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Preface

These multiple volumes (LNCS volumes 6782, 6783, 6784, 6785 and 6786) consist of the peer-reviewed papers from the 2011 International Conference on Computational Science and Its Applications (ICCSA 2011) held in Santander, Spain during June 20-23, 2011. ICCSA 2011 was a successful event in the International Conferences on Computational Science and Its Applications (ICCSA) conference series, previously held in Fukuoka, Japan (2010), Suwon, South Korea (2009), Perugia, Italy (2008), Kuala Lumpur, Malaysia (2007), Glasgow, UK (2006), Singapore (2005), Assisi, Italy (2004), Montreal, Canada (2003), and (as ICCS) Amsterdam, The Netherlands (2002) and San Francisco, USA (2001).

Computational science is a main pillar of most of the present research, as well as industrial and commercial activities and plays a unique role in exploiting ICT innovative technologies. The ICCSA conferences have been providing a venue to researchers and industry practitioners to discuss new ideas, to share complex problems and their solutions, and to shape new trends in computational science.

Apart from the general tracks, ICCSA 2011 also included 31 special sessions and workshops, in various areas of computational science, ranging from computational science technologies to specific areas of computational science, such as computer graphics and virtual reality. We accepted 52 papers for the general track, and 210 in special sessions and workshops. These represent an acceptance rate of 29.7%. We would like to show our appreciations to the Workshop and Special Session Chairs and co-Chairs.

The success of the ICCSA conference series, in general, and ICCSA 2011, in particular, is due to the support of many people: authors, presenters, participants, keynote speakers, Session Chairs, Organizing Committee members, student volunteers, Program Committee members, International Liaison Chairs, and people in other various roles. We would like to thank them all. We would also like to thank Springer for their continuous support in publishing ICCSA conference proceedings.

June 2011

Osvaldo Gervasi
David Taniar

Message from the ICCSA 2011 General Chairs

These five volumes contain an outstanding collection of refereed papers selected for the 11th International Conference on Computational Science and Its Applications, ICCSA 2011, held in Santander (Spain), June 20-23, 2011. We cordially invite you to visit the ICCSA website `http://www.iccsa.org` where you can find all relevant information about this interesting and exciting event.

ICCSA 2011 marked the beginning of the second decade of this conference series. Previous editions in this series of highly successful International Conferences on Computational Science and Its Applications (ICCSA) were held in Fukuoka, Japan (2010), Suwon, Korea (2009), Perugia, Italy (2008), Kuala Lumpur, Malaysia (2007), Glasgow, UK (2006), Singapore (2005), Assisi, Italy (2004), Montreal, Canada (2003), and (as ICCS) Amsterdam, The Netherlands (2002) and San Francisco, USA (2001).

As we enter the second decade of ICCSA, we realize the profound changes and spectacular advances in the world of computational science. This discipline plays a unique role in fostering new technologies and knowledge, and is crucial for most of the present research, and industrial and commercial activities. We believe that ICCSA has contributed to this change by offering a real opportunity to explore innovative approaches and techniques to solve complex problems. Reciprocally, the computational science community has enthusiastically embraced the successive editions of ICCSA, thus contributing to making ICCSA a focal meeting point for those interested in innovative, cutting-edge research about the latest and most exciting developments in the field. We are grateful to all those who have contributed to the current success of ICCSA with their continued support over the past ten years.

ICCSA 2011 would not have been made possible without the valuable contribution from many people. We would like to thank all session organizers for their diligent work, which further enhanced the conference levels and all reviewers for their expertise and generous effort which led to a very high quality event with excellent papers and presentations. We especially recognize the contribution of the Program Committee and Local Organizing Committee members for their tremendous support and for making this congress a very sucessful event.

We would like to sincerely thank our keynote speakers, who willingly accepted our invitation and shared their expertise through illuminating talks, helping us to fully meet the conference objectives.

We highly appreciate the University of Cantabria for their enthusiastic acceptance to host the conference on its main campus, their logistic assistance and additional financial support. The conference was held in the Faculty of Sciences of the University of Cantabria. We thank the Dean of the Faculty of Sciences, Ernesto Anabitarte, for his support before and during the congress, and for providing the venue of the conference and the use of all needed facilities.

ICCSA 2011 was jointly organized by the Department of Applied Mathematics and Computational Sciences and the Department of Mathematics, Statistics and Computation of the University of Cantabria, Spain. We thank both departments for their encouranging support of this conference from the very beginning. We would like to express our gratitude to the Local Organizing Committee for their persistent and enthusiastic work towards the success of this conference.

We owe special thanks to all our sponsors: the Faculty of Sciences, the University of Cantabria, the Municipality of Santander, the Regional Government of Cantabria and the Spanish Ministry of Science and Innovation, for their continuous support without which this conference would not be possible. We also thank our publisher, Springer, for their acceptance to publish the proceedings and for their kind assistance and cooperation during the editing process.

Finally, we thank all authors for their submissions and all conference attendants for making ICCSA 2011 truly an excellent forum on computational science, facilitating exchange of ideas, fostering new collaborations and shaping the future of this exciting field. Last, but certainly not least, we wish to thank our readers for their interest in these proceedings. We really hope you find in these pages interesting material and fruitful ideas for your future work.

June 2011   Andrés Iglesias
                                                          Bernady O. Apduhan

The Wisdom of Ancient Masters

In 1879, Marcelino Sanz de Sautuola and his young daugther María incidentally noticed that the ceiling of the Altamira cave was covered by images of bisons and other animals, some as old as between 25,000 and 35,000 years. They had discovered what came to be called the Sistine Chapel of Paleolithic Art. When the discovery was first made public in 1880, many experts rejected it under the belief that prehistoric man was unable to produce such beautiful and ellaborated paintings. Once their authenticity was later confirmed, it changed forever our perception of prehistoric human beings.

