The 11th International Modelica Conference

September 21–23, 2015
Palais des Congrès de Versailles, France
www.modelica.org

EDITORS: PROF. PETER FRITZSON AND DR. HILDING ELMQVIST
The 11th International Modelica Conference, which takes place at Palais des Congrès de Versailles, is the main event for the Modelica community. Users, library developers, tool vendors, and language designers gather to share their knowledge and learn about the latest scientific and industrial progress related to Modelica and FMI (Functional Mockup Interface).

The fundamental idea behind Modelica is to allow storing modeling knowhow in a high-level formally defined format, i.e., to collect information which you otherwise would find in engineering books only accessible by humans. By allowing convenient reuse of this knowhow by definition of component model libraries, enormous saving in man-hours for setting up simulation studies is achieved. Furthermore, by proper validation of such model libraries, much more reliable conclusions can be made from simulation studies leading to better products and user experience. These considerations lead to the equation-based object-oriented formalism of Modelica.

Since the start of the collaborative design work for Modelica in 1996, Modelica has matured from an idea among a small number of dedicated enthusiasts to a widely accepted standard language for the modeling and simulation of cyber-physical systems. In addition, the standardization of the language by the non-profit organization Modelica Association enables Modelica models to be portable between a growing number of tools. Modelica is now used in many industries including automotive, energy and process, aerospace, and industrial equipment. Modelica is the language of choice for model-based systems engineering.

The FMI standard has been added to the project portfolio of the Modelica Association. FMI provides a complementary standard that enables deployment of pre-compiled high quality models originating from different model formats to a larger number of engineers working with system design and verification.

The format of the conference is somewhat changed compared to previous years. We moved the vendor sessions to the first day of the conference to have two days of purely scientific presentations. Starting the tutorials one hour earlier allowed us to allocate more time and have room for 15 vendors to present their offers compared to 6 at the previous conference.

The program is available in an event app for smartphones, tablets, and PCs. It enables searching for papers with abstracts, authors, and conference rooms. It also allows setting up your own schedule by selecting your favorite presentations.

Taking a walk in the Garden of Versailles is suggested on Tuesday evening. We have allocated a break of more than one hour after the scientific program before the conference dinner is served at the Palais des Congrès de Versailles. This means that you have time to see the Apollo Fountain.

Conference highlights:
- 2 Keynote speeches
- 83 papers in 4 parallel tracks
- 18 posters
- 7 tutorials
- 5 libraries submitted for the Modelica Library Award
- 15 vendor sessions presenting the latest Modelica and FMI tools
- A fully booked exhibition area featuring 20 exhibitors
- Electronic proceedings including all papers and some associated Modelica libraries and models

Finally, we want to acknowledge the support we received from the conference board and program committee. Special thanks to our colleagues at this year’s organizers, Dassault Systèmes and Linköping University, and Amelie Rönngård from Altitude Meetings. The support from the conference sponsors is gratefully acknowledged. Last but not least, thanks to all authors, keynote speakers, and presenters for their contributions to this conference.

We wish all participants an enjoyable and inspiring conference.

Lund and Linköping, September 1, 2015
Hilding Elmqvist and Peter Fritzson

Hilding Elmqvist  
Peter Fritzson
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**Designing Cyber-Physical Systems: A Tale of Two Worlds Coming Together**

**Presenter:** Prof. Alberto Sangiovanni-Vincentelli  
UC Berkeley, USA

**Abstract:** Cyber-Physical Systems have been the focus of many research and public forum initiatives in the world since the early 2000s. The concept of CPS involves the tight integration and co-design of physical (for example, mechanical, electrical, biological and chemical), systems with analysis, monitoring and control implemented on a computing system. As such it has important intersections with other fields of great interests such as Internet of Things, Hybrid Systems, Swarm Systems and Systems of Systems. One of the main challenges has been to develop solid foundations for design and manufacturing including formal methods and requirement capture.

I will review the major directions of research and industrial relevance of CPS with particular attention to design methodologies and requirement capture with considerations about approaches to CPS simulation and analysis and their limitations.

**Bio:** Alberto Sangiovanni-Vincentelli holds the Buttner Chair of EECS, University of California, Berkeley. He was a co-founder of Cadence and Synopsys, the two leading companies in Electronic Design Automation. He was a member of the HP Strategic Technology Advisory Board, of the Science and Technology Advisory Board of GM, and is a member of the Technology Advisory Council of UTC. He is member of the Scientific Council of the Italian National Science Foundation (CNR) and of the Executive Committee of the Italian Institute of Technology. He is President of the Consiglio Nazionale Garanti della Ricerca, and of the Strategic Committee of the Italian Strategic Fund.

He received the Kaufman Award for “pioneering contributions to EDA”, the IEEE/RSE Maxwell Medal for groundbreaking contributions that have had an exceptional impact on the development of electronics and electrical engineering or related fields. He holds an honorary Doctorate by the University of Aalborg, Denmark and one by KTH, Sweden.

He is an author of over 850 papers, 17 books and 2 patents, is IEEE Fellow and a Member of the NAE.

