for climate policy. This paper argues that strongly simplified models can support a better understanding of economic ABMs. We present work in progress on an example case: while in economic systems in the real world many actions and interactions by various agents take place in parallel, often ABMs use sequential computation. With a simple economic agent-based model of firms that trade and produce goods, we explore and discuss two alternative modes of scheduling: the *timetable model*, where all agents complete one step after the other, and the heliotropic model, where one agent after the other completes steps. We find that the timetable model is better suited for working with data from national statistics, while the *heliotropic model* dispenses with random shuffling that is often introduced to guarantee symmetric expectations for agents. The latter can be used in a completely deterministic fashion, providing a baseline case for studying the system's dynamics.

Paper 17
11:00 - 12:00 Room Velazquez
Parallel Session 4 - Simulation Tools and Platforms

Rate-based Simulation of Coke Calcination in Rotary Kilns

E. M. Elkanzi, F. S. Marhoon and M. J. Jasim
University of Bahrain, Isa Town, Bahrain

Keywords: Rotary Kiln, Calcining Processes, Rate-based HYSYS Simulation.

Abstract: This paper presents the simulation of the green petroleum coke calcining processes using the simulation program ASPEN HYSYS. The results are validated using actual industrial data. The present study provides a detailed description of the rate-based simulation. It considers the rate of physical and chemical phenomena of interest: the rate of moisture removal, the rate of volatile matter release and combustion, and the rate of coke dust and sulfur combustion. Data supplied by a local coke calcining kiln in operation are used to validate the simulation results. It is found that the rate-based simulation can be implemented as a useful tool to predict the operating conditions needed to control the content of undesirable impurities in the calcined petroleum coke, namely, sulfur, volatile matter and moisture contents. Except for the metal content, the simulation shows that it is possible for the kiln operator to process any type of green coke for varying sulfur, volatile matter and water contents by adjusting the amount of tertiary air and/or fuel.

Paper 25
11:00 - 12:00 Room Velazquez
Parallel Session 4 - Simulation Tools and Platforms

Simulation of Shallow-water Flows in Complex Bay-like Domains

Yuri N. Skiba
National Autonomous University of Mexico (UNAM), Mexico City, Mexico

Denis M. Filatov
National Polytechnic Institute (IPN), Mexico City, Mexico

Keywords: Simulation of Fluid Dynamics Problems, Shallow-water Flows, Conservative Finite Difference Schemes, Complex Computational Domain, Closed and Open Boundaries.

Abstract: A new numerical method for the simulation of shallow-water flows in a bay-like domain is suggested. The method is based on the splitting of the original nonlinear operator by physical processes and by coordinates. An essential advantage of our finite difference splitting-based method versus others in the field is that it leads to a model allowing accurate simulation of shallow-water flows in a domain of an arbitrary shape with both closed and open boundaries, which besides may contain onshore parts inside (interior isles in the bay); the model also takes into account irregular bottom topography. Specially constructed approximations of the temporal and spatial derivatives result in second-order unconditionally stable finite difference schemes that conserve the mass and the total energy of the discrete inviscid unforced shallow-water system. Moreover, the potential enstrophy results to be bounded, oscillating in time within a narrow range. Therefore, the numerical solution, aside from being accurate from the mathematical point of view, appears to be physically adequate, inheriting a number of substantial properties of the original differential shallow-water system. Furthermore, the method can straightforwardly be implemented for distributed simulation of shallow-water flows on high-performance parallel computers. To test the method numerically, we start with the inviscid shallow-water model and verify the conservatism of the schemes in a simple computational domain. Then we introduce a domain with a more complex boundary consisting of closed and open segments, and consider more realistic viscous wind-driven shallow-water flows. Numerical experiments presented confirm the skills of the developed method.

Paper 10
11:00 - 12:00 Room Valencia
Parallel Session 4 - Application Domains

The Improved SSR Electromagnetic Simulation Model and Its Comparison with Field Measurements

Xiaorong Xie[1], Yipeng Dong[1], Kai Bai[2], Xun Gao[3] and Ping Liu[2]
[1] *Tsinghua University, Beijing, China*
[2] *North China Electric Power Research Institute Co., Ltd, Beijing, China*
[3] *North China Grid Co., Ltd, Beijing, China*

Keywords: Subsynchronous Resonance, Electromagnetic Simulation, Series Compensation.

Abstract: Electromagnetic simulation (EMS) plays an important role in the evaluation of subsynchronous resonance (SSR). To meet the requirement of practical engineering, this paper discusses how to improve the modeling method of SSR-EMS in three important aspects, i.e., the shaft system of turbine generator, the series compensation and the supplementary excitation damping controller (SEDC). Thus a systematically improved EMS model was put forward, which includes a lumped mass-spring model with adjustable and non-linear mechanical damping,

a series compensation model incorporating MOV with the gap protection logic and an engineering model of SEDC to reflect the dynamics of the power-electronic exciter. The developed model overcomes the shortage of the traditional one and is applicable to the accurate analysis on SSR stability, transient torque and fatigue expenditure when the system experiences large disturbances. The proposed method is then used for the simulation of a real SSR event caused by a short-circuit fault in the Shangdu series-compensated power system. The simulation results are compared with the field measurements and a good consistence is found. Consequently, the improved EMS model is proved to be applicable, accurate and effective for SSR analysis in practical engineering.

Paper 48
11:00 - 12:00 Room Valencia
Parallel Session 4 - Application Domains

Optimizing Operation Costs of the Heating System of a Household using Model Predictive Control Considering a Local PV Installation

Cosmin Koch-Ciobotaru
Politehnica University of Timisoara, Timisoara, Romania

Fridrik Rafn Isleifsson, Oliver Gehrke
Technical University of Denmark, Roskilde, Denmark

Keywords: Model Predictive Control, Optimization, Cost Minimization, Dynamic Thermal Storage, PV Penetration.