Today, the cave of Altamira and its paintings are a symbol of the wisdom and ability of our ancient ancestors. They remind us that our current technological development is mostly based on the work, genius and efforts of our predecessors over many generations.

The cave of Altamira (UNESCO World Heritage Site) is located in the region of Cantabria, near the city of Santander (ICCSA 2011 conference venue). The original cave is closed to the public for preservation, but conference attendees visited the "Neocave", an exact reproduction of the original space with all its cracks and textures and the permanent exhibition "The Times of Altamira", which introduces visitors to the prehistory of the peninsula and rupestrian art.

"After Altamira, all is decadence" (Pablo Picasso, famous Spanish painter)

ICCSA 2011 Welcome Message

Welcome to the proceedings of the 11th International Conference on Computational Science and Its Applications, ICCSA 2011, held in Santander, Spain.

The city of Santander is located in the self-governed region of Cantabria, on the northern coast of Spain between Asturias and the Basque Country. This beautiful region of half a million inhabitants is on the shores of the Cantabrian Sea and is crossed by a mountain range. The shores and inland valleys offer a wide variety of landscapes as a consequence of the mild, moist climate of so-called Green Spain. The coastal landscape of beaches, bays and cliffs blends together with valleys and highland areas. All along the coast there are typical traditional fishing ports and innumerable diverse beaches of soft white sand.

However, Cantabria's attractions are not limited to its natural treasures. History has provided a rich artistic and cultural heritage found in towns and villages that are outstanding in their own right. The archaeological remains and historic buildings bear the mark of a unique history starting with the world-famous Altamira cave paintings, a veritable shrine to the prehistoric age. In addition, there are remarkable remains from the Romans, the Mozarabic presence and the beginnings of the Reconquest of Spain, along with an artistic heritage of Romanesque, Gothic and Baroque styles. Examples include the Prehistoric Era (the Altamira and Puente Viesgo Caves), Roman ruins such as those of Julióbriga, medieval settlements, such as Santillana del Mar, and several examples of the civil and religious architecture of the nineteenth and twentieth centuries.

The surrounding natural landscape and the historical importance of many of its villages and buildings make this region very appealing for tourism, especially during the spring and summer seasons, when the humid, mild weather gives the region a rich and varied nature of woods and meadows. At the time of the conference, attendees enjoyed the gentle climate (with temperatures averaging 18-20 degrees Celsius) and the longest days of the year. They found themselves waiting for sunset at the beach at about 11 pm!

Capital of the autonomous region of Cantabria, the city of Santander is also a very popular destination for tourism. Based around one of the most beautiful bays in the world, this modern city is famous for its sparkling beaches of yellow sand and clean water, the hospitality of its people and the high reputation of its celebrated gastronomy, mostly based on fish and shellfish. With a population of about 200,000 inhabitants, Santander is a very safe city, with a vibrant tourist scene filled with entertainment and a high quality of life, matching the best standards in the world. The coastal side of the city boasts a long string of top–quality beaches and recreational areas, such as the Magdalena Peninsula, the Sardinero and Mataleñas Park. There are several beaches and harbors limiting the city on the northern side, toward the southern part there is the old city

center and a bit further on the green mountains. We proudly say that Santander is between the blue and the green.

The University of Cantabria (in Spanish, *the Universidad de Cantabria, UC*) is the only public university in Cantabria, Spain. It was founded in 1972 and is organized in 12 faculties and schools. With about 13,000 students and 1,000 academic staff, the University of Cantabria is one of the most reputed universities in the country, ranking in the highest positions of Spanish universities in relation to its size. Not surprisingly, it was selected as a Campus of International Excellence by the Spanish Government in 2009.

Besides the technical sessions and presentations, ICCSA 2011 provided an interesting, must-attend social program. It started with a Welcome Reception at the Royal Palace of the Magdalena (Sunday 19), the most emblematic building of Santander and also the most visited place in the city. The royal family used the palace during the period 1913–1930 as a base for numerous recreational and sporting activities, and the king sometimes also held government meetings at the property. Conference delegates had the wonderful opportunity to visit this splendid palace, enjoy the magnificent views and see some rooms where royalty lived. The Gala Dinner (Tuesday 21) took place at the Grand Casino, in the "Sardinero" area, a regal, 1920's building with large windows and spacious terraces offering superb views of the Sardinero beach. The Casino was King Alfonso XIII and Queen Victoria Eugenia's main place of entertainment during their summer holidays in the city between 1913 and 1930. The gala also included some cultural and musical events. Finally, a half-day conference tour (Wednesday 22) covered the "live museum" of the Middle Ages, Santillana del Mar (a medieval town with cobbled streets, declared "Site of Artistic and Historical Importance" and one of the best-known cultural and tourist centers in Cantabria) and the Altamira Neocave, an exact reproduction of the original Altamira cave (now closed to the public for preservation) with all its cracks and textures and the permanent exhibition "The Times of Altamira", which introduces visitors to the prehistory of the peninsula and rupestrian art.

To close the conference, attendees could join the people of Santander for St. John's day, celebrated in the night between June 23 and 24 to commemorate the summer solstice with bonfires on the beach.

We believe that all these attractions made the conference an unforgettable experience.

On behalf of the Local Organizing Committee members, I thank all attendees fot their visit.