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**A systems engineering perspective for Modelica and the heritage of synchronous language**

**Presenter:** Dr. Albert Benveniste, INRIA, France

**Abstract:** In the first part of my talk I shall develop a vision of the central role of Modelica in systems engineering. The Modrio project has recently developed a Requirements profile for Modelica and progresses have recently been made regarding the link between Modelica and safety analyses. I shall discuss how far, I think, one could go in these directions. I shall also draw directions toward using Modelica for system-wide monitoring and diagnosis. All of this calls for a rigorous understanding of Modelica, its execution semantics: paying attention to this will constitute the second part of my presentation. I shall describe the background from synchronous languages by emphasizing how sound compilation schemes can be formally derived and how some of the above mentioned uses in system engineering were performed with synchronous languages. I shall conclude by indicating how these techniques can be adapted to derive structural analyses for multi-mode DAE systems. Nonstandard analysis will be used to help for this.

**Bio:** Albert Benveniste was Directeur de Recherche at INRIA, where he is now emeritus. In 1990 he received the CNRS silver medal, he was elected IEEE fellow in 1991 and IFAC Fellow in 2013. From 1986 to 1990 he was vice-chairman of the IFAC committee on Theory and was chairman of this committee for 1991-1993. He has been Associate Editor (at Large) for IEEE Transactions on Automatic Control, Associate Editor for Int. J. of Adaptive Control and Signal Processing, and Int. J. of Discrete Event Dynamical Systems, and member of the Editorial Board of the Proceedings of the IEEE. From 1997 to 2013, he was head for INRIA of the joint Alcatel-INRIA research programme. He is a member of the scientific advisory boards of Safran Group and Orange. From 2011 to 2014, he was co-heading the Center of Excellence [Labex] CominLabs in the area of telecommunications and Information systems. He has been elected to the Académie des Technologies in december 2011. His areas of interest cover system identification in control, embedded systems in computer science, and network management in telecommunications.
## GENERAL SCHEDULE

### GENERAL SCHEDULE OF MONDAY, SEPTEMBER 21

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<td>13:00</td>
<td>Tutorials, see page 13 for more info.</td>
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<tr>
<td>16:30</td>
<td>Refreshments</td>
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<tr>
<td>17:00-17:45</td>
<td>Vendor Session Part I</td>
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<td>17:50-18:35</td>
<td>Vendor Session Part II</td>
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<td>18:40-19:25</td>
<td>Vendor Session Part III</td>
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<td>19:30-22:00</td>
<td>Reception</td>
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<tr>
<td>09:00</td>
<td>RICHELIEU</td>
<td>Opening</td>
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<tr>
<td>09:05</td>
<td>LULLI</td>
<td>Welcome Address</td>
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<tr>
<td>09:25</td>
<td>COLBERT</td>
<td>Modelica News</td>
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<tr>
<td>09:35</td>
<td>CONDÉ</td>
<td>Keynote 1</td>
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<td>Coffee Break</td>
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<tr>
<td>10:50</td>
<td>RICHELIEU</td>
<td>Exhibition</td>
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<tr>
<td>12:30</td>
<td>LULLI</td>
<td>Lunch</td>
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<tr>
<td>13:45</td>
<td>COLBERT</td>
<td>FMI 1, Building Energy Applications 1, Simulation Techniques, Automotive Applications 1</td>
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<tr>
<td>15:25</td>
<td>CONDÉ</td>
<td>Coffee Break</td>
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<tr>
<td>15:55</td>
<td>RICHELIEU</td>
<td>Optimization Applications and Methods, Building Energy Applications 2, Modelica Language &amp; Compiler Implementation 1, Automotive Applications 2</td>
</tr>
<tr>
<td>17:10</td>
<td>LULLI</td>
<td>Refreshments</td>
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<tr>
<td>17:20-18:05</td>
<td>CONDÉ</td>
<td>Panel Discussion</td>
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<tr>
<td>18:10</td>
<td>COLBERT</td>
<td>Modelica Language &amp; Electrical Systems, Control Applications 2, Mechanical Systems, Modelica Language &amp; Compiler Implementation 2, Electrical Systems</td>
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<tr>
<td>19:00</td>
<td>CONDÉ</td>
<td>Relaxation</td>
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<td>19:30-23:00</td>
<td>LULLI</td>
<td>Dinner including Library Award Announcement</td>
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### GENERAL SCHEDULE OF WEDNESDAY, SEPTEMBER 23

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<tr>
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<td>RICHELIEU</td>
<td>Keynote 2</td>
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<tr>
<td>09:15</td>
<td>LULLI</td>
<td>Small Break</td>
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<td>09:20</td>
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<tr>
<td>10:10</td>
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<td>Coffee Break</td>
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<tr>
<td>10:40</td>
<td>RICHELIEU</td>
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<tr>
<td>11:55</td>
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<td>12:55</td>
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<td>14:00</td>
<td>CONDÉ</td>
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<tr>
<td>15:15</td>
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<td>Coffee Break</td>
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<tr>
<td>15:45-16:00</td>
<td>COLBERT</td>
<td>Closing</td>
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09:00 Opening, Hilding Elmqvist, Dassault Systèmes and Peter Fritzson, Linköping University

09:05 Welcome Address, Dominique Florack, Senior Executive Vice President, Research and Development, Dassault Systèmes

