enh2016
Computation and Information Science and Engineering Conference in honor of Elias Houstis

Brought to you by
University of Thessaly, CERTH, WSO2 and Intel

Portaria, 21-24 June 2016

Welcome Address

The University of Thessaly and the Centre for Research and Technology-Hellas proudly organize an International Conference Honoring Elias N. Houstis. This conference will bring together teachers, friends, colleagues and students to honor Elias Houstis's 70th birthday, recognize his broader impact in the areas of Computational and Informational Sciences and Engineering and exhibit his overall scientific and social influence to very many scientists, entrepreneurs and engineers around the globe.

The first two days of this International Conference are devoted to high quality scientific presentations delivered by both well recognized scientists and talented young students in diverse thematic areas of Computational and Informational Sciences and Engineering that utilize both theoretical results and emerging technologies. These include but are not limited to:

- Numerical Analysis
- Scientific Computation
- High Performance Computing
- Artificial Intelligence
- Information and Knowledge Management
- Electrical Engineering
- Programming
- Education

A special session during the second day is devoted to presentations by Elias's PhD students associated with their past and recent activities and accomplishments.

The third day is devoted to presentations by Elias's teachers, collaborators and friends. The fourth day involves only social activities. Have a good time and Thank You Elias.

Christina, Yota, Nick, Naren, Sanjiva and Manolis

Contents

Abstracts

Discovering Survival Hydrodynamics through Stochastic Optimization and Learning

21 Jun
9:00-10:00
1A

Petros Koumoutsakos

Computational Science and Engineering Laboratory, ETH Zurich

We seek to understand the interplay of hydrodynamics and behavioural traits in single and multiple swimmers. To this effect we perform simulations using a hierarchy of swimmer models, ranging from simple dipoles to fully resolved incompressible viscous flows, of self propelled 3D fish-like bodies. The simulations are coupled with stochastic optimisation algorithms to investigate responses such as escape and predation patterns by single swimmers.The interplay of hydrodynamics and behavioural traits is investigated for collective swimmers using reinforcement learning algorithms. I will discuss our findings in relation to observations in natural swimmers and outline some lessons learned that may serve as inspiration for engineering devices.

Design and Implementation of an Integrated Product Traceability System based on RFID Technology: A Case Study

21 Jun
10:00-10:30
1A

Apostolos Xenakis[1], Ioannis Koutsaftikis[2] and Elias Houstis[2]

[1]University of Thessaly; [2]Institute for Research and Technology Thessaly

In this paper we outline the design and implementation of a product traceability system based on RFID technology, which is developed as a proof of concept for monitoring and control in agriculture and livestock application domains. In particular, our aim is to combine RFID/WSN monitoring technology and incorporate it to product, transport and disposal processes in order to guarantee quality product to the consumer. To this end, the proposed system requires the integration of network, telecommunication and monitoring technologies as well as the adjustment and customization to meet the very business needs of several entities of the region of Thessaly, Greece.

Applying Levenberg Marquardt Algorithm in Feedforward Neural Network Models for Predicting Crime in Public Management

21 Jun
10:30-11:00
1A

Georgios N. Kouziokas[1], Alexandros Chatzigeorgiou[2] and Konstantinos Perakis[1]

[1]University of Thessaly, School of Engineering, Department of Planning and Regional Development; [2]University of Macedonia, Department of Applied Informatics

Artificial intelligence applications have been tremendously increased in various science fields, the last decades, with the development of new machine learning techniques and algorithms and of new artificial neural network tools for developing neural network models. In this research, the application of Levenberg Marquardt algorithm in Feedforward Neural Network Models for predicting crime urban data is implemented. The Levenberg Marquardt algorithm is a combination of the steepest descent algorithm and the Gauss-Newton algorithm which is used for solving nonlinear least-squares problems. The algorithm combines the minimization advantages of the steepest descent method with the quadratic model of Gauss-Newton method in order to increase the speed of the overall process of finding the minimum of a function. Multilayer Feedforward Perceptron was utilized as it is considered as the most suitable for time series predictions, among several training algorithms such as backpropagation. Urban crime forecasting can play a significant role in urban planning and public management by facilitating decision making and the adoption of the most adequate proactive strategies in crime prevention and in public safety management planning.