June 2011   Andrés Iglesias

Message from the Chairs of the Session:
6th International Workshop on "Geographical Analysis, Urban Modeling, Spatial Statistics" (GEOG-AN-MOD 2011)

During the past few decades the main problem in geographical analysis was the lack of spatial data availability. Nowadays the wide diffusion of electronic devices containing geo-referenced information generates a great production of spatial data. Volunteered geographic information activities (e.g., Wikimapia, OpenStreetMap), public initiatives (e.g., spatial data infrastructures, geo-portals) and private projects (e.g., Google Earth, Microsoft Virtual Earth, etc.) produced an overabundance of spatial data, which, in many cases, do not help the efficiency of decision processes. The increase of geographical data availability has not been fully coupled by an increase of knowledge to support spatial decisions.

The inclusion of spatial simulation techniques in recent GIS software favored the diffusion of these methods, but in several cases led to mechanisms based on which buttons have to be pressed without having geography or processes in mind. Spatial modeling, analytical techniques and geographical analyses are therefore required in order to analyze data and to facilitate the decision process at all levels, with a clear identification of the geographical information needed and reference scale to adopt. Old geographical issues can find an answer thanks to new methods and instruments, while new issues are developing, challenging researchers for new solutions. This workshop aims at contributing to the development of new techniques and methods to improve the process of knowledge acquisition.

Conference themes include:

Geostatistics and spatial simulation
Agent-based spatial modeling
Cellular automata spatial modeling
Spatial statistical models
Space-temporal modeling
Environmental modeling
Geovisual analytics, geovisualization, visual exploratory data analysis
Visualization and modeling of track data
Spatial optimization
Interaction simulation models
Data mining, spatial data mining
Spatial data warehouse and spatial OLAP
Integration of spatial OLAP and spatial data mining
Spatial decision support systems

Spatial multicriteria decision analysis
Spatial rough set
Spatial extension of fuzzy set theory
Ontologies for spatial analysis
Urban modeling
Applied geography
Spatial data analysis
Dynamic modeling
Simulation, space-time dynamics, visualization and virtual reality.

Giuseppe Borruso
Beniamino Murgante
Stefania Bertazzon

Message from the Chairs of the Session: "Cities, Technologies and Planning" (CTP 2011)

'Share' term has turned into a key issue of many successful initiatives in recent times. Following the advent of Web 2.0, positive experiences based on mass collaboration generated "Wikinomics" hnd ave become 'Socialnomics", where 'Citizens are voluntary sensors'.

During the past few decades, the main issue in GIS implementation has been the availability of sound spatial information. Nowadays, the wide diffusion of electronic devices providing geo-referenced information resulted in the production of extensive spatial information datasets. This trend has led to "GIS wikification", where mass collaboration plays a key role in the main components of spatial information frameworks (hardware, software, data, and people).

Some authors (Goodchild, 2007) talk about 'volunteered geographic information' (VGI), as the harnessing of tools to create, assemble, and disseminate geographic information provided by individuals voluntarily creating their own contents by marking the locations of occurred events or by labeling certain existing features not already shown on a map. The term "neogeography" is often adopted to describe peoples activities when using and creating their own maps, geo-tagging pictures, movies, websites, etc. It could be defined as a new bottom up approach to geography prompted by users, therefore introducing changes in the roles of traditional' geographers and consumers' of geographical contents themselves. The volunteered approach has been adopted by important American organizations, such as US Geological Survey, US Census Bureau, etc. While technologies (e.g. GPS, remote sensing, etc.) can be useful in producing new spatial data, volunteered activities are the only way to update and describe such data. If spatial data have been produced in various ways, remote sensing, sensor networks and other electronic devices generate a great flow of relevant spatial information concerning several aspects of human activities or of environmental phenomena monitoring. This 'information-explosion era' is characterized by a large amount of information produced both by human activities and by automated systems; the capturing and the manipulation of this information leads to 'urban computing' and represents a sort of bridge between computers and the real world, accounting for the social dimension of human environments. This technological evolution produced a new paradigm of urban development, called 'u-City'. Such phenomena offer new challenges to scholars (geographers, engineers, planners, economists, sociologists, etc.) as well as to spatial planners in addressing spatial issues and a wealth of brand-new, updated data, generally created by people who are interested in geographically related phenomena. As attention is to date dedicated to visualization and content creation, little has been done from the spatial analytical point of view and in involving users as citizens in participatory geographical activities.

Conference themes include:

SDI and planning
Planning 2.0, participation 2.0
Urban social networks, urban sensing
E-democracy, e-participation, participatory GIS
Technologies for e-participation, policy modeling, simulation and visualization
Second Life and participatory games
Ubiquitous computing environment; urban computing; ubiquitous-city
Neogeography
Collaborative mapping
Geotagging
Volunteered geographic information
Crowdsourcing
Ontologies for urban planning
City Gml
Geo-applications for mobile phones
Web 2.0, Web 3.0
Wikinomics, socialnomics
WikiCities
Maps mash up
Tangible maps and planning
Augmented reality,
Complexity assessment and mapping

Giuseppe Borruso
Beniamino Murgante

Message from the Chairs of the Session: 11th Annual International Workshop on "Computational Geometry and Applications" (CGA 2011)

The 11th International Workshop on Computational Geometry and Applications CGA 2011, held in conjunction with the International Conference on Computational Science and Applications, took place in Santander, Spain. The workshop has run annually since it was founded in 2001, and is intended as an international forum for researchers in computational geometry and related areas, with the goal of advancing the state of research in computational geometry and related disciplines. This year, the workshop was chaired for 11th year by CGA workshop series Founding Chair Marina Gavrilova, University of Calgary, joined by co-Chair Ovidiu Daescu, University of Texas at Dallas. Selected papers from the previous CGA Workshops have appeared in special issues in the following highly regarded journals: *International Journal of Computational Geometry and Applications*, Springer (three special issues), *International Journal of Computational Science and Engineering* (IJCSE), Journal of CAD/CAM , *Transactions on Computational Sciences*, Springer. A special issue comprising best papers presented at CGA 2011 is currently being planned.