Abstract: This paper presents a model predictive controller developed in order to minimize the cost of grid energy consumption and maximize the amount of energy consumed from a local photovoltaic (PV) installation. The usage of as much locally produced renewable energy sources (RES) as possible, diminishes the effects of their large penetration in the distribution grid and reduces overloading the grid capacity, which is an increasing problem for the power system. The controller uses 24 hour prediction data for the ambient temperature, the solar irradiance, and for the PV output power. Simulation results of a thermostatic controller, a MPC with grid price optimization, and the proposed MPC are presented and discussed.

12:00 - 13:00 Room Plenary
The Richness of Modeling and Simulation and Its Body of Knowledge
Keynote Speaker: Tuncer Ören

The Richness of Modeling and Simulation and Its Body of Knowledge

Tuncer Ören
University of Ottawa, Ottawa, Canada

Abstract: Development of a Body of Knowledge (BoK) Index of Modeling and Simulation (M&S) to satisfy the requirements of several types of stakeholders is urgently needed. The richness of M&S, which provides a vital infrastructure to hundreds of application areas, can only be reflected by an appropriate BoK Index, if wide scopes of all its many aspects are taken into consideration. To explore the richness of M&S, its several dimensions as well as highlights of over 400 application-independent types of simulation will be presented.

Paper 15
14:30 - 16:30 Room Velazquez
Parallel Session 5 - Application Domains and Simulation Tools and Platforms

Simulation of Backflow in Automotive Body Assemblies

Jaedeuk Yun, Sunghoon Lee, Jianhui Fu, Jungwoon Lee, Yoongho Jung
Pusan National Univ., Busan, Korea, Republic of

Sungbae Park
Hyundai Motor Company, Ulsan, Korea, Republic of

Keywords: Drainage, Backflow, Octree, Voxel, Gap, CAD.

Abstract: The many parts required for aircraft and automotive development are developed by functional or sectional design groups for efficiency. Interferences and gaps can be found when the parts and subassemblies from those design groups are to be assembled. When rainwater enters the spaces between parts and there is not sufficient drainage, the rainwater within the structure can backflow to gaps or unexpected outlets, which may cause severe problems of part corrosion and electric shock. We have developed a method and a program to simulate backflow of rainwater within spaces between automotive parts; the method can find unexpected outlets and gaps. The developed program can simulate not only simple liquid flows, but also division and joining of flows with multiple channels. The developed method can also be applied to aircraft and ship design.

Paper 18
14:30 - 16:30 Room Velazquez
Parallel Session 5 - Application Domains and Simulation Tools and Platforms

Mechatronic System Optimization based on Surrogate Models
Application to an Electric Vehicle

Moncef Hammadi, Jean-Yves Choley, Olivia Penas and Alain Riviere
SUPMECA-PARIS, Saint-Ouen, France

Keywords: Mechatronic Design, Optimization, Surrogate Models, Modelica, Electric Vehicle.

Abstract: Preliminary optimization of mechatronic systems is an extremely important step in the development process of multi-disciplinary products. However, long computing time in optimization based on multi-domain modelling tools need to be reduced. Surrogate model technique comes up as a solution for decreasing time computing in multi-disciplinary optimization. In this paper, an electric vehicle has been optimized by combining Modelica modelling language with surrogate model technique. Modelica has been used to model the electric vehicle and surrogate model technique has been used to optimize the electric motor and the transmission gear ratio. Results show that combining surrogate model technique with Modelica reduces significantly computing time without much decrease in accuracy.

Paper 47
14:30 - 16:30 Room Velazquez
Parallel Session 5 - Application Domains and Simulation Tools and Platforms

Job-shop Problems with Objectives Appropriate for Train Scheduling in a Single-track Railway

Omid Gholami
Islamic Azad Univeristy, Mahmudabad, Iran, Islamic Republic of

Yuri N. Sotskov
National Academy of Sciences of Belarus, Minsk, Belarus

Frank Werner
Otto-von-Guericke-University, Magdeburg, Germany

Keywords: Job-shop, Train Scheduling, Regular Criteria.

Abstract: A train scheduling problem in a single-track railway is studied using a mixed graph model for a job-shop with appropriate criteria. There are several performance evaluations for a train schedule. Optimizing a train schedule subtends minimizing total tardiness of the trains, minimizing the sum of train transit times, minimizing the makespan for a train schedule, etc. Since the corresponding job-shop problems with the above three criteria are NP-hard, several heuristic algorithms have been developed using different priorities based on the release times of the jobs, the job due-dates and the job completion times. Experiments on a computer were used for evaluating the quality and efficiency of the heuristic algorithms developed for appropriate job-shop problems. The release times, due-dates and completion times of the jobs have been used as input parameters (priorities) in the computer simulation to see the effect of them on the quality of the schedules with different objective functions. The efficiency of the developed heuristics was demonstrated via a simulation on a set of randomly generated instances of small and medium sizes. The computational results showed that one heuristic algorithm outperformed the other algorithms tested for two of the three objective functions under consideration.

Paper 82
14:30 - 16:30 Room Velazquez
Parallel Session 5 - Application Domains and Simulation Tools and Platforms

Enhancing the RAMSAS Method for System Reliability Analysis
An Exploitation in the Automotive Domain

Alfredo Garro and Andrea Tundis
University of Calabria, Rende (CS), Italy

Keywords: Reliability Analysis, Model-based Systems Engineering, SysML, Automotive Industry.

Abstract: The paper proposes an enhancement and exploitation of the RAMSAS method, a model-based method for system reliability analysis which combines in a unified framework the benefits of popular OMG modeling languages (UML, SysML) with the wide adopted Mathworks simulation and analysis environments (Matlab, Simulink). The flexibility and scalability of the proposal, as well as its effectiveness in evaluating through simulation the system reliability performances, is exemplified through a case study in the automotive domain.