Developmental Engineering: A Pedagogy of Humans and Artifacts

21 Jun
11:30-12:00
1B

Demetra Evangelou

Democritus University of Thrace

Understanding of the fundamental ontogenic nature of the relation between humans and machines-artifacts has implications for engineering pedagogy in general and for its P-12 educational antecedents in particular. Drawing on, developmental theories, educational and instructional research and K-12 empirical observations, we propose that humans from very early on recognize human-made artifacts as different and qualitatively distinct from objects created by nature. Resulting from this assertion are some fundamental implications for how we educate children to prepare them for modern citizenship as well as careers in engineering and technology. We define human-made artifacts as a distinct class of events that create, foster, elicit and motivate humans in a manner that is differentfrom the relationships that humans form in other contexts.

Flexible Application Programming/Deployment and Soft Actuation in WSN-based Smart Environments

21 June
12:00-12:30
1B

Department of Electrical and Computer Engineering, University of Thessaly
Lalis Spyros

Wireless sensor and actuator networks (WSANs) are a key component of ubiquitous and pervasive computing, and will play an increasingly important role in the next generation of computer-based systems. This talk will present research that was performed at IRETETH/CERTH and UTH on flexible application programming/deployment and actuation in smart home environments. The first part of the talk will describe a WSAN application programming/deployment model and corresponding middleware support, which was developed in the POBICOS FP7 project. Applications are structured as a hierarchy of mobile components, called micro-agents, which are dynamically created on the nodes of the WSAN to perform in-network processing, and can move between nodes at runtime to reduce the traffic over the wireless links as a function of the application dynamics. The second part of the talk will present a new form of actuation, whereby the application does not perform any proactive/automatic actuation but instead generates low-key, non-imposing hints suggesting that the user perform specific actuating actions. We call the delivery of such hints soft actuation because the purpose of a hint is to trigger actuation, but the decision as well as the execution (if any) is left to the user, who becomes a part of the control loop. We also present results from an experiment that was performed in the wild, as part of the SmartSantander FP7/FIRE project, using the SmartCampus Internet of Things (IoT) testbed at the University of Surrey.

An Alternative Algorithm for Bulk-loading xBR+-trees

21 Jun
12:30-13:00
1B

George Roumelis[1] and Michael Vassilakopoulos[2]
[1]Dept. of Informatics, Aristotle University of Thessaloniki; [2]Dept. of Electrical and Computer Engineering, University of Thessaly

Nowadays, applications and systems using spatial information and embedding spatial database capabilities (e.g. location based services) are becoming more common and continuously evolving.

Spatial indexes play a crucial role in spatial databases for the efficient execution of queries involving spatial constraints. The Quadtree is a well-known hierarchical index structure based on the principle of recursive regular decomposition of space. The External Balanced Regular Plus Tree (xBR+-tree) [1] is a balanced disk-based index structure for multidimensional point data that belongs to the Quadtree family. Unlike any other Quadtree variant, this tree is a totally disk-based, height-balanced, pointer-based, multiway tree. Members of the R-tree family and especially the R*-tree have been a de-facto choice in spatial databases, so far. Recently, in [2] the performance of the xBR+-tree vs. R-trees for tree building and processing of the most popular spatial queries has been extensively studied, using medium and big datasets, and it was shown that the xBR+-tree is a big winner in execution time in all cases and a winner in I/O in most cases.

Fast building is a key issue for spatial indexes. Bulk-loading refers to the process of creating an index from scratch as a whole, when the dataset to be indexed is available beforehand, instead of creating (loading) the index gradually, when the dataset items are available one-by-one. Bulk-loading xBR+-trees is necessary for embedding this indexing method in SpatialHadoop.