The workshop attracts international attention and receives papers presenting high-quality original research in the following tracks:

- Theoretical computational geometry
- Applied computational geometry
- Optimization and performance issues in geometric algorithms implementation Workshop topics of interest include:
- Design and analysis of geometric algorithms
- Geometric algorithms in path planning and robotics
- Computational geometry in biometrics
- Intelligent geometric computing
- Geometric algorithms in computer graphics and computer vision
- Voronoi diagrams and their generalizations
- 3D Geometric modeling
- Geometric algorithms in geographical information systems
- Algebraic geometry
- Discrete and combinatorial geometry
- Implementation issues and numerical precision
- Applications in computational biology, physics, chemistry, geography, medicine, education
- Visualization of geometric algorithms

CGA 2011 was located in beautiful Santander, Cantabria, Spain. Santander, the capital city of Cantabria, is located on the northern coast of Spain, between Asturias and the Basque Country overlooking the Cantabrian Sea, and is surrounded by beaches. The conference preceded the Spanish Meeting on Computational Geometry, which took place in Madrid, facilitating interested researchers to attend both events. The 14 articles presented in this Springer LNCS proceeding volume represent papers selected fromi a large number of submissions to this year's workshop. We would like to express our sincere gratitude to the following International Program Committee members who performed their duties diligently and provided constructive feedback for authors to improve on their presentation:

Tetsuo Asano (Japan Advanced Institute of Science and Technology, Japan)
Sergei Bereg (University of Texas at Dallas, USA)
Karoly Bezdek (University of Calgary, Canada)
Ovidiu Daescu (University of Texas at Dallas, USA)
Mirela Damian (Villanova University, USA)
Tamal Dey (Ohio State University, USA)
Marina L. Gavrilova (University of Calgary, Canada)
Christopher Gold (University of Glamorgan, UK)
Hisamoto Hiyoshi (Gunma University, Japan)
Andrés Iglesias (University of Cantabria, Spain)
Anastasia Kurdia (Smith College, USA)
Deok-Soo Kim (Hanyang University, Korea)
Ivana Kolingerova (Unversity of West Bohemia, Czech Republic)
Nikolai Medvedev (Novosibirsk Russian Academy of Science, Russia)
Asish Mukhopadhyay (University of Windsor, Canada)
Dimitri Plemenos (Université de Limoges, France)
Val Pinciu (Southern Connecticut State University, USA)
Jon Rokne (University of Calgary, Canada)
Carlos Seara (Universitat Politecnica de Catalunya, Spain)
Kokichi Sugihara (University of Tokyo, Japan)
Vaclav Skala (University of West Bohemia, Czech Republic)
Muhammad Sarfraz (KFUPM, Saudi Arabia)
Alexei Sourin (Nanyang Technological University, Singapore)
Ryuhei Uehara (Japan Advanced Institute of Science and Technology, Japan)
Chee Yap (New York University, USA)
Kira Vyatkina (Sanct Petersburg State University, Russia)

We also would like to acknowledge the independent referees, ICCSA 2011 organizers, sponsors, volunteers, and Springer for their continuing collaboration and support.

Marina C. Gavrilova
Ovidiu Daescu

Message from the Chair of the Session: 3rd International Workshop on "Software Engineering Processes and Applications" (SEPA 2011)

The Third International Workshop on Software Engineering Processes and Applications (SEPA 2011) covered the latest developments in processes and applications of software engineering. SEPA includes process models, agile development, software engineering practices, requirements, system and design engineering including architectural design, component level design, formal methods, software modeling, testing strategies and tactics, process and product metrics, Web engineering, project management, risk management, and configuration management and all those areas which are related to the processes and any type of software applications. This workshop attracted papers from leading researchers in the field of software engineering and its application areas. Seven regular research papers were accepted as follows.

Sanjay Misra, Ibrahim Akman and Ferid Cafer presented a paper on "A Multi-Paradigm Complexity Metric(MCM)" The authors argued that there are not metrics in the literature for multi-paradigm. MCM is developed by using function points and procedural and object–oriented language's features. In this view, MCM involves most of the factors which are responsible for the complexity of any multi-paradigm language. MCM can be used for most programming paradigms, including both procedural and object–oriented languages.

Mohamed A. El-Zawawy's paper entitled 'Flow Sensitive-Insensitive Pointer Analysis Based Memory Safety for Multithreaded Programs' presented approaches for the pointer analysis and memory safety of multithreaded programs as simply structured type systems. The author explained that in order to balance accuracy and scalability, the proposed type system for pointer analysis of multithreaded programs is flow-sensitive, which invokes another flow-insensitive type system for parallel constructs.

Cesar Pardo, Francisco Pino, Felix Garcia, Francisco Romero, Mario Piattini, and Maria Teresa Baldassarre presented their paper entitled 'HProcessTOOL: A Support Tool in the Harmonization of Multiple Reference Models'. The authors have developed the tool HProcessTOOL, which guides harmonization projects by supporting specific techniques, and supports their management by controlling and monitoring the resulting harmonization projects. The validation of the tool is performed by two case studies.

Wasi Haider Butt, Sameera Amjad and Farooque Azam presented a paper on 'Requirement Conflicts Resolution: Using Requirement Filtering and Analysis'. The authors presented a systematic approach toward resolving software requirements spanning from requirement elicitation to the requirement analysis

activity of the requirement engineering process. The authors developed a model 'conflict resolution strategy' (CRS) which employs a requirement filter and an analysis strategy for resolving any conflict arising during software development. They also implemented their model on a real project.