Paper 91
14:30 - 16:30 Room Velazquez
Parallel Session 5 - Application Domains and Simulation Tools and Platforms

Flatness based Control of a 2 DOF Single Link Flexible Joint Manipulator

E. D. Markus, J. T. Agee, A. A. Jimoh
Tshwane University of Technology, Pretoria, South Africa

N. Tlale
CSIR, Pretoria, South Africa

B. Zafer
Kocaeli University, Kocaeli, Turkey

Keywords: Flexible Joint Manipulator, Differential Flatness, Position Control.

Abstract: The demand for high speed robotic manipulators with little or no vibrations has been a challenging research problem. In this paper, a position control for a 2 DOF single link flexible manipulator with joint elasticity is studied. It is shown that using the flatness control approach, faster response and less oscillations and overshoots can be achieved. The flat output of the linearized system is determined as the tip of the manipulator end effector. This output and a finite order of its derivatives is defined in terms of the input and states variables of the manipulator. Using the parameters of the output in flat space, a trajectory is planned and executed to test the effectiveness of the designed control.

Paper 92
14:30 - 16:30 Room Madrid
Parallel Session 5 - Simulation Tools and Platforms

A Simulation-based Scheduling Strategy for Scientific Workflows

Sergio Hernández, Javier Fabra, Pedro Álvarez and Joaquín Ezpeleta
University of Zaragoza, Zaragoza, Spain

Keywords: Scientific Workflows, Grid Modelling and Simulation, Workloads, Performance Analysis.

Abstract: Grid computing infrastructures have recently come up as computing environments able to manage heterogeneous and geographically distributed resources, being very suitable for the deployment and execution of scientific workflows. An emerging topic in this discipline is the improvement of the scheduling process and the overall execution requirements by means of simulation environments. In this work, a simulation component based on realistic workload usage is presented and integrated into a framework for the flexible deployment of scientific workflows in Grid environments. This framework allows researchers to simultaneously work with different and heterogeneous Grid middlewares in a transparent way and also provides a high level of abstraction when developing their workflows. The approach presented here allows to model and simulate different computing infrastructures, helping in the scheduling process and improving the deployment and execution requirements in terms of performance, resource usage, cost, etc. As a use case, the Inspiral analysis workflow is executed on two different computing infrastructures, reducing the overall execution cost.

Paper 52
14:30 - 16:30 Room Madrid
Parallel Session 5 - Simulation Tools and Platforms

A Framework to Provide Real Time Useful Knowledge in E-Learning Environments

Àngela Nebot, Francisco Mugica
Technical University of Catalonia, Barcelona, Spain

Félix Castro
Universidad Autónoma del Estado de Hidalgo, Mexico, Mexico

Keywords: Data Mining, E-Learning, Fuzzy Inductive Reasoning (FIR), Fuzzy Logic.

Abstract: This research presents a framework that provides valuable knowledge to teachers and students, mainly based on fuzzy logic methodologies. The framework offers the following knowledge: 1) gives a sets of rules describing the students' learning behaviour; 2) provides a relative assessment of the features involved in the students' evaluation performance, i.e. detects and assess the most important topics involved in the course evaluation process; 3) groups the learning behaviour of the students involved in online courses, in an incremental and dynamical way, with the ultimate goal to timely detect failing students, and properly provide them with a suitable and actionable feedback. In this paper the proposed framework is applied to the Didactic Planning course of Centre of Studies in Communication and Educational Technologies virtual campus. The application shows it usefulness, improving the course understanding and providing valuable knowledge to teachers about the course performance.

Paper 56
14:30 - 16:30 Room Madrid
Parallel Session 5 - Simulation Tools and Platforms

Reusing Simulation Models for Weapons Effectiveness Analysis

Kangsun Lee
MyongJi University, Kyunggi-Do, Korea, Republic of

Taesup Kim
KT ds, Kyunggi-Do, Korea, Republic of

Keywords: Reuse Repository, Ontology, Simulation-based Weapons Effectiveness Analysis.

Abstract: Simulation-based weapons effectiveness analysis involves complex modeling tasks to represent weapons, natural environment and operational environment. An integrated M&S (Modeling and Simulation) environment provides useful tools and services to partly automate the modeling tasks. Along with the M&S environment, a model repository can help model developers to ease the required tasks by sharing predefined and already validated models, generated from inside and outside the M&S environment. In this paper, we introduce our M&S environment, OpenSIM (Open Simulation Engine for Interoperable Models), and illustrate how the model repository in OpenSIM can enable users to reuse models for weapons effectiveness analysis. OpenSIM manages weapon ontology and thesaurus dictionaries to assess structural and contextual similarity between weapon models. We present semantic information and similarity measures of OpenSIM and illustrate how the model repository of OpenSIM helps users locate reusable weapon models.

Paper 77
14:30 - 16:30 Room Madrid
Parallel Session 5 - Simulation Tools and Platforms

Estimating Real Process Derivatives in on-Line Optimization
A Review

M. Mansour
USTHB, Algiers, Algeria

Keywords: on-Line Optimization, Model-based, Process Derivatives, ISOPE Algorithm, ANN.

Abstract: The solution of the Integrated System Optimization and Parameter Estimation (ISOPE) problem necessitates the calculus of real process output derivatives with respect to the inputs. This information is needed in order to satisfy first and second order optimality conditions. Several methods exist and have been developed for calculating these derivatives. In this paper a review of most of the existing methods is presented, in which the Finite Difference Approximation, Dual Control Optimization, Broydon's method, Dynamic Model Identification, with both linear and nonlinear models, together with a neural networks scheme are presented and applied, under simulation, to a cascade Continuous Stirred Tank Reactor (CSTR) system. The results are then discussed and compared to identify the advantages and disadvantages of using each method.

16:45 - 17:45 Room Plenary
Advances in e-Science and e-Research:
e-Infrastructures for Modelling and Simulation
Keynote Speaker: Simon Taylor

Advances in e-Science and e-Research: e-Infrastructures for Modelling and Simulation

Simon Taylor
Brunel University, Middlesex, U.K.