09:25 Modelica News, Martin Otter, DLR

09:35 Keynote 1: Designing Cyber-Physical Systems: A Tale of Two Worlds Coming Together, Prof. Alberto Sangiovanni-Vincentelli, UC Berkeley, USA, Chair: Hilding Elmqvist

10:50 Experience with Industrial In-House Application of FMI

Kilian Link, Leo Gall, Monika Mühlbauer and Stephanie Gallardo-Yances

A Novel Proposal on how to Parameterize Models in Dymola Utilizing External Files under Consideration of a Subsequent Model Export using the Functional Mock-Up Interface

Thomas Schmitt, Markus Andres, Stephan Ziegler and Stephan Dehl

Design Choices for Thermofluid Flow Components and Systems that are Exported as Functional Mockup Units

Michael Wetter, Marcus Fuchs and Thierry S. Noudui

FMI for Physical Models on Automotive Embedded Targets

Christian Bertsch, Jonathan Neudorfer, Elmar Ahle, Siva Sankar Arumugham, Karthikeyan Ramachandran and Andreas Thuy

11:15 A Novel Proposal on how to Parameterize Models in Dymola Utilizing External Files under Consideration of a Subsequent Model Export using the Functional Mock-Up Interface

Kilian Link, Leo Gall, Monika Mühlbauer and Stephanie Gallardo-Yances

Methodology for Obtaining Linear State Space Building Energy Simulation Models

Damien Picard, Filip Jorissen and Lieve Helsen

Simulation Speed Analysis and Improvements of Modelica Models for Building Energy Simulation

Filip Jorissen, Michael Wetter and Lieve Helsen

Energy Efficient Design for Hotels in the Tropical Climate using Modelica

Reymundo Miranda, Sen Huang, German Barrios, Dan Li and Wangda Zuo

Presentation, Validation and Application of the District Heating Modelica Library

Loïc Giraud, Roland Baviere, Mathieu Vallée and Cédric Paulus

11:40 Design Choices for Thermofluid Flow Components and Systems that are Exported as Functional Mockup Units

Michael Wetter, Marcus Fuchs and Thierry S. Noudui

Fractional-Order Modelling in Modelica

Alexandre Pollok, Dirk Zimmer and Francesco Casella

Modelica Library for Feed Drive Systems

Denis Özdemir, Tobias Motschke, Werner Herfs and Christian Brecher

12:05 FMI for Physical Models on Automotive Embedded Targets

Christian Bertsch, Jonathan Neudorfer, Elmar Ahle, Siva Sankar Arumugham, Karthikeyan Ramachandran and Andreas Thuy


Torben Fischer, Florian Goß, Lars Fredrik Berg, Hans-Peter Kollmeier and Frank Gauterin

Predicting the Effect of Gearbox Preconditioning on Vehicle Efficiency

Romain Gillot, Alessandro Picarelli and Mike Dempsey

Model Based Development of Future Small Electric Vehicle by Modelica

Yutaka Hirano, Shintaro Inoue and Junya Ota

Modelling of Torque-Vectoring Drives for Electric Vehicles: a Case Study

Franciscus L. J. van der Linden and Jakub Tobolá
SCIENTIFIC PROGRAM – TUESDAY SEPTEMBER 22

13:45 Co-Simulation of Hybrid Systems with SpaceEx and Uppaal
Chair: Rüdiger Franke
Sergio Bogomolov, Manos Gecelik, Peter J. Jensen, Kim F. Larsen, Maria Mikučionis, Falk Cudik, Alexander Ingerd, Stefan Kranz and Christof Nyach-Geussen

14:10 Automated Deployment of Modelica Models in Excel via Functional Mockup Interface and Integration with modeFRONTIER
Chair: Gerhard Schmitz
Håkan Runvik, Per-Göran Larsson, Stéphane Velut, Jonas Funkquist, Markus Bohlin, Andreas Nilsson and Samo Mravenec

14:35 An Open-Source Graphical Composite Modeler for Electrical Power System Modeling and Simulation Based on FMI and TLM Co-Simulation
Chair: Michael Tiller
Ataç Becel, Adel Asghari, Adrien Pop, Peter Fritzson, Wille Braun, Alexander Scharfen and Dániel Filizson

15:00 The Modelica Language and the FMI Standard for Modeling and Simulation of Smart Grids
Chair: Jonathan Brembeck
Oliver Chaint, Jeremy Boss, Alexandre Pérès, Guy Camilleri, Marie-Pierre Glastra, Jean-Philippe Horvath and Dominique Girod
SCIENTIFIC PROGRAM – TUESDAY SEPTEMBER 22

10:15

Discussion Panel

10:45

Panel Discussion

11:10

Mechanical Systems

Chair: Yuka Hirano

Effective Configuration of Large-Scale Dynamic Models of Complex Systems

Federico Bergero, Mariano Botta, Esteban Campostrini and Ernesto Kofman

Simulation of Large-Scale Models in Modelica: State of the Art and Future Perspectives

Francesco Casella

12:00

Building Energy Applications 3

Chair: Michael Wetter

An Open Toolkit for Generating Modelica Code from Building Information Models

Mathis Thiéry et al.