Rajesh Prasad, Suneeta Agarwal, Anuj Kumar Sharma, Alok Singh and Sanjay Misra presented a paper on 'Efficient Algorithm for Detecting Parameterized Multiple Clones in a Large Software System'. In this paper the authors have tried to solve the word length problem in a bit-parallel parameterized matching by extending the BLIM algorithm of exact string matching. The authors further argued that the extended algorithm is also suitable for searching multiple patterns simultaneously. The authors presented a comparison in support of their algorithm.

Takahiro Uchiya and Tetsuo Kinoshita presented the paper entitled 'Behavior Analyzer for Developing Multiagent Systems on Repository-Based Multiagent Framework'. In this paper the authors proposed an interactive design environment of agent system (IDEA) founded on an agent-repository-based multiagent framework. They focused on the function of the behavior analyzer for developing multiagent systems and showed the effectiveness of the function.

Jose Alfonso Aguilar, Irene Garrigos, and Jose-Norberto Mazon presented a paper on 'Impact Analysis of Goal-Oriented Requirements in Web Engineering'. This paper argues that Web developers need to know dependencies among requirements to ensure that Web applications finally satisfy the audience. The authors developed an algorithm to deal with dependencies among functional and non-functional requirements so as to understand the impact of making changes when developing a Web application.

Sanjay Misra

Message from the Chair of the Session: 2nd International Workshop on "Software Quality" (SQ 2011)

Following the success of SQ 2009, the Second International Workshop on "Software Quality" (SQ 2011) was organized in conjunction with ICCSA 2011. This workshop extends the discussion on software quality issues in the modern software development processes. It covers all the aspects of process and product quality, quality assurance and standards, quality planning, quality control and software quality challenges. It also covers the frontier issues and trends for achieving the quality objectives. In fact this workshop covers all areas, that are concerned with the quality issue of software product and process. In this workshop, we featured nine articles devoted to different aspects of software quality.

Roberto Espinosa, Jose Zubcoff, and Jose-Norberto Mazon's paper entitled "A Set of Experiments to Consider Data Quality Criteria in Classification Techniques for Data Mining" analyzed data–mining techniques to know the behavior of different data quality criteria from the sources. The authors have conducted a set of experiments to assess three data quality criteria: completeness, correlation and balance of data.

In their paper, Ivaylo Spassov, Valentin Pavlov, Dessislava Petrova-Antonova, and Sylvia Ilieva's have developed a tool "DDAT: Data Dependency Analysis Tool for Web Service Business Processes". The authors have implemented and shown experimental results from the execution of the DDAT over BPEL processes.

Filip Radulovic and Raul Garca-Castro presented a paper on "Towards a Quality Model for Semantic Technologies". The authors presented some well-known software quality models, after which a quality model for semantic technologies is designed by extending the ISO 9126 quality model.

Luis Fernandez-Sanz and Sanjay Misra authored the paper "Influence of Human Factors in Software Quality and Productivity". The authors first analyzed the existing contributions in the area and then presented empirical data from specific initiatives to know more about real practices and situations in software organizations.

Eudisley Anjos, and Mario Zenha-Rela presented a paper on "A Framework for Classifying and Comparing Software Architecture Tools for Quality Evaluation". This framework identifies the most relevant features for categorizing different architecture evaluation tools according to six different dimensions. The authors reported that the attributes that a comprehensive tool should support include: the ability to handle multiple modeling approaches, integration with the industry standard UML or specific ADL, support for trade–off analysis of

competing quality attributes and the reuse of knowledge through the build-up of new architectural patterns.

Hendrik Decker presented a paper on "Causes of the Violation of Integrity Constraints for Supporting the Quality of Databases". He presented a quality metric with the potential of more accuracy by measuring the causes. He further argued that such measures also serve for controlling quality impairment across updates.

Csaba Nagy, Laszlo Vidacs , Rudolf Ferenc, Tibor Gyimothy Ferenc Kocsis, and Istvan Kovacs's presented a paper on "Complexity measures in a 4GL environment". The authors discussed the challenges in adopting the metrics from 3GL environments. Based on this, they presented a complexity measure in 4GL environments. They performed the experimentations and demonstrated the results.

Lukasz Radlinski's paper on "A Framework for Integrated Software Quality Prediction Using Bayesian Nets" developed a framework for integrated software quality prediction. His framework is developed and formulated using a Bayesian net, a technique that has already been used in various software engineering studies. The author argues that his model may be used in decision support for software analysts and managers.

Seunghun Park, Sangyoon Min, and Doohwan Bae authored the paper entitled "Process Instance Management Facilities Based on the Meta-Process Models". Based on the metar-process models, the authors proposed a process model and two types of process instance models: the structural instance model and the behavioral instance model. The authors' approach enables a project manager to analyze structural and behavioral properties of a process instance and allows a project manager to make use of the formalism for management facilities without knowledge of the formalism.

Sanjay Misra

Message from the Chairs of the Session: "Remote sensing Data Analysis, Modeling, Interpretation and Applications: From a Global View to a Local Analysis" (RS 2011)

Remotely sensed data provide temporal and spatial consistent measurements useful for deriving information on the dynamic nature of Earth surface processes (sea, ice, land, atmosphere), detecting and identifying land changes, discovering cultural resources, studying the dynamics of urban expansions. Thanks to the establishment and maintenance of long-term observation programs, presently a huge amount of multiscale and multifrequency remotely sensed data are available.

To fully exploit such data source for various fields of application (environmental, cultural heritage, urban analysis, disaster management) effective and reliable data processing, modeling and interpretation are required. This session brought together scientists and managers from the fields of remote sensing, ICT, geospatial analysis and modeling, to share information on the latest advances in remote sensing data analysis, product development, validation and data assimilation.

