Keynote Speaker-1.

Feasibility of Object Throwing as a New Technology for Factory Automation

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In a research project at the Reinhold-Wuerth-University in Künzelsau, Germany, a new approach for logistic functions in production systems is investigated. Objects are thrown by throwing devices and captured by capturing devices. With this approach for the separation, transportation and commissioning of work pieces, tools, packaging etc. the features of high speeds, high flexibilities and the need of few resources are expected to be achieved in future.

At the beginning an overview will be given for this new technology. It was inspired by observations in nature, where the fastest movements can be watched at flying. When this basic idea is implemented in a technical environment, the functions can be subdivided in launching of the objects, measuring the objects on their trajectories and capturing the objects.

In the second section the physical basics for the ballistic of flying objects will be considered. At flying objects in particular the thrust (driving respectively braking force), the gravitational force, the drag force and the lift force have to be considered. With these forces a mathematical model for the trajectories can be deduced. These forces are also determining the stability of the object orientation during flight. Different methods will be presented for the flight stabilization of cylinders.

For the realization of the throwing technology two basic concepts have to be distinguished.

- Throwing with indirect hits: When objects are thrown, which are unsymmetrical or not identical, their trajectories are depending on sensitive influences like different conditions during the acceleration by a throwing device or the influence of the gravitation and the aerodynamic forces during the flight. In this case the objects must be detected on their trajectories by a sensor system and a robot has to move a capturing device during the flight to the final capturing point.

- Throwing with direct hits: If the objects can be thrown into a capturing device with a direct hit, the visual tracking of the objects on their trajectories and the tracking of the capturing device are not required.

Several approaches for throwing devices, sensor systems for measuring the objects on their trajectories, robots for moving capturing devices and capturing devices will be presented for these concepts.

Finally an outlook with some visionary applications will be given. Examples like throwing of workpieces from one machine to another, throwing of objects over obstacles and the commissioning of goods by throwing shall illustrate the potential of the new technology for the factory automation in the future.

Biography

Heinz Frank received the M.S. degree in Electrical Engineering, Control- and Automation Engineering, from the Stuttgart University, Germany, in 1979. In the same year he joined the Institute for Control Engineering of Machine Tools and Manufacturing Equipment at the same university, were he received his Ph.D in 1985. From 1985 to 1991 he worked at the machine tool company Liebherr Verzahntechnik, Kempten, Germany. There he was in charge for the development of control systems for flexible manufacturing systems and production lines for the automotive industry.

Since 1991 he has been with the Reinhold-Wuerth-University of the Heilbronn University in Kuenzelsau, Germany. His fields of teaching are electrical engineering and automation engineering. In his research work he has two fields of interest, which are fast mechatronic systems and industrial communication systems. Currently his main projects are throwing/shooting as a new technology for logistic functions in production systems and the application of the new standard IEC 61850 for distributed energy resources.

He is a member of several learned societies including the IEEE Robotics & Automation Society and in the TC-BACM (Building, Automation, Control, and Management) of the IEEE Industrial Electronics Society. He is also active with several other scientific groups in Germany.

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Keynote Speaker-2

Classification and Comparison of Modelling Approaches and Simulation Techniques based on Benchmarks

Felix Breitenecker, Vienna University of Technology

The ARGESIM Benchmarks - Benchmarks for Modelling Approaches and Simulation Techniques are using comprehensive and small but non-trivial and relevant systems and models. Up to now twenty benchmarks have been defined, and about 300 solutions / results / suggestions for modelling and implementation have been sent in and published in SNE (Journal Simulation News Europe). These results allow various evaluations and give deep insight into modelling approaches and features of simulators.

This contribution presents the 2010 status of the *ARGESIM Comparison Tables* (sketch below)- which document the availability of a certain modelling feature or implementation feature by an extended YES/NO – table: 'yes' – available, '(yes)' – available but difficult to use, 'no' – not available, and '(no)' – not available, but implementation possible or way around.

First, classical features of continuous or hybrid simulators (model sorting, event description, time event handling, state event handling, and DAE support with or without index reduction) are discussed.

Next, structural features are introduced, which reflect the developments in the last decade: object-oriented approach, a-causal modelling, physical modelling, structural dynamic systems, modelling standardisations as Modelica and VHDL-AMS, impacts from computer engineering (e.g. state charts), co-simulation, and environments.

The feature list includes textual and/or graphical physical modelling, simulation-driven visualisation, Modelica modelling standard, textual and/or graphical state chart modelling, modelling of structural-dynamic systems, frequency analysis, real-time capabilities, solver splitting, and access to derived state equations.