In [3] an algorithm for bulk-loading xBR+-trees for big datasets residing on disk, using a limited amount of RAM was presented. It consists of four phases. During the first phase, the initial dataset file is transformed to binary format and is split in two files. During the second phase, each of the two input item files is partitioned into item blocks of size ¡= MemoryLimit in a regular fashion. The resulting blocks are transferred in main memory, as input for the next phase. During the third phase, for each block of items, a Quadtree is built in main memory by splitting this block as long as they correspond to regions containing more items than the capacity of xBR+-tree leaves. This Quadtree is gradually transformed to an xBR+-tree in main memory in a bottom-up fashion. During the last phase, the tree created in main memory is merged with the xBR+-tree already built in secondary memory (created during the previous iteration of the bulk-loading process), discriminating between four different cases among the heights of the trees to be merged.

In this work, we present an alternative algorithm for the third phase. Instead of building a Quadtree that is gradually transformed to an xBR+-tree in a bottom-up fashion, we directly built an xBR+-tree in main memory in a bottom-up fashion, by recursively partitioning elements that represent data items (when building leaves), or lower level nodes (when building internal nodes).

The new method focuses on using less memory, since a temporary Quadtree is not stored. Main memory is a key factor for the performance of the bulk-loading process, especially for big datasets. In the future, we plan to study the performance of the new method and also to embed it in the process of incrementally building xBR+-trees, when the dataset items are available one-by-one.

[1] G. Roumelis, M. Vassilakopoulos, T. Loukopoulos, A. Corral and Y. Manolopoulos: The xBR+-tree: An Efficient Access Method for Points, DEXA Conference, Valencia, Spain, pp. 43-58, September 2015.

[2] G. Roumelis, M. Vassilakopoulos, A. Corral and Y. Manolopoulos: Performance Comparison of xBR+-trees and R-trees for Processing Spatial Queries, submitted for publication, March 2016.

[3] G. Roumelis, M. Vassilakopoulos, A. Corral and Y. Manolopoulos: Bulk-Loading xBR+-trees, submitted for publication, May 2016.

Recent Developments in Power Flow and Stability Modelling

21 Jun
13:00-13:30
1B

Dimitris Zimeris

Dept. of Electrical and Computer Engineering, University of Thessaly

Power flow and stability analysis have been used for decades, for analyzing both the traditional electric power grids and the new reformed grid infrastructure the so-called smart grids. Recently, both the power flow and stability analysis have entered a new area of research where several research teams all over the world have contributed with radically new modeling approaches. Regarding power flow, efforts are focused on a more dynamical perspective aiming at incorporating differential equations for evaluating branch parameters, rather than nodal ones. As far as stability concerns, new evaluation techniques based on network oscillations properties are introduced. Synchronization and basin stability as a complement to linear stability are utilized to cope with the dynamical nature of electric power grids. This allows us to view power systems as complex networks, so as to take advantage of complex systems properties. In other words, the new power systems viewpoint is in fact a compromise between two major fields of research and technology, namely electrical power engineering and statistical physics. Among others, the following three new approaches seem to offer the most promising results that pave the way to a radically new approach in power grid analysis.

1. Distflow ODE modeling is an outcome of the branch flow model (Wang, Turitsyn, & Chertkov, 2012) which involves the rate of change of power flow in power grid branches (links), unlike the classic nodal power flow.

2. Models capturing the self-synchronization procedures on power grids (Nishikawa & Motter, 2015; Motter, Myers, Anghel, & Nishikawa, 2013; Rohden, Sorge, Witthaut, & Timme, 2014). They are based on the extended 2nd order Kuramoto model of phase coupled oscillators in complex networks. They also incorporate dynamic spectral analysis. Basin stability as an assistance tool for linear stability is also incorporated in this new research field (Menck & Kurths, 2012; Menck, Heitzig, Marwan, & Kurths, 2013).

