CIVIL-COMP CONFERENCES
35
1983 - 2018

Thirteenth International Conference

Computational Structures Technology 2018

Tenth International Conference

Engineering Computational Technology 2018

4–6 September 2018 | Sitges, Barcelona, Spain

Programme

Organised by

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Dear Delegates,

I am delighted to welcome you to:

- The Thirteenth International Conference on Computational Structures Technology, and
- The Tenth International Conference on Engineering Computational Technology

Both of these conferences are part of the Civil-Comp Conference Series that commenced in 1983. For the first time these are being organised by Elsevier. There has been a gap of four years since the last conferences in this series which I hope will continue to be a regular biennial event. I would like to thank Elsevier for taking up the baton!

These conferences sit well alongside each other, offering a range of complementary themes. Participants are welcome to dip in and out of the parallel sessions to make up their own programmes.

I wish to thank our Opening Plenary Speaker Professor K.J. Bathe of MIT, Cambridge, USA who has contributed to this conference series before and always provides us with fresh insights to his innovative and highly applicable research. A further eight Keynote Lectures will be presented with some 300 Contributed Presentations. I would like to take this opportunity to thank all speakers who have contributed to these conferences this year and in years past.

This year we are encouraging all speakers to submit full journal papers to the special issues of Computers & Structures and Advances in Engineering Software. (For further details and deadlines please see: http://www.bhvt.org.uk/si2018/)

I am grateful to the Conference Editorial Board, in particular those board members who organised a special session. The special sessions and their organisers/chairmen are listed in the conference programme. I would also like to thank Professor Jaroslav Kruis and Professor Peter Ivanyi, the co-chairs for the two conferences. Their contributions in this and other endeavours are especially appreciated.

Finally, I would like to congratulate the Elsevier team for their organisational skills and their perseverance in bringing these conferences to fruition: Carrie Christensen, Amy McCormac, Prathibha Mehta, Carly Mole, Karen Purvis, Neha Aggarwal, Laura Grossmann and Thomas Faulkner.

I wish you all a successful and stimulating conference.

Professor Barry H V Topping
Co-Editor: Computers and Structures
Co-Editor: Advances in Engineering Software
University of Pecs, Hungary
Heriot-Watt University, United Kingdom

On-Site Information

REGISTRATION DESK

The registration desk is located in the Hall Auditorium. Registration will start at 15:00 on Monday 3rd September. The registration desk will remain open for the duration of the conference.

BADGES & SECURITY

For security reasons and for catering purposes, please ensure that you wear your conference badge throughout the conference.
The colour coding of the badge strips are as follows:

Blue: Invited Speakers
Red: Conference Session Chairs
Green: Staff
Clear: Delegates

Replacements for lost badges are available from the registration desk. Please write your name in your programme booklet and do not leave either your booklet or your delegate bag unattended at the conference at any time—for example, on your seat in the meeting room during breaks. Free-of-charge replacements for lost booklets or bags will unfortunately not be available.

CONFERENCE SESSION LOCATIONS

Delegates can access sessions at both the **Computational Structures Technology** and **Engineering Computational Technology** Conferences.

Room Usage	Room Name
Registration	Hall Auditorium
Conference Plenary Session – Monday 3rd September	Auditorium
Conference Parallel Sessions	Please refer to programme
Refreshment Breaks	Hall Auditorium and Atrium
Lunch	Noray Restaurant

LUNCH, REFRESHMENTS AND DRINKS RECEPTION

The registration fee includes the following catering arrangements**:**

Catering Arrangements	Dates	Times
Welcome Drinks Reception	Monday 3rd September	Please see the full programme for timing
Coffee breaks	Tuesday 4th – Thursday 6th September	Please see the full programme for timing
Lunch	Tuesday 4th – Thursday 6th September	Please see the full programme for timing

CONFERENCE DINNER

The Conference Dinner will take place on Wednesday 5th September at Can Laury Restaurant.
If you have already booked your dinner ticket, you will find this printed on your delegate badge. Please make sure that you bring your badge with you.
If you wish to purchase a dinner ticket, please enquire at the registration desk; a limited number may be available. Tickets are €70 per person and include a three-course meal with wine and entertainment. The restaurant is a 5 minute walk from the hotel.

SPEAKERS
Oral presenters are reminded to be in the room of their session no later than 15 minutes before the start of the session in order to meet with the session chair.
All presentations must be preloaded at the speaker upload desk situated next to the registration desk at least 2 hours before the relevant session. A technician will be available during conference hours.

PROGRAMME
Any last-minute changes to the programme or "Late News" will be indicated on the information board located by the Registration Desk and on the conference App.