Abstract: Scientists today are exploiting exciting new developments in Information and Communication Technology such as high speed networks, high performance computing and distributed collaborative environments. These cyberinfastructures or e-Infrastructures are facilitating e-Science and e-Research and the formation of global virtual research communities capable of addressing challenging large scale problems with a critical mass of expertise. What does this mean for academic and industrial Modelling and Simulation? This presentation discusses how e-Infrastructure advances can be used to the benefit of modelling and simulation researchers and practitioners. The presentation asks if the development e-Infrastructures for Modelling and Simulation is really necessary or critical to making an urgently needed step-change in the field.

Monday Sessions

Paper 88
09:15 - 10:30 Room Velazquez
Parallel Session 6 - Application Domains, Formal Methods and Simulation Tools and Platforms

A Geometrical Refinement of Shape Calculus Enabling Direct Simulation

Federico Buti, Flavio Corradini, Emanuela Merelli and Luca Tesei
University of Camerino, Camerino, Italy

Keywords: Process Calculi, Spatial Simulation, Calculus Refinement, Computational Biology.

Abstract: The Shape Calculus is a bio-inspired timed and spatial calculus for describing 3D geometrical shapes moving in a space. Its purpose is twofold: i) modelling and formally verifying (not only) biological systems, and ii) simulating the models for validation and hypothesis testing. The original geometric primitives of the calculus are highly abstract: the associated simulator needs to attach a lot of code to the model specification in order to perform an effective simulation. In this work we propose a calculus refinement in which a detailed 3D characterization of the geometric primitives is injected into the syntax of the calculus. In this way, models written with the new syntax can be directly simulated.

Paper 79
09:15 - 10:30 Room Velazquez
Parallel Session 6 - Application Domains, Formal Methods and Simulation Tools and Platforms

Automatic Design Optimisation of Pharmaceutical Tablets using PDEs

Norhayati Ahmat[1,2], Gabriela González Castro[1] and Hassan Ugail[1]
[1] *University of Bradford, Bradford, U.K.*
[2] *Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, Perak, Malaysia*

Keywords: Pde Method, Parametric Surfaces, Pharmaceutical Tablets, Automatic Optimisation.

Abstract: Pharmaceutical tablets and capsules are the dominant forms for drug delivery. Both types of dosage forms need to be strong enough to handle different types of stress due to packaging and loading conditions before use. Hence, it is important to produce these pharmaceutical forms with maximum mechanical strength while conserving the properties of their active ingredients during the design process. The present work describes a methodology for parametric design and optimisation of a solid cylindrical tablet and a soft spherical capsule, which is based on the use of Partial Differential Equations (PDEs). The PDE-based formulation is capable of parameterising complex shapes using the information at some boundary curves that describe the shape. It is shown that the optimal designs of both tablet and capsule can be obtained using an automatic design optimisation which is performed by combining the PDE method and a standard method for numerical optimisation.

Paper 80
09:15 - 10:30 Room Velazquez
Parallel Session 6 - Application Domains, Formal Methods and Simulation Tools and Platforms

A Structuring Mechanism for Embedded Control Systems using Co-modelling and Co-simulation

Xiaochen Zhang and Jan F. Broenink
University of Twente, Enschede, The Netherlands

Keywords: Model Structuring, Collaborative Modelling, Co-simulation, Embedded Control System.

Abstract: In most embedded control system (ECS) designs, multiple engineering disciplines and various domain-specific models are involved, such as embedded software models in discrete-event (DE) domain and dynamic plant model in continuous-time (CT) domain. In this paper, we advocate collaborative modelling and co-simulation to verify different aspects of the system as a whole before implementation. This paper proposes a development approach and structuring mechanism for CT-intensive ECS designs using co-modelling and co-simulation techniques. Based on this approach, an integrated co-model can be developed and refined using different domain-specific languages and tools. Influences from one domain to the other can be simulated via cosimulation and analysed in both perspectives. Our structuring and development process has been applied to a mobile robot using this co-simulation technique. We have experienced that structuring the co-modelling process allows us to produce co-models an co-simulations effectively. Future work is on checking for model inconsistencies during collaboration, and provide approaches to deal with this.

Paper 55
09:15 - 10:30 Room Valencia
Parallel Session 6 - Complex Systems Modeling and Simulation

A Combined DTA Approach for Road Network Robustness Analysis

Minwei Li[1], Henk J. van Zuylen[2] and Huimin Wen[1]
[1] *Beijing Transportation Research Center, Beijing, China*
[2] *Delft University of Technology, Delft, The Netherlands*

Keywords: Combined DTA, Road Network, Robustness.

Abstract: In this paper a DTA model with two components is described: a user equilibrium (UE) model and an en-route model. The UE model is called MARPLE (Model for Assignment and Regional Policy Evaluation) that uses an iterative process to achieve equilibrium (deterministic or stochastic) (Taale *et al.*, 2004). In each iteration a network loading model is used to determine travel times. MARPLE en-route is developed based on the MARPLE model, which runs one-shot simulation starting with the equilibrium assignment results. It updates the path sets and path costs after each evaluation interval during the simulation. Travellers will update their path choice according to the instantaneous path costs at the end of each interval using some heuristic rules. A systematic framework for the robustness study of road networks is built up by combining both DTA approaches, in which the results of UE approach are used as references and en-route approach is used to simulate the network response for non-recurrent and short-term disturbances. The results for a hypothetical network show that for evaluating the network performance after such disturbances, the en-route assignment approach based on UE assignment results shows its capability and advantages in appropriately representing dynamic driver's route choice behaviour when facing unfamiliar or unexpected situations on the route.

Paper 72
09:15 - 10:30 Room Valencia
Parallel Session 6 - Complex Systems Modeling and Simulation

SysML Parametric Models for Complex System Performance Analysis A Case Study

Nga Nguyen and Hubert Kadima
EISTI, Cergy, France

Keywords: Model-based System Engineering, SysML Parametric Diagram, Performance Analysis, Cruise Control.