Lessons Learnt from Network Modelling of a Low-Load Building Heating System

Mehmet Mete Ak, Martin Tribelsky, Filip Jakob and Jirí Kofranek

14:00

Modelica Language & Compiler Implementation

Chair: Hans Olsson

Efficient Compilation of Large Scale Dynamical Systems

Federico Bergero, Mariano Botta, Esteban Campostrini and Ernesto Kofman

Simulation of Large-Scale Models in Modelica: State of the Art and Future Perspectives

Francesco Casella

17:20

Panel Discussion

18:00

Mechanical Systems

Chair: Yuka Hirano

Effective Configuration of Large-Scale Dynamic Models of Complex Systems

Federico Bergero, Mariano Botta, Esteban Campostrini and Ernesto Kofman

Simulation of Large-Scale Models in Modelica: State of the Art and Future Perspectives

Francesco Casella

18:45

Central Applications 2

Chair: Lars Mikesons

How to Design Noise Spectra for Continuous System Simulation

Andreas Olofsson and Anders Hemborg

Dynamic Modeling of a Flat-Plate Solar Collector for Control Purposes

Sascha Hermecz, Uwe-Ludger Lenz, Christian Rinder and Andreas Hemborg

19:15

Building Energy Applications 3

Chair: Michael Wetter

An Open Toolkit for Generating Modelica Code from Building Information Models

Mathis Thiéry et al.

Lessons Learnt from Network Modelling of a Low-Load Building Heating System

Mehmet Mete Ak, Martin Tribelsky, Filip Jakob and Jirí Kofranek

19:45

Panel Discussion

20:15

Industry Sessions

21:30

Banquet Dinner

22:00

Conference Close
08:30 | Keynote 2: A systems engineering perspective for Modelica and the heritage of synchronous language, Albert Benveniste, Chair: Peter Fritzson

09:00 | 3D Representations of Modelica Models
Albert Benveniste, Chair: Peter Fritzson

09:45 | Model Based Specifications in Aircraft System Design
Chair: Dirk Zimmer

10:40 | A New Fault Injection Method for Liquid Rocket Pressurization and Feed System
Jörg Schumacher, Chair: Philipp J. Offen

11:00 | Autonomous Safety Analysis by Minimal Path Set Detection for Multi-Domain Object-Oriented Models
Christian Schuller, Chair: Alexander Pollok and Francesco Casella

11:30 | High-fidelity Modelling of Self-regulating Pneumatic Valves
Christian Schuller, Chair: Alexander Pollok and Francesco Casella

12:00 | Lunch Break

14:00 | Dynamic Modelling of a Central Receiver CSP System in Modelica
Chair: Käte Link

14:45 | Towards a Formalized Modelica Subset Modeling of the German National Standard for High Pressure Natural Gas Flow Metering in Modica
Chair: Michael von der Heyde, Gerhard Schmitz and Bodo Mickan

15:30 | Thermal Fluid System Models and Libraries 1
Chair: Dirk Zimmer

16:15 | Formal Requirements Modeling for Simulation Language using Deep Belief Network
Chair: Timothy Boese

17:00 | Thermodynamic Properties in Modelica using Direct Steam Generation with Parabolic Trough Power Plant
Chair: Michael von der Heyde, Gerhard Schmitz and Bodo Mickan

18:00 | Closing
SCIENTIFIC PROGRAM – WEDNESDAY SEPTEMBER 23

RICHELIEU

Testing & Diagnostics
Chair: Lena Buffoni

14:00
Automatic Regression Testing of Simulation Models and Concept for Simulation of Connected FMUs in PySimulator
Adeel Asghar, Andreas Pfeiffer, Arunkumar Palanisamy, Alachew Mengist, Martin Sjölund, Adrian Pop and Peter Fritzson

14:25
Abrasive Waterjet Intensifier Model for Machine Diagnostics
Gianni Ferretti, Michele Monno, Bruno Scaglioni, Massimo Goletti and Marco Grasso

14:50
Anders Tilly, Victor Johnsson, Jon Sten, Alexander Perlman and Johan Åkesson

15:45
Closing the Conference

LULLI

Power, Energy & Process Applications 2
Chair: Daniel Bouskela

14:00
Status of the TransiEnt Library: Transient Simulation of Coupled Energy Networks with High Share of Renewable Energy
Lisa Andresen, Pascal Dubucq, Ricardo Peniche Garcia, Günter Ackermann, Alfons Kather and Gerhard Schmitz

14:25
Mathematical Model of Soot Blowing Influences in Dynamic Power Plant Modelling
Conrad Gierow, Moritz Hübel, Jürgen Nocke and Egon Hassel

14:50
Flexibilization of Coal-fired Power Plants by Dynamic Simulation
Marcel Richter, Florian Möltenbruck, Andreas Starinsk, Gerd Oeljeklaus and Klaus Görner

15:45
Closing the Conference

COLBERT

Modelica Tools
Chair: Adrian Pop

14:00
Where impact got Going
Michael Tiller and Dietmar Winkler

14:25
Visualizing Simulation Results from Modelica Fluid Models Using Graph Drawing in Python
Marcus Fuchs, Rita Streblow and Dirk Müller