Main topics included:

Remotely sensed data – Multispectral satellite : from medium to very high spatial resolution; airborne and spaceborne Hypespectral data; open data source (Modis, Vegetation, etc..); airborne Laser Scanning; airborne and spaceborne Radar imaging; thermal imaging; declassified Intelligence Satellite Photographs (Corona, KVR); ground remote sensing

Methods and procedures – change detection; classification Data fusion / Data integration; data mining; geostatistics and Spatial statistics; image processing; image interpretation; linear and on linear statistical analysis; segmentation Pattern recognition and edge detection; time space modeling

Fields of application and products – archaeological site discovery; cultural Heritage management; disaster management; environmental sciences; mapping Landscape and digital elevation models; land cover analysis; open source softwares; palaeoenvironmental studies; time series

Nicola Masini
Rosa Lasaponara

Message from the Chairs of the Session: "Approximation, Optimization and Applications" (AOA 2011)

The objective of the session Approximation, Optimization and Applications during the 11th International Conference on Computational Science and Its Applications was to bring together scientists working in the areas of Approximation Theory and Numerical Optimization, including their applications in science and engineering.

Hypercomplex function theory, renamed Clifford analysis in the 1980s, studies functions with values in a non-commutative Clifford algebra. It has its roots in quaternionic analysis, developed as another generalization of the classic theory of functions of one complex variable compared with the theory of functions of several complex variables. It is well known that the use of quaternions and their applications in sciences and engineering is increasing, due to their advantages for fast calculations in 3D and for modeling mathematical problems. In particular, quasi-conformal 3D-mappings can be realized by regular (monogenic) quaternionic functions. In recent years the generalization of classical polynomials of a real or complex variable by using hypercomplex function theoretic tools has been the focus of increased attention leading to new and interesting problems. All these aspects led to the emergence of new software tools in the context of quaternionic or, more generally, Clifford analysis.

<div align="right">

Irene Falcão
Ana Maria A.C. Rocha

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Message from the Chair of the Session: "Symbolic Computing for Dynamic Geometry" (SCDG 2011)

The papers comprising in the Symbolic Computing for Dynamic Geometry technical session correspond to talks delivered at the conference. After the evaluation process, six papers were accepted for oral presentation, according to the recommendations of the reviewers. Two papers, "Equal bisectors at a vertex of a triangle" and "On Equivalence of Conditions for a Quadrilateral to Be Cyclica", study geometric problem by means of symbolic approaches.

Another contributions deal with teaching ("Teaching geometry with TutorMates" and "Using Free Open Source Software for Intelligent Geometric Computing"), while the remaining ones propose a framework for the symbolic treatment of dynamic geometry ("On the Parametric Representation of Dynamic Geometry Constructions") and a formal library for plane geometry ("A Coq-based Library for Interactive and Automated Theorem Proving in Plane Geometry").

Francisco Botana

Message from the Chairs of the Session: "Computational Design for Technology Enhanced Learning" (CD4TEL 2011)

Providing computational design support for orchestration of activities, roles, resources, and systems in technology-enhanced learning (TEL) is a complex task. It requires integrated thinking and interweaving of state-of-the-art knowledge in computer science, human–computer interaction, pedagogy, instructional design and curricular subject domains. Consequently, even where examples of successful practice or even standards and specifications like IMS learning design exist, it is often hard to apply and (re)use these efficiently and systematically. This interdisciplinary technical session brought together practitioners and researchers from diverse backgrounds such as computer science, education, and cognitive sciences to share their proposals and findings related to the computational design of activities, resources and systems for TEL applications.

The call for papers attracted 16 high-quality submissions. Each submission was reviewed by three experts. Eventually, five papers were accepted for presentation. These contributions demonstrate different perspectives of research in the CD4TEL area, dealing with standardization in the design of game-based learning; the integration of individual and collaborative electronic portfolios; the provision of an editing environment for different actors designing professional training; a simplified graphical notation for modeling the flow of activities in IMS learning design units of learning; and a pattern ontology-based model to support the selection of good-practice scripts for designing computer–supported collaborative learning.

Michael Derntl
Manuel Caeiro-Rodríguez
Davinia Hernández-Leo

Message from the Chair of the Session: "Chemistry and Materials Sciences and Technologies" (CMST 2011)

The CMST workshop is a typical example of how chemistry and computer science benefit from mutual interaction when operating within a grid e-science environment. The scientific contributions to the workshop, in fact, contain clear examples of chemical problems solved by exploiting the extra power offered by the grid infrastructure to the computational needs of molecular scientists when trying to push ahead the frontier of research and innovation.

Ideal examples of this are the papers on the coulomb potential decomposition in the multiconfiguration time–dependent Hartree method, on the extension of the grid–empowered simulator GEMS to the a priori evaluation of the crossed beam measurements and on the evaluation of the concentration of pollutants when using a box model version of the Community Multiscale Air Quality Modeling System 4.7. Another example of such progress in computational molecular science is offered by the paper illustrating the utilization of a fault–tolerant workflow for the DL-POLY package for molecular dynamics studies.

At the same time molecular science studies are an excellent opportunity for investigating the use of new (single or clustered) GPU chips as in the case of the papers related to their use for computationally demanding quantum calculations of atom diatom reactive scattering. In addition, of particular interest are the efforts spent to develop tools for evaluating user and service quality to the end of promoting collaborative work within virtual organizations and research communities through the awarding and the redeeming of credits.

Antonio Laganà

Message from the Chairs of the Session: "Cloud for High Performance Computing" (C4HPC 2011)

On behalf of the Program Committee, it is a pleasure for us to introduce the proceedings of this First International Workshop on Cloud for High–Performance Computing held in Santander (Spain) in 2011 during the 11th International Conference on Computational Science and Its Applications. The conference joined high quality researchers around the world to present the latest results in the usage of cloud computing for high–performance computing.