Abstract: Parametric analysis is an essential tool in optimizing the performance of any system; it is, in particular, used to fine-tune key parameters in a system design process. In this paper, using a vehicle cruise control system as a non-trivial case study, we introduce a new approach for the performance parametric analysis of complex systems using SysML models and a parametric constraint solver. System requirements are taken into account to verify automatically whether the design solutions satisfy these requirements. This suggests that in order to reduce time and resources, it is possible to perform initial performance analysis in a modeling tool, just after the system functional and architectural analyses. Of course, once an approximate operating point has been determined using this approach, experiments in specialized simulation tools can be used to confirm and further refine the parameters of a system.

Paper 14
10:30 - 11:30 Foyer
Poster Session 1

An Approach to Implementation of Physical Simulation Models

Shpakov Vladimir
St.Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, St.Petersburg, Russian Federation

Keywords: Process-Oriented, Hybrid Simulation, Model Design, Transitive Model, Rule-based Approach.

Abstract: Advantages of a rule-based approach to dynamic system physical models specification and implementation are discussed. Much need for the approach at the modern state of system engineering is pointed out. In particular, such an approach may be useful for simulation of control and self-organizing systems. A rule-based situation formalism of an interacting hybrid processes

specification is briefly stated and some ways of its use for physical simulation model implementation are shown. Facilities of the considered methods are illustrated by examples of some simple dynamic system models implementations. Specifications of these physical models and some results of simulation are presented.

Paper 16
10:30 - 11:30 Foyer
Poster Session 1

Strategic and Standardized Simulation of a Distribution Network
A Case for a Drugstore Company in Mexico

Homero H. Contrera, José Pablo Nuño
UPAEP University, Puebla, Mexico

Eric Porras, Eduardo Zelaya
ITESM-Santa Fe, México, Mexico

Keywords: Simulation, Standardized Model, Multi-echelon Inventory, Distribution Network.

Abstract: Analysis of distribution network is a crucial issue in supply chain management. There is a vast array of analysis tools for logistics, but analytic tools cannot deal with the inherited variability. Thus, simulation might be a better alternative, and the use of standardized models represents a promising areas. In this paper, a simulation model facing a strategic approach will be proposed as a way to analyze a distribution network based on model consisting of two-echelons; this model can work both forwards and backwards in a recursive manner, and relies on operative key performance indicators that affect the strategy in the long term. Using a standardized model increases flexibility, focus the problem and provides a better computer performance. The model is validated through a business case for a Mexican company dealing with bottom of pyramid clients in the drugstore sector.

Paper 27
10:30 - 11:30 Foyer
Poster Session 1

Simulative Model and Multicriteria Optimization of Truss Beam in Super-Large Columns at High Temperature

Yanzhen Liu, Hong Gao and Jinsheng Sun
Tianjin University, Tianjin, China

Keywords: Truss Beam, Multicriteria Optimization, Super-Large Column, Finite Element Analysis, Side Beam.

Abstract: With the increasingly enlarged process scale and the consequent requirement for large equipment, such as column, trusses ever widely applied in civil and building engineering have been introduced in petroleum chemical industry these years. Under this circumstance, truss structure optimization emerges as a study focus to balance safety, durability and economy. In this paper, an optimization example is introduced of a main truss beam system, namely centre, and its side beams in super-large column at high temperature. The main truss beam is optimized on three counts, that is, cross-section shape of the chord members, structure height and the pairs of the web members, while side beams are optimized by compromising among workability, stress, stiffness and weight.

Paper 35
10:30 - 11:30 Foyer
Poster Session 1

Parametric Study of Complex Liquid Flow in a Centrifugal Pump Consisting of an Impeller, a Volute and a Diffuser

Guyh Dituba Ngoma, Walid Ghie and Nicolas La Roche-Carrier
University of Quebec in Abitibi-Témiscamingue, Rouyn-Noranda, Canada

Keywords: Centrifugal Pump, Impeller, Volute, Diffuser, Turbulence, CFD, Modeling and Simulation.

Abstract: In this work, the numerical investigation of the complex liquid flow in a centrifugal pump modelconsisting of an impeller, a diffuser and a volute was done to analyze the effects that the blade height, the diffuser blade number, and the volute size had on the pump performance. The continuity and Navier-Stokes equations with the k-ε turbulence model and the standard wall functions based on the logarithmic law were used by mean of ANSYS-CFX code. The results achieved reveal that the selected key design parameters have an impact on the pump head, the brake horsepower and the overall efficiency.

Paper 41
10:30 - 11:30 Foyer
Poster Session 1

Practical Considerations for Enabling a srTCM Behavior in Opnet Modeler

Pana Flavius and Put Ferdi
Katholieke Universiteit Leuven, Leuven, Belgium

Keywords: Qos, Diffserv, srTCM, Simulation, OPNET.

Abstract: Different Quality of Service (QoS) mechanisms have been proposed over time. Differentiated Services (DiffServ) represents one of the main QoS mechanisms developed, and is based on a strategy of traffic differentiation. Introduced in order to be used within DiffServ, the single rate Three Color Marker (srTCM) represents a policer which meters the IP packet stream and marks the traffic with different drop probabilities. This paper presents the technical aspects of implementing the srTCM in one of the most important network simulation tools on the market, OPNET Modeller. Practical considerations and a test case of the proposed implementation are presented.

Paper 63
10:30 - 11:30 Foyer
Poster Session 1

Simulation of the Thermal Management of the Semiconductor Disk Laser

Yanrong Song, ZhenHua Yu, Peng Zhang and Zili Li
Beijing University of Technology, Beijing, China

Keywords: Optically Pumped Semiconductor Disk Lasers, Finite-Element Analysis Method, Thermal Management.

Abstract: For the optically pumped semiconductor disk lasers, the thermal problem is the key to obtain the high out power. To solve this problem, we simulated the heat distribution of the gain chip by finite-element analysis method to discover the heat spread affected by the thickness of the substrate and found the outstanding heat spread result of the diamond chip.