ABSTRACTS
All the conference abstracts can be viewed online; the link with the login details was sent to you in advance of the conference. If you did not receive this information, please visit the registration desk for the details.

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Wi-Fi is available free of charge throughout the conference venue during the conference hours;
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The official Conference #Hashtags are:
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CONFERENCE APP
The conference has its own free app, available on all Android and iOS devices! This includes information on presentations, speakers, exhibitors, and more. It allows you to plan which presentations to attend, add notes to the programme, make lists via the To Do feature, and add custom tags to presentations and exhibitors. Speakers (invited and poster) have also been invited to make their presentations available through the app. To download the conference app, please search for download the **Elsevier Conferences App** in the app stores.

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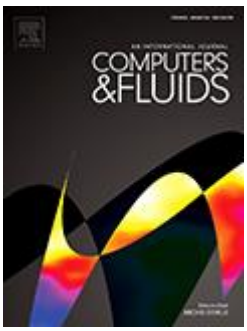

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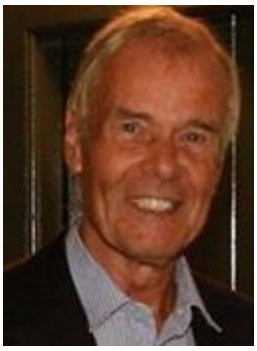
Klaus-Jürgen Bathe
Massachusetts Institute of Technology
Cambridge MA
USA

Klaus-Jürgen Bathe is Professor of Mechanical Engineering at the Massachusetts Institute of Technology. Professor Bathe is also the Founder of the company ADINA R & D, Inc. where he leads the development of the ADINA system, used world-wide, for the analysis of structures, fluids, and multi-physics problems.



He has published numerous articles, six textbooks, and is a co-editor of the international journal Computers and Structures.

He has been honored by the ASME, ASCE, U.S. National Academy of Engineering, M.I.T., and many honorary doctorates for his teaching, his pioneering and widely used contributions in computational mechanics, and for bridging the world between Academia and Industry.

See KJ Bathe Wikipedia, KJ Bathe Google Scholar and http://meche.mit.edu/people/faculty/kjb@mit.edu

Plenary Speaker Abstract

Frontiers & challenges in CAE simulations

Klaus-Jürgen Bathe
Massachusetts Institute of Technology
USA

Introduction

We focus on some recent achievements and current challenges in finite element procedures. These pertain to insights and developments of methods for dynamic analyses, shell elements, 3D solid elements, simulations of DNA and Protein structures, overlapping finite elements, and the development of a new paradigm for finite element analyses in CAD.

Many achievements have taken place and numerous challenges still exist. However, in this presentation we only focus on our achievements and largely only mention challenges based on our experiences. We apologize that due to the length restriction of this abstract the references below pertain only to our works. The presentation is in essence a continuation of ref. [1].

Methods and Results

More effective procedures for dynamic analysis are of great interest because the complexities of structures tackled for dynamic analysis are continuously increasing and the finite element models become larger in size. To achieve progress in the simulation of dynamic phenomena, we have focused on the more effective solution of structural vibration and wave propagation problems [2-7]. We proposed an algorithm for the more effective solution of free surface flow problems [2], increased significantly the efficiency of the subspace iteration method to calculate frequencies [3], obtained new insights into a time integration scheme [4,5], and proposed a new discretization scheme for wave propagation problems using 'overlapping finite elements' that has much potential [7].

The efficient and reliable analysis of shell structures presents great challenges because shells can behave in membrane-dominated, bending-dominated and mixed behaviors [8]. To our knowledge, there does not yet exist a single shell element that has been *mathematically* proven to perform optimally (in an appropriate norm) in any and all shell analyses. Although we started to focus our first research efforts already in the 1980's on shell elements [9, 10], we have only now reached a 4-node element that shows in *all-encompassing stringent numerical tests* an almost optimal behavior when using uniform and distorted meshes [11-13].

In our research on shell elements, we have used the MITC technique. This approach is effective because only the usual nodal displacement / rotational degrees of freedom are used without incompatible modes. Naturally, the technique can also be employed in the development of elements for the analysis of solids, and we have proposed a 4-node element for two-dimensional [13] and an 8-node element for three-dimensional analyses [14].

A large field of interest is the computational modelling of molecular structures, like Proteins and DNA structures [15, 16]. Molecular dynamics procedures are used but can hardly be employed for large molecules or assemblages thereof. With the current hardware and software available, many years of computational time would be needed. We have proposed finite element procedures for coarse-graining with Brownian dynamics and obtained encouraging results [15, 16].