High–performance computing, or HPC, is a great tool for the advancement of science, technology and industry. It intensively uses computing resources, both CPU and storage, to solve technical or scientific problems in minimum time. It also uses the most advanced techniques to achieve this objective and evolves along with computing technology as fast as possible. During the last few years we have seen the introduction of new hardware isuch as multi-core and GPU representing a formidable challenge for the scientific and technical developers that need time to absorb these additional characteristics. At the same time, scientists and technicians have learnt to make faster and more accurate measurements, accumulating a large set of data which need more processing capacity. While these new paradigms were entering the field of HPC, virtualization was suddenly introduced in the market, generating a new model for provisioning computing capacity: the cloud. Although conceptually the cloud is not completely new, because it follows the old dream of computing as a utility, it has introduced new characteristics such as elasticity, but at the cost of losing some performance.

Consequently, HPC has a new challenge: how to tackle or solve this reduction in performance while adapting methods to the elasticity of the new platform. The initial results show the feasibility of using cloud infrastructures to execute HPC applications. However, there is also some consensus that the cloud is not the solution for grand challenges, which will still require dedicated supercomputers. Although recently a cluster of more than 4000 CPUs has been deployed, there are still many technical barriers to allow technicians to use it frequently. This is the reason for this workshop which we had the pleasure of introducing.

This First International Workshop on Cloud for High–Performance Computing was an original idea of Osvaldo Gervasi. We were working on the proposal of a COST action devoted to the cloud for HPC which would link the main researchers in Europe. He realized that the technical challenges HPC has to solve in the next few years to use the Cloud efficiently, need the collaboration of as many scientists and technicians as possible as well as to rethink the way the applications are executed.

This first workshop, which deserves in the next ICCSA conferences, joined together experts in the field that presented high quality research results in the area. They include the first approximations of topology methods such as cellular data system to cloud to be used to process data. Data are also the main issue for the TimeCloud front end, an interface for time series analysis based on Hadop and Hbase, designed to work with massive datasets. In fact, cloud can generate such a large amount of data when accurate information about its infrastructure and executing applications is needed. This is the topic of the third paper which introduce LISA algorithm to tackle the problem of information retrieval in cloud environment where the methods must adapt to the elasticity, scalability and possibility of failure. In fact, to understand Cloud infrastructures, researchers and technicians will need these series of data as well as the usage of tools that allow better knowledge to be gained. In this sense, iCanCloud, a novel simulator of cloud infrastructures, is introduced presenting its results for the most used and cited service: Amazon.

We strongly believe that the reader will enjoy the selected papers, which represent only a minimal, but important, part of the effervescent activity in Cloud for HPC. This selection was only possible thanks to the members of the Program Committee, all of them supporting actively the initiative. We appreciate their commitment to the workshop. Also, we want to thank all of the reviewers who kindly participated in the review of the papers and, finally, to all the scientists who submitted a paper, even if it was not accepted. We hope that they will have the opportunity to join us in the next editions.

Andrés Gomez
Osvaldo Gervasi

ICCSA 2011 Invited Speakers

Ajith Abraham
Machine Intelligence Research Labs, USA

Marina L. Gavrilova
University of Calgary, Canada

Yee Leung
The Chinese University of Hong Kong, China

Evolving Future Information Systems: Challenges, Perspectives and Applications

Ajith Abraham

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Abstract

We are blessed with the sophisticated technological artifacts that are enriching our daily lives and society. It is believed that the future Internet is going to provide us with the framework to integrate, control or operate virtually any device, appliance, monitoring systems, infrastructures etc. The challenge is to design intelligent machines and networks that could communicate and adapt according to the environment. In this talk, we first present the concept of a digital ecosystem and various research challenges from several application perspectives. Finally, we present some real–world applications.

Biography

Ajith Abraham received a PhD degree in Computer Science from Monash University, Melbourne, Australia. He is currently the Director of Machine Intelligence Research Labs (MIR Labs), Scientific Network for Innovation and Research Excellence, USA, which has members from more than 75 countries. He serves/has served the editorial board of over 50 international journals and has also guest edited 40 special issues on various topics. He has authored/co-authored more than 700 publications, and some of the works have also won best paper awards at international conferences. His research and development experience includes more than 20 years in industry and academia. He works in a multidisciplinary environment involving machine intelligence, network security, various aspects of networks, e-commerce, Web intelligence, Web services, computational grids, data mining, and their applications to various real-world problems. He has given more than 50 plenary lectures and conference tutorials in these areas.

Dr. Abraham is the Chair of IEEE Systems Man and Cybernetics Society Technical Committee on Soft Computing. He is a Senior Member of the IEEE, the IEEE Computer Society, the Institution of Engineering and Technology (UK) and the Institution of Engineers Australia (Australia). He is actively involved in the Hybrid Intelligent Systems (HIS), Intelligent Systems Design and Applications (ISDA), Information Assurance and Security (IAS), and Next–Generation Web Services Practices (NWeSP) series of international conferences, in addition to other conferences. More information can be found at: `http://www.softcomputing.net`.

Recent Advances and Trends in Biometric

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Extended Abstract

The area of biometric, without a doubt, is one of the most dynamic areas of interest, which recently has displayed a gamut of broader links to other fields of sciences. Among those are visualization, robotics, multi-dimensional data analysis, artificial intelligence, computational geometry, computer graphics, e-learning, data fusion and data synthesis. The theme of this keynote is reviewing the state of the art in multi-modal data fusion, fuzzy logic and neural networks and its recent connections to advanced biometric research.