14:50
Reuse of Physical System Models by means of Semantic Knowledge Representation: A Case Study applied to Modelica
Elena Gallego, Jose María Alvarez Rodríguez and Juan Llorens

15:45
Closing the Conference

CONDÉ

Thermofluid Systems, Models and Libraries 2
Chair: Hubertus Tummescheit

14:00
Mass Conserving Models of Vapor Compression Cycles
Christopher Laughman and Hongtao Qiao

14:25
EPSILON Modelica Library for Thermal Applications
Laurent Lachassagne, Arnaud Colleoni, Hervé Feral and Nicolas Dolin

14:50
Uwe Bau, Daniel Neitzke, Franz Lanzerath and André Bardow
POSTER SESSION

Wednesday September 23, 11:55–12:55
The poster session is held in Le Nôtre gallery on Level 2.

A new Modelica Electric and Hybrid Power Trains Library
Massimo Ceraolo

Initiatives for Acausal Model Connection using FMI in JSAE (Society of Automotive Engineers of Japan)
Yutaka Hirano, Satoshi Shimada, Yoichi Teraoka, Osamu Seya, Yujl Ohsumi, Shitaroh Murakami, Tomohide Hirono, Takayuki Sekisueman

Dynamical Model of a Vehicle with Omni Wheels: Improved and Generalized Contact Tracking Algorithm
Ivan Kosenko, Sergey Stepanov, Kirill Gerasimov, Alexey Rachkov

Kansei Modeling for Delight Design based on 1DCAE Concept
Koichi Ohtomi

Control Development and Modeling for Flexible DC Grids in Modelica
Andreas Olenmark, Jens Sloth, Anna Johnsson, Carl Wilhelmsson, Jörgen Svensson

Towards Enhanced Process and Tools for Aircraft Systems Assessments during very Early Design Phase
Eric Thomas, Olivier Thomas, Raphael Bianconi, Matthieu Crespo, Julien Daumas

Anticipatory Shifting – Optimization of a Transmission Control Unit for an Automatic Transmission through Advanced Driver Assistance Systems
Salim Chaker, Michael Folie, Christian Kehrer, Frank Huber

A Modelica Library Organization Method Supporting Online Modeling and Simulation
Xiong Tifan, Zhou Zuming, Wan Li, Li Yongchao

Experimental Calibration of Heat Transfer and Thermal Losses in a Shell-and-Tube Heat Exchanger
Javier Bonilla, Alberto de La Calle, Margarita M. Rodríguez-Garcia, Lidia Roca, Loreto Valenzuela

Suitability of Different Real-Time Solvers for a Model-Based Engineering Toolchain using Industrial Rexroth Controllers
Nils Menager, Rüdiger Kampfmann, Niklas Worschech, Lars Mikelsons

Coupling Model Exchange FMUs for Aggregated Simulation by Open Source Tools
Pukashawar Pannu, Christian Andersson, Claus Führer, Johan Åkesson

An Aeronautic Case Study for Requirement Formalization and Automated Model Composition in Modelica
Wladimir Schamai, Lena Buffoni, Nicolas Albarello, Pablo Fontes De Miranda, Peter Fritzson

Open Source Library for the Simulation of Wind Power Plants
Philip Eberhart, Tek Shan Chung, Anton Haumer, Christian Kral

FastHVAC – A Library for Fast Composition and Simulation of Building Energy Systems
Sebastian Stinner, Markus Schumacher, Konstantin Finkbeiner, Rita Streblow, Dirk Müller

Integration of Engineering based on Modelica
Andreas Hofmann, Nils Menager, Issam Belhaj, Lars Mikelsons

Using FMI in a Cloud-based Web Application for System Simulation
Stefan Bittner, Olaf Oelsner, Thomas Neidhold

Test of Basic Co-Simulation Algorithms Using FMI
Kosmas Petridis, Christoph Clauss

Praseeth Prabhakaran, Wolfgang Koeppe, Frank Graf

Experimental Calibration of Heat Transfer and Thermal Losses in a Shell-and-Tube Heat Exchanger
Javier Bonilla, Alberto de La Calle, Margarita M. Rodríguez-Garcia, Lidia Roca, Loreto Valenzuela

Integrated Engineering based on Modelica
Andreas Hofmann, Nils Menager, Issam Belhaj, Lars Mikelsons

Control Development and Modeling for Flexible DC Grids in Modelica
Andreas Olenmark, Jens Sloth, Anna Johnsson, Carl Wilhelmsson, Jörgen Svensson

POSTER SESSION

Wednesday September 23, 11:55–12:55
The poster session is held in Le Nôtre gallery on Level 2.
TUTORIALS

The tutorial sessions are held at the venue on Monday September 21, 13.00–16.30. Coffee break is included.

MODELICA Modeling Tutorial
– Learn using Modelica with a tool of your choice

PRESENTER: Dr. Dirk Zimmer, DLR
ROOM: Boileau

Abstract: This tutorial offers a basic hands-on introduction in modeling and simulation with Modelica. The tutorial is aimed at people with little or no practical experience in using Modelica. All participants have the opportunity to create a model of a controlled inverse pendulum in a graphical way. This model will demonstrate the strength of Modelica by combining different fields of engineering. To this end, mechanical, electrical, and control components are simulated in a single environment.