3. Network oscillation model based on graph wave equations, incorporated in a discrete spectral graph analysis of the power grid, is also recently introduced (Caputo, Knippel, & Simo, 2013). Graph wave equations obtained as an outcome of the linearization of the Kuramoto model, are only tested for very small-scale networks mainly of mechanical nature, leaving the electric power networks for future investigation.

We briefly present specific topics from the above mentioned efforts, elucidate related concepts, understand the impact of certain characteristics of these models and comment on their practical capabilities and possible theoretical extensions. We focus on computational techniques that hopefully leads to more effective and advanced practical solution techniques.

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21 Jun
14:30-15:30
1C

On the optimal solution of the "saddle point problem"

Apostolos Hadjidimos

Department of Electrical and Computer Engineering, University of Thessaly

The "saddle point problem" is of great interest because of its many applications in Science, Technology, Economics, etc. So, its effective solution is most imperative. In this talk the optimal solution is presented for the first time.

The "saddle point problem" is stated as follows:

"Determine a vector $[x^T, y^T]^T \in \mathbb{R}\}^{m+n}$, $x \in \mathbb{R}^m, y \in \mathbb{R}^n$, $n \leq m$, satisfying the equation below

$$\mathcal{A}\begin{bmatrix} x \\ y \end{bmatrix} := \begin{bmatrix} A & B \\ -B^T & 0 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} p \\ -q \end{bmatrix}, \tag{1}$$

where $A \in \mathbb{R}^{m\times m}$ is a nonsymmetric positive definite matrix, $B \in \mathbb{R}^{m\times n}$ is rank deficient ($\text{rank}(B) = r < n$), $p \in \mathbb{R}^m, q \in \mathbb{R}^n$ and $[p^T, -q^T]^T \in range(\mathcal{A})$."

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21 Jun
16:00-16:30
1C

Reliability and Energy-efficiency optimizations using Significance-Based Computing

Nikolaos Bellas, Spyros Lalis, Christos D. Antonopoulos, Vassilis Vassiliadis and Konstantinos Parasyris

Department of Electrical and Computer Engineering, University of Thessaly

Manufacturing process variability at low geometries and energy dissipation are the most challenging problems in the design of future computing systems. Currently, manufacturers go to great lengths to guarantee fault-free operation of their products by introducing redundancy in voltage margins, conservative layout rules, and extra protection circuitry.

However, such design redundancy leading to significant energy overheads may not be really required, given that many modern workloads, such as multimedia, machine learning, visualization, etc. can tolerate a degree of imprecision in computations and data.

In this talk, I will introduce SCoRPiO, a toolflow which seeks to exploit this observation and to relax reliability requirements for the hardware layer by allowing a controlled degree of imprecision to be introduced to computations. We show that one can gracefully trade-off output quality for energy savings, via the degree of unreliable task execution.

A high-order incompressible Navier-Stokes solver coupled with a parallel multigrid pressure correction technique for GPUs

21 Jun
16:30-17:00
1C

Emmanuel Mathioudakis and Vassilios Mandikas

Applied Mathematics and Computers Lab - Technical University of Crete - University Campus

A parallel multigrid pressure correction scheme is developed for the numerical solution of the incompressible Navier-Stokes equations for computing architectures with accelerators. The discrete pressure Poisson equation is solved with high-order compact finite-difference approximations of the momentum equations on a staggered grid arrangement. This procedure is the most computationally intensive part of the algorithm and a parallel iterative method based on multigrid techniques can accelerate the computation for high resolution simulation problems. Partial semi-coarsening strategy and line red-black ordering Gauss-Seidel relaxation are employed to solve the resulting large and sparse linear system for both equal and unequal mesh-size discretizations. The staggered grid leads to cell-centred multigrid techniques application, having an intrinsic difficulty, since the coarse grid points do not form a subset of the fine-grid points as in the vertex-centered case. The parallel algorithm is based on mapping the multigrid computation on a shared memory multicore architecture. Its realization is developed with using cuBLAS basic linear algebra operations and the OpenACC API for the remaining parallel procedures.