Paper 67
10:30 - 11:30 Foyer
Poster Session 1

Simulation of Real-time Data Grid Systems via DGridSim Simulator

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C. Tech, TUBITAK MAM TEKSEB, Kocaeli, Turkey
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Anadolu University, Eskisehir, Turkey

Keywords: Data Grid, Real-time, Job Scheduling, Data Dissemination, Data Replication.

Abstract: In this study, DGridSim simulator will be introduced and some example simulation results will be presented. DGridSim can simulate four different Data Grid system organizations. Furthermore, for every system organization, the simulation of job scheduling, data dissemination, and data replication algorithms are supported, while all related system resources including computing, data storage, and network are reserved in advance in order to meet deadlines associated with jobs. DGridSim simulator is designed to be modular and easily extensible.

Paper 74
10:30 - 11:30 Foyer
Poster Session 1

RECORD
An Integrated Platform for Agro-ecosystems Study

Ronan Trépos, Hélène Raynal and Gauthier Quesnel
INRA, Castanet-Tolosan, France

Keywords: Agro-ecosystems, Modeling and Simulation Platform.

Abstract: The complexity of models developped in order to improve the agricultural systems and the need to have efficient tools to build them, simulate and analyse them have motivated the conception and the development of the new modelling and simulating platform RECORD. This paper describes how this initiative of the French National Institute for Agricultural Research has been conducted. A pragmatic strategy consisting in integrating heterogeneous tools into a same framework has been used. The example of the integration of the 3 different tools: VLE, R, Python illustrates how the users' requirements have been fullfilled. The platform is currently used in various projects, and on the basis of the first experiences, we conclude on the interest of this strategy. We underline that this strategy must be accompanied by efforts on developping user's training and coaching on these powerful tools. Finally software design should facilitate collaborative developments, which will motivate our future works.

Paper 85
10:30 - 11:30 Foyer
Poster Session 1

The Application of Evolutionary Algorithm for the Linear Dynamic System Modelling

Ivan Ryzhikov and Eugene Semenkin
Siberian State Aerospace University, Krasnoyarsk, Russian Federation

Keywords: Linear Dynamic System, Linear Differential Equation, Evolutionary Strategies, Parameters Identification Problem, Structure Identification.

Abstract: The approach to dynamic system modelling in the linear differential equations form is

presented. The given approach fits the identification problems with the system output observations sample and the input sample even if the output data is distorted by a noise. The structure and parameters identification problem is reduced to a global optimization problem, so that every solution consists of the model structure and its parameters. This allows searching the analytical model in the ordinary differential equation form with any limited order. The analytical model delivers a special benefit in its further use in the control and behaviour estimation problem.

Paper 90
10:30 - 11:30 Foyer
Poster Session 1

A General Process for Developing Business Simulations Games

Claudia Ribeiro, José Borbinha, João Pereira and José Tribolet
INESC-ID, Lisbon, Portugal
IST/UTL, Lisbon, Portugal

Keywords: Business Simulations Games, Simulation Development Process, Enterprise Modelling, Agent-based Models.

Abstract: Nowadays people, groups and organizations are increasingly confronted with problems and situations that show an increasing level of complexity. However, human abilities to deal with complex dynamic systems and processes, while behaving in a sustainable way, have not improved to the required extent. One way to deal with complex situation is the simulation approach: build a simplified model of this reality, learn from this simplified model, and, finally, translate the findings or knowledge back to reality. Simulation games are based on this idea. Nevertheless, if we want to make inferences about reality based on experiences and knowledge acquired in a simulation game, we have to be sure that the underlying conceptual model is a good, or valid, representation of the real situation. Based on knowledge gather from the simulation development process and Agent-based Modelling, this paper proposes a general process for developing business simulation games.

Paper 96
11:30 - 13:00 Room Velazquez
Parallel Session 7 - Application Domains and Simulation Tools and Platforms

Dynamic Simulation of Opioid Misuse Outcomes

Alexandra Nielsen and Wayne Wakeland
Portland State University, Portland, U.S.A.

Keywords: Prescription Drug Abuse, System Dynamics Modelling, Opioid Analgesics.

Abstract: The objective of the study was to develop a system dynamics model of the medical use of pharmaceutical opioids, and the associated diversion and nonmedical use of these drugs. The model was used to test the impact of simulated interventions in this complex system. The study relied on secondary data obtained from the literature and from other public sources for the period 1995 to 2008. In addition, an expert panel provided recommendations regarding model parameters and model structure. The behaviour of the resulting systems-level model compared favourably with reference behaviour data (R^2=.95). After the base model was tested, logic to simulate interventions was added and the impact on overdose deaths was evaluated over a seven-year period, 2008-2015. Principal findings were that the introduction of a tamper resistant formulation unexpectedly increased total overdose deaths. This was due to increased prescribing which counteracted the drop in the death *rate*. We conclude that it is important to choose metrics carefully, and that the system dynamics modelling approach can help to evaluate interventions intended to ameliorate the adverse outcomes in the complex system associated with treating pain via opioids.

Paper 98
11:30 - 13:00 Room Velazquez
Parallel Session 7 - Application Domains and Simulation Tools and Platforms

SimCore: A Library for Rapid Development of Large Scale Parallel Simulations

Sunil Thulasidasan[1], Lukas Kroc[2] and Stephan Eidenbenz[1]
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Keywords: Discrete-event Simulation, Parallel Simulation Library, Python Simulation.

Abstract: We present the SimCore parallel simulation library, an object-oriented framework for developing parallel distributed discrete-event simulation applications, implemented in C++ with a Python front-end. SimCore is designed to scale to

thousands of processors but is simple enough to use for application programmers, an outcome of its fast C++ core and message passing routines integrated with the full expressive power of Python. We discuss the design philosophy of SimCore including the software architecture and the C++/Python interface implementation that allows applications to be written in pure Python or a hybrid of Python and C++ or even pure C++. We also provide real world examples of the scalability and briefly describe a few diverse applications that have been deployed using SimCore.