Please bring your own laptop! For the tutorial, you can use any Modelica tool that supports graphical modeling. For participants with no tool at hand, demo versions will be provided by tool vendors. According to the current planning, at least Dymola, OpenModelica, SimulationX, and SystemModeler will be provided.

In addition to the basic modeling task, background knowledge is presented that explains six key elements of the Modelica language:

- Equation-based modeling
- Non-causal system description
- Physical connectors and signals
- Object-orientation
- Graphical modeling
- Modelica Standard Library

As final step, tasks like the modeling of hybrid systems will be carried out by introducing dry-friction and backlash to the gear model, and adapting the controller.

About the tutor:
Dr. Dirk Zimmer is a member of the Modelica Association and teaches Modelica at the Technical University of Munich (TUM). In addition, he holds guest lectures at Universities of Applied Sciences and workshops for industry partners. In his teaching work, he explains the theoretical background and uses his modeling experience that he acquired at the German Aerospace Center and ETH Zurich.

Introduction to Modeling, Simulation, Debugging and Optimization with Modelica and OpenModelica

PRESENTERS: Peter Fritzson and Bernhard Thiele, Linköping University, Sweden; Bernhard Bachmann, FH Bielefeld, Germany
ROOM: Colbert

Abstract: This tutorial gives an introduction to the Modelica language and technology to people who are familiar with basic programming concepts and to engineers who wish to learn about Modelica. It gives a basic introduction to the concepts of modeling and simulation, as well as the basics of object-oriented component-based modeling for the novice, and an overview of modeling and simulation in a number of application areas. Moreover, an introduction to debugging Modelica models will be given, and an introduction of model-based dynamic optimization with OpenModelica including goal functions, constraints, convergence.

A number of hands-on exercises will be done during the tutorial, both graphical modeling using model components from the Modelica standard library and textual modeling involving writing a few small Modelica models. The schedule is approximately as follows:

1. Modelica background and important aspects
2. Graphical modeling and simulation introductory exercise – make an RL circuit using components from MSL (Modelica Standard Library)
3. Overview of the OpenModelica environment and its capabilities
4. Simple hands-on model debugging exercise
5. Modelica language concepts of types, variables, classes, inheritance
6. Hands-on textual modeling of a small model
7. Modelica discrete event and hybrid properties including state machines
8. Small discrete-event and small state machine exercise
9. Modelica concepts of components, connectors and connections
10. Short overview of the Modelica standard library
11. Graphical modeling hands-on exercise: extend the RL-circuit to a DC-Motor; if there is time also add a PI controller in a feedback loop.
12. Model-based dynamic optimization with OpenModelica including goal functions, constraints, convergence.
13. If there is time, a small model-based dynamic optimization exercise.

Bring your Laptop! Extensive hands-on exercises using OpenModelica will be done during the tutorial.
**Optimal control and state estimation with Modelica and Optimica**

**PRESENTERS:** Johan Åkesson, Christian Andersson, Toivo Henningsson, Per-Ola Larsson, Stéphane Velut, Modelon

**ROOM:** Condé

**Abstract:** This tutorial demonstrates how Modelica and Optimica are used to formulate and solve optimization problems targeting control of industrial processes.

A key focus of the tutorial is usability of numerical algorithms when solving dynamic optimization problems arising in control applications. While numerical algorithms and software for non-linear dynamic optimization has been available for many years, industrial application is often hindered by challenges in achieving robust convergence for large-scale models. This tutorial demonstrates how new tool capabilities support users in isolating and resolving convergence problems. In particular, means to isolate problematic equations that contribute to non-convergence in Modelica models are presented. In addition novel heuristics for problem scaling is used to further improve convergence robustness. Participants are offered hands on experiences with effective tools for achieving convergence in industrial optimization problems.

Attention is given to methods to achieve real-time performance in non-linear model predictive control (NMPC) and Moving Horizon Estimation (MHE) applications. New tool capabilities supporting warm-start of optimization algorithms significantly reduce solve time when solving a sequence of optimization problems, as is done in NMPC and MHE.

The tutorial offers an open source tool track which is based on JModelica.org and one commercial tool track which is based on the OPTIMICA Compiler Toolkit. The latter track also offers hands on experiences with optimization of industrial power generation systems.

**Working with MapleSim 2015**

**PRESENTER:** Chad Schmitke, MapleSim Development, Maplesoft

**ROOM:** Montesquieu

**Abstract:** MapleSim allows users to create and document their own symbolic and numeric analyses of Modelica models in a rich problem-solving environment. Although the basics of creating and simulating models within MapleSim will be covered, the focus of the tutorial will be on the connection between MapleSim and Maple, and the unique analysis opportunities it provides. Hands-on exercises in a variety of application areas will demonstrate how to work with Modelica models within this environment. We will also look at how the resulting analysis can be easily wrapped in a custom UI (sliders, interactive plots, etc.) and deployed on the web.

Example areas will include: extracting, interrogating, and solving kinematic and dynamic equations; creating, manipulating and discretizing PDEs; automatically converting Maple equations into Modelica components; creating parametric, linearized models and finding their Eigenvalues; using MapleSim’s programming interface to perform parameter sweeps and optimizations.