The performance investigation demonstrates that the parallel pressure correction solver can achieve an acceleration up to 11x for CPU-GPU computations and up to 4x for multi-CPU only environments, over the sequential CPU implementation for realistic applications.

Building an Efficient Micro-Server Ecosystem by Exceeding the Energy / Performance Scaling Envelope.

21 Jun
17:00-17:30
1C

Manolis Maroudas, Panagiotis Koutsovasilis, Christos Kalogirou, Spyros Lalis, Nikolaos Bellas, Georgios Karakonstantis, Christos D. Antonopoulos

Department of Electrical and Computer Engineering, University of Thessaly

The number of intelligent Internet-connected devices is constantly growing and will soon be in the orders of tens of billions, forming the Internet of Things (IoT). The aggregate data exchange and processing requirements created by the IoT is immense. Coping with this imminent data flood requires to rethink the ways that we communicate and process data across the Internet and Cloud services and come up with more sustainable paradigms.

A recently introduced approach that has the potential to ensure the viability and scaling of the Internet in the IoT era is Edge computing, which evangelizes running services close to the data sources. Edge computing can reduce application latency, and decrease bandwidth requirements between the end-user and the data-center, since part of, or in some cases all, processing is performed closer to the user.

Realizing such an approach requires the design of new server ecosystem that can be deployed closer to data sources, without the need of any expensive cooling or powering infrastructure.

Achieving high performance and energy efficiency is particularly challenging due to the stagnant voltage scaling and the worsening process variations transistors experience as they approach the atomic scale. Each manufactured processor and memory module is becoming inherently different in terms of its energy footprint and performance. By neglecting this and continuing adopting pessimistic operating margins in voltage and frequency based on worst case operating conditions - that may seldom occur during the execution a realistic workload - we are artificially constraining the energy efficiency and performance that can be achieved.

To overcome these scaling boundaries we need to treat intrinsic hardware heterogeneity as an opportunity and not as a problem. Substituting the existing rather conservative margins according to the real capabilities of each individual core and memory-array has the potential to improve energy efficiency and performance, while allowing better utilization of the silicon real estate. This is exactly the target of our research effort. We introduce a novel hardware and software ecosystem for enabling and allowing operation at extended operating margins, far beyond the conservative ones.

The proposed cross-layer approach contributes to the following layers: i) at the circuit, micro-architecture and architecture layer by automatically revealing the possible extended operating points (i.e.,voltage, frequency, refesh rate) of each hardware component; ii) at the firmware layer, with low-level handlers for monitoring and controlling the operating status of the underlying hardware components, as well as performing periodical benchmarking of the hardware. iii) at the software layer by enabling virtualization and programmability, ensuring high dependability and full utilization of the operational margins, observed in the underlying hardware by the Hypervisor. This level also features extensions for resource management within the cloud management framework (i.e. OpenStack). The proposed software stack enables the exploitation of extended margins with high, or even total transparency to developers and end-users.

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22 Jun
09:30-10:30
2A

Mobile robots in bio-production systems

Dionysis Bochtis
School of Sciences, University of Lincoln

Robotic applications have outgrown the structured industrial environments and moved also to semi-structured environments, such as hospitals and storage facilities, urban transportation, and agricultural environments. These environments require robots with advanced capabilities for planning and executing the allocated missions. Especially agriculture, where biological entities are involved, provides a highly challenging operation environment for robotic applications that is non-static, non-certain, and not known in advance. In terms of the market perspective, the potential for the implementation of robotics as an evolving process seems also high. According to a VDMA (Mechanical Engineering Industry Association) agricultural

machinery was valued at 96bn (2013) and considering the introduction of mobile agricultural robots an increasing share of 30bn is expected to be assigned to the robotic market.