Paper 104
11:30 - 13:00 Room Velazquez
Parallel Session 7 - Application Domains and Simulation Tools and Platforms

OPN-Ont: Object Petri Nets Ontology Tool

Lynda Dib and Fouad Bousetouane
LASE- LAboratoire des Systèmes Embarqués, Badji Mokhtar University, Annaba, Algeria

Keywords: OPN-Ont System, Ontology, Objects Petri Nets, Requests, Concepts, Relations.

Abstract: Ontologies are being used nowadays in many areas, including software engineering, business, and biology, to evaluate their suitability for representing and simulating domain processes. To assist users in developing and maintaining ontologies a number of tools have been developed. The representation of knowledge bases and conceptual domain models, hierarchical process, the structural components that participate in the process and the roles that they play in a complex domain, is therefore a major challenge for computer scientists for this complex domain. Without aiming at exhaustiveness, our study combining ontology and Petri Nets (PNs) tries to identify some promising tracks in this area, which seems a rather interesting alternative in the optics of the expressive power of the deductive representations. The context of our work consists to develop a graphical knowledge model for complex domain. This paper presents the OPN-Ont (Object Petri Nets Ontology) model. In this system ontology is represented in the PNs format, which allows verification of formal properties and qualitative and quantitative simulation. It leads to represent and exploit the different ontological components: concepts, relations and requests. The illustration of our model is made in biological domain where process supports methods for qualitative and quantitative reasoning.

Paper 62
11:30 - 13:00 Room Valencia
Parallel Session 7 - Complex Systems Modeling and Simulation

Direct Numerical Simulation of Flow Past a Sphere in a Plane Turbulent Boundary Layer with Immersed Boundary Method

Hui Zhao, Anyang Wei, Kun Luo and Jianren Fan
Zhejiang University, Hangzhou, China

Keywords: Direct Numerical Simulation, Immersed Boundary Method, Boundary Layer, Sphere, Plane.

Abstract: Direct Numerical Simulation coupled with Immersed Boundary Method (IBM) has attracted wide attention recent years, making this technique a significant role in many practical engineering areas. This paper described a direct numerical study of flow past a sphere above a plane, which can obtain detail information of flow field and vortex structure. A combined multiple-direct forcing and immersed boundary method (MDF/IBM) was used to deal with the coupling between fluid and solid. The Reynolds number based on sphere diameter was 4171. Behaviours of the vortices were observed through the simulation. The velocity distribution switched from laminar boundary to turbulent boundary. A recirculation region was observed behind the sphere. The influence of the sphere on the boundary layer, the center peak defect, the turbulence intensity and the Reynolds stresses are explored.

Paper 8
11:30 - 13:00 Room Valencia
Parallel Session 7 - Complex Systems Modeling and Simulation

CFD in the Capillary Rheometry of Polyethylene Melts

Evan Mitsoulis
National Technical University of Athens, Zografou, Athens, Greece

Savvas G. Hatzikiriakos
The University of British Columbia, Vancouver, Canada

Keywords: Capillary Rheometery, Polyethylenes, Entrance Pressure, Viscous.

Abstract: The capillary flow of a commercial LDPE melt was studied both experimentally and numerically. The excess pressure drop due to entry (Bagley correction), the compressibility, the effect of pressure and temperature on viscosity on the capillary data analysis have been examined. It was found that only the viscoelastic simulations (using the K-BKZ constitutive relation) were capable

of reproducing the experimental data well, while any viscous modeling always underestimates the pressures, especially at the higher apparent shear rates and *L/D* ratios.

Paper 21
11:30 - 13:00 Room Valencia
Parallel Session 7 - Complex Systems Modeling and Simulation

Eulerian-Lagrangian Modeling of Forestry Residues Gasification in a Fluidized Bed

Jun Xie[1], Wenqi Zhong[1], Baosheng Jin[1], Ming Song[1], Yingjuan Shao[1,2] and Hao Liu[2]

[1] *Southeast University, Nanjing, China*

[2] *The University of Nottingham, Nottingham, U.K.*

Keywords: Forestry Residues, Fluidized Bed Gasifier, Numerical Simulation, Eulerian-Lagrangian Approach.

Abstract: A comprehensive three-dimensional model is developed to simulate forestry residues gasification in a fluidized bed gasifier using Eulerian-Lagrangian method. Both complex gas-solid flow and chemical reactions are considered. The model is based on the multiphase particle-in-cell (MP-PIC) method, which uses an Eulerian method for fluid phase and a discrete particle method for particle phase. Homogenous and heterogeneous chemistry are described by reduced-chemistry and the reaction rates are solved on the Eulerian grid. Simulations were carried out in a laboratory scale pine gasifier at different operating conditions. The predicted product gas contents and carbon conversion efficiency compare well with the experimental data. The formation of flow patterns, profiles of temperature and distributions of gas compositions were also obtained.

Paper 38
11:30 - 13:00 Room Valencia
Parallel Session 7 - Complex Systems Modeling and Simulation

A Fast, Efficient Multi-Direct Forcing of Immersed Boundary Method for Flow in Complex Geometry

Anyang Wei, Hui Zhao, Jin Jun and JianRen Fan

State Key Laboratory of Clean Energy Utilization, Zhejiang University, Hangzhou, China

Keywords: Immersed Boundary Method, Efficient, Fast, Multi-Direct Forcing.

Abstract: The Immersed Boundary method (IBM) has received wide attention from last decade, due to its promising application to solve the fluid-solid interaction problems in large quantities of practical engineering areas. This paper implemented IBM with Multi-Direct-Forcing (MDF), presenting the evaluation of momentum forces on the body surface - interaction forces between fluid-solid. Grounded on the Multi-Direct-Forcing method, we constructed a new system that could be efficiently and fast solved. Meanwhile, this proposed algorithm is easy to code and implement parallelization. Besides, it can be extended to three-dimensional simulation without much more extra efforts. Accuracy of the proposed MDF immersed boundary method has been investigated, as well as some applications such as flow past the cylinder at a set of low Reynolds numbers.