Recently, the list of features has been extended by three new items: functional hybrid modelling, co-simulation, and multibody notations. Functional hybrid modelling is an essential extension of hybrid decoupling for structural-dynamic systems, co-simulation is an alternative approach in multidomain modelling, and the entry of multibody notations remember that Modelica is not the only standard. And consequently, the list of simulators is extended by two systems supporting functional hybrid modelling.

The paper concludes with an outlook on new features suggested for the feature list for continuous / hybrid simulators and sketches the development of a feature list for purely discrete simulation systems.

	MS - Model Sorting	ED - Event Description	SEH - State Event Handling	DAE - DAE Solver	IR - Index Reduction	PM-T - Physical Modelling - Text	PM-G - Physical Modelling - Graphics	MOD – Modelica Modelling	AMOD – Appl.-based a-causal Modelling	OEA – Access Derived Equations	SC-T – State Chart – Modelling - Text	SC-G – State Chart Modelling – Graphics	SD – Structural Dynamic Systems	FHM – Functional Hybrid Modelling	VIS – 'Online' - Visualisation	FA – Frequency Analysis	ENV – Extended Environment	RT – Reel-time Features	SSP – Solver Splitting	CO-S – Co-Simulation
MATLAB	N	N	(Y)	(Y)	N	N	N	N	N	Y	N	N	Y	(N)	(Y)	Y	Y	Y	(Y)	Y
Simulink	Y	(Y)	(Y)	(Y)	N	N	(N)	N	(Y)	Y	N	N	N	N	(Y)	Y	(Y)	Y	(N)	Y
Dymola	Y	Y	Y	Y	Y	Y	Y	Y	N	N	(Y)	(Y)	N	N	Y	(N)	(Y)	(Y)	(N)	(Y)
SimulationX	Y	Y	Y	Y	Y	Y	Y	Y	Y		(N)	(Y)	N	(N)	Y	Y	(Y)	(Y)	(N)	(Y)
AnyLogic	Y	Y	(Y)	(Y)	N	N	N	N	N	Y	Y	Y	Y	(N)	Y	N	N	(N)	N	(N)
MapleSim	Y	(Y)	(Y)	Y	Y	Y	Y	Y	Y	Y	N	N	(Y)	(Y)	Y	(Y)	Y	Y	(N)	(Y)
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Author’s Biography

Felix Breitenecker is professor for Mathematical Modelling and Simulation at Vienna University of Technology and head of the ARGESIM group which is involved into master programs, PhD programs and various research projects in modeling and simulation and which is editing the journal SNE – Simulation News Europe and running benchmarks on M&S approaches.

Felix Breitenecker is author of five books and of about 300 scientific publications in the area of modeling and simulation. Recent research activities include physical modeling (port-based DAE modeling), elearning with/for modeling and simulation, modeling and simulation in physiology and health care systems.

Felix Breitenecker is active in various simulation societies and simulation activities in Europe. At present he is president of ASIM, the German simulation society, and board member of EUROSIM, the Fderation of European Simulation Societies.

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Tutorial

Diffusion in Biological Systems

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Abstract - In biological systems, the passive diffusion may take place in liquid phases as well as across compartments and membranes. A tissue as well as the interior of a cell is a highly inhomogeneous and anisotropic milieu. Therefore the process of simple diffusion of particles, such as ions and proteins in inter- and intra-cellular medium undergoes successive discontinuities as the particles encounter compartment interfaces or aggregates of bio-molecules, which give the whole diffusion process a complex character. Furthermore, often in living systems the diffusive transport of particles occurs in conjunction with chemical reactions that produce, transform or remove chemical species, so that the systems has to be considered as a *reaction-diffusion* system.

In an unstructured and homogeneous medium, ideally behaving solutes (i.e., solutes for which solute-solute interaction are negligible) obey the Fick's law of diffusion, that states that the diffusity is a constant scalar. However in biological systems there are indications that even for purely diffusive transport phenomena and even if they are simple as small prokaryotic cells, the classical Fick's diffusion is at best a first approximation. Spatial effects due to a non-uniform distribution of molecules are present in many biological systems. Some very well known examples are: (i) diffusion is a main form of transport for necessary materials such as amino acids within cells, (ii) diffusion of water is classified as osmosis, (iii) metabolism and respiration. Other examples of spatial effects include mRNA movement within the cytoplasm, Ash 1 mRNA localization in budding yeast, morphogen gradients across egg-polarity genes in Drosophila oocyte, and the synapse-specificity of long-term facilitation in Aplysia.