Over the past decade, multimodal biometric systems emerged as a feasible and practical solution to counterweight the numerous disadvantages of single biometric systems. Active research intoi the design of a multimodal biometric system has started, mainly centered around: types of biometrics, types of data acquisition and decision-making processes. Many challenges originating from non-uniformity of biometric sources and biometric acquisition devices result in significant differences on which information is extracted, how is it correlated, the degree of allowable error, cost implications, ease of data manipulation and management, and also reliability of the decisions being made. With the additional demand of computational power and compact storage, more emphasis is shifted toward database design and computational algorithms.

One of the actively researched areas in multimodal biometric systems is information fusion. Which information needs to be fused and what level is needed to obtain the maximum recognition performance is the main focus of current research. In this talk I concentrate on an overview of the current trends in recent multimodal biometric fusion research and illustrate in detail one fusion strategy: rank level fusion. From the discussion, it is seen that rank level fusion often outperforms other methods, especially combined with powerful decision models such as Markov chain or fuzzy logic.

Another aspect of multi-modal biometric system development based on neural networks is discussed further. Neural networks have the capacity to simulate learning processes of a human brain and to analyze and compare complex patters, which can originate from either single or multiple biometric sources, with amazing precision. Speed and complexity have been the downsides of neural networks, however, recent advancements in the area, especially in chaotic neural networks, allow these barriers to be overcome.

The final part of the presentation concentrates on emerging areas utilizing the above developments, such as decision making in visualization, graphics, e-learning, navigation, robotics, and security of web-based and virtual worlds. The extent to which biometric advancements have an impact on these emerging areas makes a compelling case for the bright future of this area.

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Biography

Marina L. Gavrilova is an Associate Professor in the Department of Computer Science, University of Calgary. Prof. Gavrilova's research interests lie in the area of computational geometry, image processing, optimization, spatial and biometric modeling. Prof. Gavrilova is founder and co-director of two innovative research laboratories: the Biometric Technologies Laboratory: Modeling and Simulation and the SPARCS Laboratory for Spatial Analysis in Computational Sciences. Prof. Gavrilova publication list includes over 120 journal and conference papers, edited special issues, books and book chapters, including World Scientific Bestseller of the Month (2007) *Image Pattern Recognition: Synthesis and Analysis in Biometric* and the Springer book Computational Intelligence: A Geometry-Based Approach. Together with Dr. Kenneth Tan, Prof. Gavrilova founded the ICCSA series of successful international events in 2001. She founded and chaired the International Workshop on Computational Geometry and Applications for over ten years, was co-Chair of the International Workshop on Biometric Technologies BT 2004, Calgary, served as Overall Chair of the Third International Conference on Voronoi Diagrams in Science and Engineering (ISVD) in 2006, was Organizing Chair of WADS 2009 (Banff), and general chair of the International Conference on Cyberworlds CW2011 (October 4-6, Banff, Canada). Prof. Gavrilova is an Editor-in-Chief of the successful LNCS Transactions on Computational Science Journal, Springer-Verlag since 2007 and serves on the Editorial Board of the International Journal of Computational Sciences and Engineering, CAD/CAM Journal and Journal of Biometrics. She has been honored with awards and designations for her achievements and was profiled in numerous newspaper and TV interviews, most recently being chosen together with other outstanding Canadian scientists to be featured in the National Museum of Civilization and National Film Canada production.

Theories and Applications of Spatial-Temporal Data Mining and Knowledge Discovery

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Abstract

Basic theories of knowledge discovery in spatial and temporal data are examined in this talk. Fundamental issues in the discovery of spatial structures and processes will first be discussed. Real-life spatial data mining problems are employed as the background on which concepts, theories and methods are scrutinized. The unraveling of land covers, seismic activities, air pollution episodes, rainfall regimes, epidemics, patterns and concepts hidden in spatial and temporal data are employed as examples to illustrate the theoretical arguments and algorithms performances. To round up the discussion, directions for future research are outlined.

Biography

Yee Leung is currently Professor of Geography and Resource Management at The Chinese University of Hong Kong. He is also the Associate Academic Director of the Institute of Space and Earth Information Science of The Chinese University of Hong Kong. He is adjunct professor of several universities in P.R. China. Professor Leung had also served on public bodies including the Town Planning Board and the Environmental Pollution Advisory Committee of Hong Kong SAR. He is now Chair of The Commission on Modeling Geographical Systems, International Geographical Union, and Chair of The Commission on Quantitative and Computational Geography of The Chinese Geographical Society. He serves on the editorial board of several international journals such as *Annals of Association of American Geographers*, *Geographical Analysis*, *GeoInformatica*, *Journal of Geographical Systems*, *Acta Geographica Sinica*, *Review of Urban and Regional Development Studies*, etc. Professor Leung is also Council member of The Society of Chinese Geographers.

Professor Leung carried out pioneer and influential research in imprecision/uncertainty analysis in geography, intelligent spatial decision support systems, geocomputation (particularly on fuzzy sets, rough sets, spatial statistics,

fractal analysis, neural networks and genetic algorithms), and knowledge discovery and data mining. He has obtained more than 30 research grants, authored and co-authored six books and over 160 papers in international journals and book chapters on geography, computer science, and information engineering. His landmark books are: *Spatial Analysis and Planning under Imprecision* (Elsevier, 1988), *Intelligent Spatial Decision Support Systems* (Springer-Verlag, 1997), and *Knowledge Discovery in Spatial Data* (Springer-Verlag, 2010).

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Session on Computational Design for Technology Enhanced Learning: Methods, Languages, Applications and Tools (CD4TEL 2011)

Session on Virtual Reality in Medicine and Surgery (VRMS 2011)

Session on Logical, Scientific and Computational Aspects of Pulse Phenomena in Transitions (PULSES 2011)