This speech provides of overview of the current state of mobile robotics in bio-production systems, the available technical solutions applicable both in pure robotic systems and in manned machinery with advanced automation capabilities, the recent advances on planning aspects, i.e. route planning, multiple-units coordination, task assignment, and mission planning, and on navigation and perception aspects. Finally, the envisioned short- and mid-term future of mobile robotics in bio-production are presented alongside with the missing links for a fully deployment of autonomous vehicles in arable and high value crops production.

Performance of Some hp-Adaptive Strategies for 3D Elliptic Problems

21 Jun
10:30-11:00
2A

William Mitchell

National Institute of Standards and Technology, Gaithersburg, Maryland, U.S.A.

The hp version of the finite element method (hp-FEM) combined with adaptive mesh refinement is a particularly efficient method for solving partial differential equations (PDEs) because it can achieve an exponential convergence rate in the number of degrees of freedom. hp-FEM allows for refinement in both the element size, h, and the polynomial degree, p. Like adaptive refinement for the h version of the finite element method, a posteriori error estimates can be used to determine where the mesh needs to be refined, but a single error estimate can not simultaneously determine whether it is better to do the refinement by h or p. Several strategies for making this determination have been proposed over the years. Recently, we presented the results of a numerical experiment to compare the performance of several hp-adaptive strategies for 2D elliptic PDEs. In this paper we present the results of a similar experiment for some of the strategies applied to 3D elliptic PDEs.

IOT, API, Big Data and FinTech, Are Technologies Really Disrupting the Financial Industry?

22 Jun
11:30-12:30
2B

Ko-Yang Wang

fusions360.com

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22 Jun
12:30-13:00
2B

Intelligent climate management for sustainable greenhouse eco-systems

Constantinos Kittas, Nikos Katsoulas, Eva Kittas and Thomas Bartzanas

Centre for Research and Technology-HELLAS / Institute for Research and Technology-Thessaly

According to Food Agriculture Organisation (FAO) in the next 20 years world food production must increase by 50%, while 80% of that increase must come from intensification. Modern agriculture is constantly seeking ways to overcome the constraints of decreasing agricultural land and limited water supply in an economic manner. More than 50% of the production cost of greenhouse industry is linked to the use of water, fertilisers and energy. Not only does this fact negatively affects the greenhouse environmental footprint but it also creates a financial drawback in greenhouse SMEs development. According to the Food and Agriculture Organization (FAO), greenhouses should be more sustainable and their environmental impact should be significantly reduced. In this context, the major challenges that greenhouses face are to increase their production efficiency and reduce their environmental impact.

To do so, the combination of modern ICT technology with unparalleled agronomists scientific knowledge is a key factor: such a combination would favor a holistic approach for greenhouses efficiency and sustainability, covering diverse aspects, ranging from reducing the need for high energy, water, and chemicals inputs to optimal climate and cultivation control. Such an approach would also add extra value to the greenhouse products, enabling their classification in a premium product category with limited environmental impact. In the present presentation the main challenges that modern agriculture and greenhouse industry are facing today are presented and discussed. Based on these challenges the main technical solutions, technologies and systems for increasing the sustainability of greenhouse sector are analysed. Focus is given to climatisation systems (heating, ventilation, cooling, shading), rational use of energy and water resources, integrated pest management technologies and on smart greenhouse climate control.

The technologies and systems for sustainable greenhouse systems do exist. It remains to growers and greenhouse managers to use appropriately applied these technologies in practice. Then greenhouse horticulture would have a good substantial progress towards its sustainable development.