The description of diffusion processes in non-homogenoeus and structured medium starts from a model of the diffusion coefficient containing its dependency on the local concentrations of the solutes and solvent. On the contrary, if the solute moves in an homogeneous system in thermal equilibrium, the diffusion coefficients are constants that do not depend on the local concentration of solvent and solute. Moreover, the great majority of mesoscopic reaction-diffusion models in intracellular kinetics is usually performed on the premise that all concentrations are homogeneous in space. A necessary condition for the maintenance of the spatial homogeneity of the concentration is that the rate of diffusion is much higher than the rate of the chemical reactions involved in the system under consideration. The assumptions of spatial homogeneity and fast diffusion do not allow to build realist models of biological reaction-diffusion systems.

The tutorial presents a new model of diffusion coefficient for a non-homogeneous non-well-stirred reaction-diffusion system. In this model the diffusion coefficient explicitly depends on the local concentration of solute, frictional coefficient and temperature. The derivation of the diffusivity consists of five main steps: 1. calculation of the local virtual force per molecules as the spatial derivative of the chemical potential 2. calculation of the particles mean drift velocity in terms of the local force and local frictional coefficient; 3. estimation of the flux of particles as the product of the mean drift velocity and the local concentration; 4. definition of diffusion coefficients as function of local activity and frictional coefficients and concentration, and 5. calculation of diffusion rates as the negative first spatial derivative of the flux of particles.

The tutorial presents also the software tool Redi (REaction-DIffusion simulator) that implements our diffusion model into a Gillespie-like stochastic simulation algorithm. In this algorithmic framework, the diffusion events are modeled as reaction events and the spatial domain of the reaction chamber is divided into cubic subvolumes of fixed size (called boxes). The movement of a molecule A from box i to box j is represented by the reaction Ai → Aj, where Ai denotes the molecule A in the box i and Aj denotes the molecule A in the box j. Thus, the reaction-diffusion system is seen as a pure reaction system in which the diffusion events are conceived as first order reactions whose rate coefficients are expressed in terms of state-dependent diffusion coefficients. The time evolution of the system is computed by a Gillespie-like stochastic simulation algorithm that at each simulation step selects in each subvolume the fastest reaction to occur. Some real case studies of application of Redi are also illustrated. Redi is a free downloadable software for non-commercial purposes at http://www.cosbi.eu/index.php/research/prototypes/redi.

Author's Biography

Paola Lecca received a Master Degree in Theoretical Physics from the University of Trento (Italy) in 1997 and a PhD in Computer Science in 2006 from the International Doctorate School in Information and Communication Technologies at the University of Trento. From 1997 to 2000 she was a Research Assistant at Fondazione Bruno Kessler – Centre for Information Technology, Trento (Italy) by the research unit Predictive Models for Biomedicine and Environment. In 2001-2002 she was Research Assistant at the Department of Physics at the University of Trento with a scholarship of the Italian National Institute of Nuclear Physics.

Since 2006 she is researcher at The Microsoft Research – University of Trento Centre for Computational and Systems Biology (CosBi), Italy.Her principal research interests are biochemical system identification and model calibration, stochastic chemical kinetics, reaction-diffusion systems and experimental design for parameter and structure inference of biological and biochemical networks.

Paola Lecca is author of many conference and journal papers (some of which awarded) in the areas of biophysics, bioinformatics, biological and medical research. Paola Lecca held a teaching position at The University of Trento with the courses on "Computer Science Methods in Physics" and "Simulation of Biological Systems" for master students in Physics and Computer Science. She is a member of the Association for Computing Machinery, the world's largest educational and scientific computing society, and Italian Society of Pure and Applied Biophysics. She was PC member, Track Chair and Organizer of many international events in the area of computational systems biology. She is part of the editorial board of the International Journal of Imaging and associate editor of the International Journal of Biometrics and Bioinformatics. She is also editor of Bioinformatics & Computational Systems Biology: Recent Advances and Applications, that is an IGI-Global book publication.

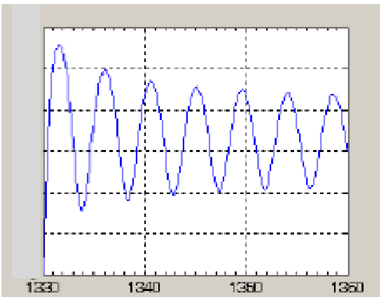
Plenary Presentation

‘Laura & Petrarca’ Modelling Emotions by Sonnets and Classic Modelling Techniques

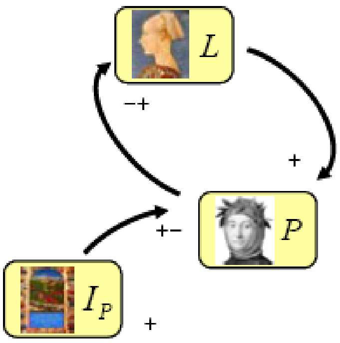
LAURA GROUP, VIENNA UNIVERSITY OF TECHNOLOGY
SPECIAL PRESENTATION EMS 2010
EMOTIONS, FUNCTIONS, EQUATIONS, SONNETS, AND MUSIC