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**FMI user meeting**

**PRESENTERS:** Torsten Blochwitz (MAP FMI Project Leader) et. al.

**ROOM:** Richeieu

**Abstract:** The FMI Project organizes this “FMI User Meeting” within the tutorial/workshop session on the first day of the MODELICA Conference 2015 as a complement to the scientific tracks on FMI. The intention is to increase the interaction between FMI users in different companies / institutions and the Modelica Association Project FMI.

In a first part, an overview on the FMI ecosystem will be given by the FMI Project leader. The working modus of the FMI Project and the new development process will be presented including FMI Change Proposals and supporting tools. The current status of the FMI standard and current development directions will be summarized. In a second part, FMI users will give presentations showing how FMI is used for model interchange between different companies or different departments resp. engineering domains within one company, enabling collaborative model-based systems engineering. Users can also give feedback on their experience with FMI and missing features for the future. Additionally, the connection of FMI to past and future research projects will be summarized.

**INVITED PRESENTATIONS**

**Title:** Overview on the FMI project

**Authors:** Torsten Blochwitz [MAP FMI Project Leader + ITI]

**Title:** FMI Processes

**Authors:** Torsten Blochwitz [MAP FMI Project Leader + ITI] and Andreas Junghanns (QTronic)

**Title:** FMI Working Groups

**Authors:** Torsten Blochwitz [MAP FMI Project Leader + ITI]
**SELECTED PRESENTATIONS**

**Title**: Initiatives for acausal model connection using FMI in JSAE (Society of Automotive Engineers of Japan)

**Authors**: Yutaka Hirano (Toyota Motor Corporation), Satoshi Shimada (Honda R&D Co., Ltd.), Yoichi Teraoka (Mazda Motor Corporation), Osamu Seya (DENSO CORPORATION), Yuji Ohsumi (AZAPA Co., Ltd.), Shintaro Murakami (Dassault Systèmes K.K.), Tomohide Hiroko (NewtonWorks Corporation), Takayuki Sekise (ANSYS Japan K.K.)

**Title**: Getting started with Git: This tutorial provides an introduction to Git, the recommended

**Authors**: Dietmar Winkler, Mike Tiller

**PRESENTERS**: Dietmar Winkler, Mike Tiller

**ROOM**: Pascal

**Abstract**: This tutorial provides an introduction to Git, the distributed version control system, and GitHub. It is divided in two main parts:

1. Getting started with Git:
   - Why Version Control
   - Light introduction to what Git actually does
   - First commands to create repositories, change files, commit changes
2. Getting started with GitHub:
   - Create a fork of an existing project
   - Real bug fixing of example issues by use of
     * branching
     * committing changes with correct commit messages
     * creating pull requests
     * getting pull-requests accepted
3. More advanced git commands explained (if time allows)

**Prerequisites:**
* a laptop with a modern browser (Firefox or Chrome are recommended)

**Background**: In the past, open-source projects have been migrating away from centralized version control systems like CVS and Subversion to decentralized ones. At the moment, the most popular of these is Git. Two years ago, the Modelica Association started making all its Modelica libraries available via GitHub as Git mirrors (https://github.com/modelica) and placing all user libraries in one central place (https://github.com/modelica-3rdparty). Subsequently library repositories increasingly evolved from being mirrors to being real Git repository with development taking place on GitHub. Git’s decentralized development makes it easy for developers to modify, fix and contribute to the libraries of others. In addition, GitHub provides great infrastructure to support communication, forking and issue tracking. For open source projects, GitHub’s functionality is completely free.

**Dependability Analysis for Modelica Models**

**PRESENTERS**: Marc Bouissou, EDF; Lena Buffoni, Linköping University

**ROOM**: Vauban

**Abstract**: In the development of modern large-scale systems, the verification of important non-functional requirements such as dependability and safety is often postponed to the last stages of the development process with a high risk of having to revise even basic design choices and with a consequent increase in both completion time and development costs. Including dependability information in models from the early stages would ensure that the system design takes into consideration these important factors. The tutorial will introduce the basic principles of dependability analysis for beginners, with a focus on Fault Analysis Trees. The goal is to show how to model failures in a system using FTA, to introduce key algorithms for FTA analysis and to introduce the tool-chain for generating FTAs automatically from Modelica models using the Figaro extension for Modelica. Figaro is a reliability modelling language developed by EDF (Électricité de France) to be a general representation formalism. The tutorial will be hands on, so bring a laptop with a Windows environment. Participants will be shown through a series of exercises how to add dependability information to Modelica models with the use of the Figaro library, how to work with a Figaro knowledge base to define dependability rules for a class of Modelica systems and how to generate fault trees from Modelica models extended with dependability properties. Emphasis will be made on using inheritance and OO principles to maximise reusability and efficiency when adding dependability information to models.
The following companies/institutes will exhibit (alphabetic order):