Paper 24
14:30 - 16:00 Room Velazquez
Session 8 - Simulation Tools and Platforms

Process-oriented Discrete-event Simulation in Java with Continuations Quantitative Performance Evaluation

Antonio Cuomo[1], Massimiliano Rak[2] and Umberto Villano[1]

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[2] *Seconda Università di Napoli, Aversa, Italy*

Keywords: Discrete-event Simulation, Java, Continuations, Benchmark.

Abstract: In discrete-event simulation the process interaction view is appreciated in many different contexts, as it often provides the cleanest and simplest way to express models. However, this view is harder to implement than the more common event-oriented view. This is mostly due to the need for the simulation engine to support in a efficient way the coroutine-like semantics needed to implement the simulation processes. A common solution adopted in many Java-based simulators is the use of system threads to provide coroutines. This paper shows that this choice leads to unnecessary overheads and limitations, and presents an alternative implementation based on *continuations*. For many common models the continuation-based simulator shows significant performance gains compared to the most popular open source Java engines.

Paper 93
14:30 - 16:00 Room Velazquez
Session 8 - Simulation Tools and Platforms

A Model for Simulation of Application and Resource Behavior in Heterogeneous Distributed Computing Environments

Per-Olov Östberg
Umeå University, Umeå, Sweden

Keywords: Discrete-event Simulation, Virtual Infrastructure, Distributed Computing.

Abstract: Accurate modeling of the behavior of resources and scientific applications in distributed computing environments is complicated by factors such as resource heterogeneity, variability, and volatility. In this work we present a simulation model for fine-grained simulation and analysis of resource environments composed by multiple types of distributed computing resources. The simulation model is based on simulation of individual computational resources and emulation of virtual infrastructures and resource environments. Application and resource behavior are modeled in behavior profiles that capture the wide variability of distributed computing applications and resources, and allow modeling of non-standard metrics such as heterogeneity, variability, and volatility of resources and resource environments. Around the behavior profiles, virtual infrastructures are emulated using discrete-event simulations where infrastructure components are independently modeled. The design of the framework is aimed to facilitate both verification of middleware and application software as well as experimentation with prototype infrastructure components.

Paper 94
14:30 - 16:00 Room Velazquez
Session 8 - Simulation Tools and Platforms

A Meta-Model for DEVS Designed following Model Driven Engineering Specifications

Stéphane Garredu, Evelyne Vittori, Jean-François Santucci and Paul-Antoine Bisgambiglia
Università di Corsica, Corte, France

Keywords: DEVS, MDE, MDA, MOF, UML, Meta-modeling, DEVS Interoperability, Model-to-Model Transformations, Model-to-Text Transformations, OMG MTL.

Abstract: In this paper we give a state-of-art of DEVS components interoperability, and we propose a meta-model for classic DEVS formalism, designed following a Model-Driven Engineering philosophy. After glancing at the existing related works, we explain in a step-by-step way how our meta-model is built, starting from the formal definition of DEVS formalism. As the hardest steps when defining a DEVS Platform-Independent Model (PIM) are the definition of the states and the definition of the DEVS functions, we particularly focus on those concepts and we propose a way to describe them in a simple and platform-independent way. UML class diagrams were chosen to represent this meta-model. Not only can this meta-model be useful to generate DEVS PIMs but it can also be seen as a powerful tool to improve interoperability between DEVS models (and in a larger way discrete-event models, via model-to-model transformations) and to provide automatic code generation towards DEVS simulators (model-to-text transformations). As this meta-model is not a final version but rather a starting point, we tried to make it as modular and upgradable as possible.

Paper 110
14:30 - 16:00 Room Velazquez
Session 8 - Simulation Tools and Platforms

Simulation of Protection Mechanisms against Botnets on the Basis of "Nervous Network" Framework

Igor Kotenko and Andrey Shorov
St. Petersburg Institute for Informatics and Automation (SPIIRAS), Saint-Petersburg, Russian Federation

Keywords: Security Support Tools, Packet-level Simulation, Botnets, Network Security, Nervous Network.

Abstract: The paper suggests a simulation approach to investigate the protection against botnets on the basis of the "nervous network" framework. This approach is an example of bio-inspired approaches to the computer networks protection. The developed simulator is described. Results of the experiments are considered. Finally, we analyze and compare the performance of the basic protection mechanisms with "nervous network" protection technique.

16:00 - 17:00 Room Plenary
Modelling for the Complex Issue of Groundwater Management
Keynote Speaker: Anthony John Jakeman

Modelling for the Complex Issue of Groundwater Management

Anthony John Jakeman
Australian National University, Canberra, Australia

Abstract: Modelling and simulation are becoming

increasingly important for addressing today's environmental problems. Many of these, such as assessing the impacts of climate change and the sustainability of groundwater systems, are messy or wicked problems. These are defined by there being multiple stakeholders and decision makers with competing and conflicting goals, and where the systems of interest are complex - being social, economic, and ecological - and are subject to a range of uncertainties caused by limited data, information and knowledge. Modellers can nevertheless play a key role in resolving and providing support for clarifying decision options for managing environmental issues. Indeed the more messy the problem the greater need for a proper process of 'integrated assessment.' In this process modellers undertake integration in several ways. They can help to frame the right problem, identify and include the key stakeholders, map out the system interactions, select the appropriate modelling paradigm(s) for analyzing consequences of policy changes and other influences, manage uncertainties and communicate them. This talk will illustrate the effectiveness of integrated assessment and decision support using our experiences in the water resources sector, provide some guidance on the process and lay out some of the challenges ahead.

Closing Session
17:00 - 17:15 Room Plenary