Laura, a very beautiful but also mysterious lady, inspired the famous poet Francesco Petrarca for poems, which express ecstatic love as well as deep despair. F. J. Jones – a scientist for literary - recognised in these changes between love and despair in the years 1328 to 1350 an oscillating behaviour, which he called Petrarch’s emotional cycle, measured by individuals ‘grades’ for the poems (enthusiastic hope ~ +1, deep despair ~ -1). It is evident, that this cycle is based on the emotional relations between Laura and Petrarch and on Petrarch’s inspiration.

> *Di tempo in tempo mi si fa men dura*
> *l’angelica figura e’l dolce riso,*
> *et l’aria del bel viso*
> *e degli occhi leggiadri meno oscura*
> *Sonett CXLIX, grade ~ 0.7*

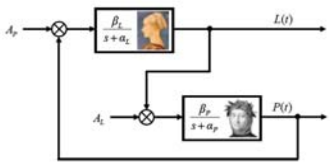


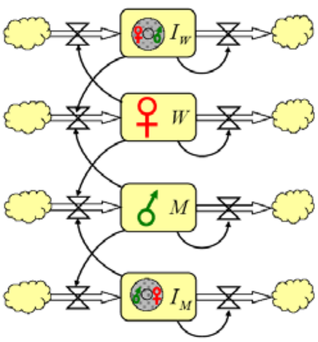
The mathematician S .Rinaldi investigated as first Petrarch’s emotional cycle and established a mathematical model based on ordinary differential equation of predator-prey type: two coupled ODEs with nonlinear reaction functions, reflecting Laura’s and Petrarch’s emotion for each other, drive an inspiration variable. Rinaldi’s ODE model for Laura’s and Petrarch’s emotions were starting point for the Laura Group at Vienna University of Technology to investigate in two directions: mapping the mathematical model to a suitable modelling concept, and trying to extend the model for love dynamics in modern times.



The modelling concept of System Dynamics fits very well to model the qualitative behaviour. In principle, emotions and inspiration emerge from a source, and are fading into a sink. But the controlling parameters for increase and decrease of emotion create a broad variety of emotional behaviour and of degree of inspiration, because of the nonlinearities.

Emotions and inspiration are fading over time – behaving like a transfer function approaching a steady state. This observation suggests a modelling approach by transfer functions. Emotions and inspiration are modelled by first order lags driven by the other’s emotion and by inspiration as inputs.





Both approaches make the basic modelling easy, but for nonlinear influences the nonlinear reaction functions must be used. For construction of these functions as well as for identification of model parameters Petrach’s sonnets are a valuable source in qualitative and quantitative analysis, so that Jones’ emotional cycle can be retraced by the model. But simulation experiments also allow interesting ‘what-if’ – analysis in history: what, if Petrarch would have been more attractive ? - what, if Laura would have left her husband and would have married Petrarch ?

In times of gender equality woman as well as men may play an active part in a love affair. Consequently also women express their love by poems or other media, and they confess their love to public. For Laura and Petrarch this would mean, that also Laura writes poems, that Petrarch's appeal is influenced by Laura's poetic inspiration, and that Petrarch shows more sensibility in his reaction to Laura. By this, the *Laura-Petrarch* model develops to a *Woman-Man* – model, expressed by ODEs, stock-flow diagram or transfer functions – and interesting possibilities for simulation experiments.

This EMS 2010 Special Presentations gives an overview on the historical background inspiring the audience by Renaissance music and citation of Petrarch's sonnets to Laura, sketches the modelling techniques for emotional states and invites the audience to help in model development by grading the cited sonnets – with an remarkable conclusion about the best model for (Laura's and Petrarch's) emotions.

Laura Group- Vienna University of Technology: Aman Atri, Felix Breitenecker, Katharina Breitenecker, Florian Judex, Andreas Körner, Anna Mathe, Andy Mathe, Nicole Nagele, Nikolas Popper, Shabnam Tauböck, Siegfried Wassertheurer

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Presenters at EMS 2010, Pisa, Italy: Katharina Breitenecker, Felix Breitenecker

Amor con sue promesse lunsingando, mi ricondusse alla prigione antica	*Love's promises so softly flattering me have led me back to my old prison's thrall*	*It's time indeed to die, and I have lingered more than I desire.*	*Tempo e ben di morire, et o tardato piu ch'i non vorrei.*