- Ansys, booth 7
- Cenit AG, booth 16
- Claytex Services Limited, booth 15
- Concurrent, booth 10
- D2T, booth 6
- Dassault Systèmes, booth 11
- ESI-Group, booth 1
- ITI GmbH, booth 9
- Kiastek, booth 19
- LTX Simulation GmbH, booth 17
- Maplesoft, booth 8
- Modelon, booth 12
- National Instruments, booth 5
- Open Source Modelica Consortium, booth 3
- Ricardo Software, booth 20
- Siemens, booth 18
- United Technologies Research Centre Ireland Ltd., booth 4
- Wolfram, booth 14
- XRG Simulation GmbH, booth 13
Program of the Vendor Sessions on Monday, September 21

17:00
DASSAULT SYSTÈMES
Dymola News and a New Approach for Modelica Modeling
Hilding Elmqvist, Johannes Gerl, Martin Malmheden, Fabrice Pinot

17:45
MODELON
Modelica and FMI Products from Modelon
Johan Åkesson, Maria Henningsson, Johan Andreasson

18:35
OPEN SOURCE MODELICA CONSORTIUM
OpenModelica Status and News on Simulation, Debugging, FMI, and Optimization
Peter Fritzson, Bernhard Bachmann, Francesco Casella, Adrian Pop, Ruediger Franke

18:40
ANSYS
Virtual System Prototyping: Combining Modelica + 3D Physics + Embedded Software
Eric Bantegnie, Lee Johnson

19:25
SIEMENS
LMS Imagine. Lab Amessim
Michael Sasena, Nicolas Orand

Welcome Reception
Monday September 21, 19.30
The Welcome Reception will take place at Palais des Congrès de Versailles, room Mazarin. The reception will include refreshments and canapés. Please note that no dinner is served.

Conference Dinner
Tuesday September 22, 19.30
The Conference Dinner will take place at Palais des Congrès de Versailles, room Mazarin.
**PRACTICAL INFORMATION**

**Venue**
The Modelica conference will take place at Palais des Congrès de Versailles, approximately 40 minutes by train (RER C) from central Paris.

**Venue Address**
Palais des Congrès de Versailles
10 rue de la Chancellerie
78000 Versailles

**Exhibition**
A commercial exhibition will take place at the venue and will be open:

- **Monday**: 19.00–21.00 (during Welcome Reception)
- **Tuesday**: 08.00–17.30
- **Wednesday**: 08.00–15.45

**Emergency**
Emergency number is 112. This number will connect you to police, ambulance, or fire department. The emergency number does not require an area code and the phone call is free.

**Internet / WiFi**
At the conference venue you will be able to access wireless Internet.

- **Login**: modelicaconference2015
- **Password**: modelicaconference2015

**Meals**
Coffee breaks, lunches, Welcome Reception and optional Conference Dinner are included. They will be served in room Mazarin close to the exhibition area at the venue. Please note that there will be no lunch served Monday September 21 before the Tutorial sessions start.

**Parking**
Nearby blocks offers three car parks. There are no parking lot located nearby the building.

**Poster sessions**
Wednesday September 23, 11.55–12.55 there will be poster sessions held in Le Nôtre on Level 2.

**Registration desk**
The registration desk at the venue will be open:

- **Monday**: 10.00–19.00
- **Tuesday**: 08.00–18.00
- **Wednesday**: 08.00–17.00

Please contact us at the registration desk if you have any questions or requests and we will try to help you.

**Taxi**
Recommended taxi companies in Versailles are:
- Taxi Abeille +33 (1) 39 50 50 00, e-mail: taxis-abeille@wanadoo.fr
- Association Taxi +33 (1) 39 51 04 04

**Travel/Transportation Information**
Once you have arrived in Paris, public transportation is recommended within the city and to Versailles. Please see further details regarding transportation at the map below and on next page. For more information on public transport options see http://parisbytrain.com

**Tourist Information**
Paris is a wonderful city to visit and explore. For more information about what to do when in Paris, please go to http://en.parisinfo.com

If you are interested in visiting the Versailles castle when in Versailles, please go to http://en.chateauversailles.fr/homepage for more information.

**Tutorials**
All tutorial sessions are held at the venue Monday September 21, 13.00–16.30. Coffee break is included.

**Vendor Sessions**
Vendor sessions are held at the venue Monday September 21, 17.00–19.25.

**Voltage**
Voltage in France is 220-240 V AC, 50 Hertz frequency. Continental Europe uses 2 round pin plugs.
From CHARLES-DE-GAULLE airport

- RoissyBus to Paris - Opéra
  - RER B heading towards Saint-Rémy-lès-Chevreuse to Saint-Michel - Notre-Dame
- From Saint-Michel - Notre-Dame, RER C heading towards Versailles Château - Rive Gauche. Get off at Versailles Château - Rive Gauche

From ORLY airport

- Orlyval to Antony
  - RER B heading towards Mitry-Claye or Charles-de-Gaulle airport to Saint-Michel-Notre-Dame
- From Saint-Michel-Notre-Dame, RER C heading towards Versailles Château-Rive Gauche. Get off at Versailles Château-Rive Gauche

From Charles de Gaulle airport:
- 40 min by car;
- 1 hr 10 min: RER B + RER C.

From Orly airport:
- 30 min by car;
- 1 hr 15 with ORLY RAIL + RER C.
The conference is organized by Dassault Systèmes and Linköping University in cooperation with the Modelica Association.