An expert irrigation system based on could computing

22 Jun
13:00-13:30
2B

Nikos Katsoulas, Eva Kittas, Thomas Bartzanas and Constantinos Kittas
Centre for Research and Technology-HELLAS / Institute for Research and Technology-Thessaly

In countries with scarce water resources where irrigation of farmland accounts for more than 70% of water use, the competition for this resource is intensifying and will continue so as long as the demand for water increases and its quality decreases. In 2012, the EU-report on identifying water saving potentials in the EU countries mentioned that improving water application efficiency would save 15 to 60% of water use. Water conservation potential accrue from not irrigating non-cropped areas, matching irrigation schedules (doses and frequency) to the real crop water requirements and fully optimizing the economic value of water applied through irrigation. This potential could be targeted through precision irrigation defined as any system that can determine the timing, magnitude and spatial pattern of applications for the next irrigation to give the best chance of meeting the seasonal objective. Recent advances in precision irrigation have substantially improved present knowledge about the tolerance of crops to water deficit and about the ability of soils to supply water, which have led to the application of regulated deficit irrigation, highlighting therefore potential water savings between 15 and 30%.

Aim of the paper is the presentation of a knowledge-based system for online precise irrigation scheduling (OpIRIS) using advanced results from previous FP projects on water and fertilizers productivity in fruit trees orchards and hydroponic productions in greenhouses. The proposed system has been tested (sensors, data transfer, analysis and interpretation) in field conditions for hydroponic exploitations in order to evaluate its performance and versatility for different agricultural conditions. First results from its use show a 30% reduction on water use, 20% on fertilizer use without compromise the quality and quantity of the products.

A Personal Journey through Scientific Computing

22 Jun
14:30-15:00
2C

Manolis Vavalis
Department of Electrical and Computer Engineering, University of Thessaly

How Scientific Computing started? How it has been evolved? Where it stands now? Where it will be in the near future? What machines have been used? How it influenced the evolution of these machines? How much the programming languages have changed? What computing/programming paradigms have been considered? Is there a future in it?

This talk concerns the authors journey through the scientific computing saga. From punch cards to exascale computing. From subroutines to libraries to modules and to services, From serial computing, to vector computing to shared and distributed memory parallel computing. From Linkpack and to Itpack, to Lapack and of course to Ellpack and //Ellpack and the such.

It has been a very exiting journey and Elias has been my advisor all the way from the beginning till now.

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22 Jun
15:00-15:30
2C

PDE option pricing with variable correlations

Christina Christara

Department of Computer Science, University of Toronto

Correlation between financial quantities plays an important role in pricing financial derivatives. Existing popular models assume that correlation either is constant, or exhibits some deterministic behaviour. However, market observations suggest that correlation is a more complicated process.

We consider correlation structures that are guided by regime switching or by a stochastic process. We derive the related Partial Differential Equation (PDE) problems for pricing several types of financial derivatives, and solve them by accurate and efficient numerical methods. We also study the effect of model parameters to the prices. We present the PDE, the numerical solution, and comparison of the PDE results to Monte-Carlo simulations. We also discuss the relevant numerical challenges.

Joint work with Chun Ho (Nat) Leung.

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22 Jun
15:30-16:00
2C

Towards Exascale Parallel Mesh Generation and Real-Time Medical Image Computing

Nikos Chrisochoides

CRTCLab, Computer Science Dept. Old Dominion University

In this talk we will present a new approach for guaranteed quality extreme-scale parallel mesh generation and its broader impact to real-time medical image computing. First, we will present a telescopic algorithmic approach to explore a billion-way concurrency by using a hierarchy of abstractions that leverage the memory and network hierarchy of current and emerging multi-layered parallel architectures. Then we will present our work on a parallel runtime software system for implementing effectively mesh generation codes with a billion-way concurrency.

In the second part of this talk we will present a real-time, non-rigid registration method for aligning pre-operative MRI with intra-operative MRI to compensate for brain deformation during tumor resection and Deep Brain Stimulation (DBS). The new method leverages our work on parallel mesh generation and it reduces the alignment error up to seven and six times compared to a widely used rigid and ITKs FE-based non-rigid registration methods, respectively. Finally, we will present preliminary results on the anatomic modeling for: (i) blood flow diversion of Cerebral Aneurysms and (ii) surgical simulation of Arteriovenous Malformations (AVM).

TBA

22 Jun
16:30-17:00
2D

Sanjiva Weerawarana
WSO2

Computational Methods and Applications

22 Jun
17:00-17:30
2D

Panagiota Tsompanopoulou
Dept. of Electrical and Computer Engineering, University of Thessaly

The talk aims to present few of my past steps on scientific computations.

My very first work was on the formulation, analysis and implementation of iterative ADI methods for the solution of linear equations systems arising from the discretization of k-D elliptic PDEs using cubic splines.

A next step was on Interface Relaxation (IR) Methods for Elliptic Problems. This was about the formulation, theoretical study, analysis and error estimation for a variety of such methods with numerical results and applications.

IR methods are closely connected with Problem Solving Environments for complex multi-physics and multi-domain problems. The design, implementation and study of their efficiency on distributed computer systems followed.

Finally, new approaches that enable fast and accurate simulation of large-scale power delivery networks found in contemporary ICs were investigated. These methodologies combine an iterative linear system solution algorithm along with two problem-specific preconditioners. Experimental evaluation demonstrated that the proposed approaches can achieve up to two or three orders of magnitude speedup for power grid electrical analysis compared to state-of-the-art direct and iterative solvers.

Serious games as learning tools for building basic skills in school education

22 Jun
17:30-18:00
2D

Hariklia Tsalapatas and Olivier Heidmann
Dept. of Electrical and Computer Engineering, University of Thessaly

Over the past decade there is a renewed emphasis on the development of basic learning skills, such as literacy as well as science, technology, and math (STEM). Furthermore, there is a renewed focus on the development of transversal learning competences that can help learners excel in all subjects, independently of academic discipline, such as analytical and critical thinking, capacity to collaborate, ability to work across cultures, ability to learn independently, and more. It may be argued that this trend represents a return to the roots in terms of the objective of learning initiatives, due partly to observations that the engagement with and achievement levels of learners in these basic and transversal competencies at key times in their lives, such as at the early education stage or at the age of 15, is correlated with how effectively a learner may use these skills later in life to fulfill personal and professional growth (PISA 2009). In terms of learning design and implementation,

however, initiatives such as the ET2020 objectives highlight the need to update educational practices by integrating emerging pedagogies and supporting ICT into learning towards promoting quality education for all in formal and informal settings.

Serious games, namely games designed for learning purposes, are a good example of how emerging learning frameworks combined with technology can enrich learning experiences and, when properly designed, help reach educational objectives. Experiential, active, collaborative, and explorative educational methodologies can be instantiated through gamified learning that enables youngsters to build and better retain knowledge actively, by doing through realistic scenarios that draw inspiration from real-life. Gaming mechanisms, such as challenges, rewards, effective feedback that helps learners link cause and effect of actions, collaboration, gradual access to educational content based on achievement, social interaction, and recognition of achievement, when effectively integrated into learning may enhance the motivation and long-term engagement of learners, help scaffold knowledge in small, incremental steps, and help build learner confidence in their own skills.

This work presents diverse educational games designed for helping develop basic skills of learners in school education. The first game, developed in the context of the EMPLOY project, deploys experiential learning design to address the enhancement of highly in demand digital skills for learners aged 10-15 in line with industry needs. The game deploys experiential learning design to expose learners to the way digital skills are used in professional settings not only in the ICT sector but also in wider ICT-using sectors. These competencies are essential in the face of a lack of as much as 900k professionals in Europe in ICT using sectors (New Skills for New Jobs, Digital Agenda for Europe) and may help curb the high youth unemployment through a better matching of available to needed skill sets. The second game, developed in the context of the LanguageGames project, exploits active learning for fostering multilingualism among young learner in pre-school and early primary education validating in practice emerging attitudes on language education that argue that multilingualism may positively affect a childs cognitive development as a whole, making a child more intellectually perceptive and flexible (Goethe Institut). Both projects are funded with the support of the ERASMUS+ program.

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