In traditional finite element analysis, a major effort is frequently required for meshing the domain of solution. Typically, an analyst spends much more time on meshing than the computer time used for the solution of the finite element equations, in particular when considering linear static analyses. To drastically reduce the time required for meshing, including for analyses in CAD, we are focusing on the development of a "new paradigm for finite element analyses" [17, 18]. The analysis domain is immersed in a Cartesian mesh (spanned within seconds), the boundary is discretized while removing geometric deficiencies, internal cells are turned into undistorted traditional finite elements, and near the geometric boundaries 'overlapping finite elements' are employed. An important ingredient of the overlapping elements is that they are quite distortion-insensitive [19-22].

Concluding Remarks

While during the recent years major advances have been accomplished by many researchers in the fields of CAE simulations, it is clear that there is still much exciting research to be conducted. In this paper, we focused only on our insights and contributions that we hope are of interest.

CST Keynote Speaker Biographies

Lars Beex
University of Luxembourg
Luxembourg

Lars Beex is a Research Scientist at the University of Luxembourg who has received the Biezeno Solid Mechanics Award 2012 for his PhD thesis. He has co-authored 16 publications related to the computational modelling of solids, of which 11 as first author. Dr Beex focuses on materials with some form of small-scale discreteness. Examples are printed lattices, foams, fabrics and paper materials. Mechanical phenomena of particular interest are geometrical nonlinearities, plasticity, damage, contact and stochastic aspects. He aims to incorporate these phenomena in multiscale approaches, such as the quasicontinuum method, and model-order-reduction frameworks in order to increase computational efficiency.

Franz G. Rammersdorfer
Vienna University of Technology (TU Wien)
Austria

Franz G. Rammerstorfer is a permanent faculty at the Vienna University of Technology (TU Wien).

He received his PhD in 1976 from TU Wien. After a number of years in industry and several stays abroad, he received the *venia docendi* for "Mechanics" and became 1983 full Professor for Lightweight Structures and Aerospace Engineering at the Vienna University of Technology. 1991-1997 he was Co-Chairman of the Christian Doppler Laboratory for Micromechanics of Materials, and 1998-2007 he served as Vice-Rector for Research at TU Wien. 2003/2004 he was Visiting Professor at TU Munich.

At the time being Rammerstorfer is Professor emeritus and Rector of CISM (Int. Centre for Mechanical Sciences) Udine, Italy.

Rammerstorfer has received several awards, among them full membership of the Austrian Academy of Sciences and of the Academia Europae; he is IACM-Fellow, CDG-Senior Fellow, and recipient of the Viktor Kaplan Medal.

Evangelos Sapountzakis
National Technical University of Athens
Greece

Dr. Evangelos Sapountzakis is Civil Engineer, Professor at School of Civil Engineering of National Technical University of Athens (NTUA). Diploma from NTUA (1984) and MSc and DIC degrees (Concrete Structures) from Imperial College London (1985). PhD degree from NTUA (1991). Extensive experience (32 years) in the design, analysis and consultancy services in bridge and other large scale structural projects. Also Professor of Structural Analysis at School of Corps of Engineers of the Hellenic Army. His published research work comprises 115 original papers in international journals and 158 papers in international conference proceedings. Author of 12 Chapters in books, 5 Technical Reports and 7 educational books. Editor of 4 Books or Conference Proceedings. Participation in many financially supported research projects. He is Honorary Editor, Editor-in-Chief, Academic Editor, Regional Editor, Associate Editor of international journals, member of the editorial board of 25 international journals, member of 50 scientific advisory committees of international conferences, reviewer of scientific papers in 60 international journals, while more than 1700 citations have been noticed in international literature (h-index=23). Evaluator of research proposals of Ministries of Science, Research and Development of 3 foreign countries.

Anton Tkachuk
University of Stuttgart
Germany

Dr Anton Tkachuk was born in Kharkiv, Ukraine and obtained his Bachelor's and Master's degrees in mechanical engineering at the National Technical University "KhPI", in Kharkiv, Ukraine. In 2009 he obtained his Master's degree in Computational Mechanics at the University of Stuttgart since which he worked as a research associate at the Institute for Structural Mechanics, University of Stuttgart.

His Dr.-Ing. thesis (2013) was on Variational methods for consistent singular and scaled mass matrices. In 2014 he was a Postdoctoral Fellow at Colorado University in Boulder, USA and since 2015 a Postdoctoral fellow at the Institute for Structural Mechanics, University of Stuttgart.

ECT Keynote Speaker Biographies

Sondipon Adhikari
Swansea University
United Kingdom

Prof Adhikari is the chair of Aerospace Engineering in the College of Engineering of Swansea University. His research areas are multidisciplinary in nature and include uncertainty quantification in computational mechanics, dynamics of complex systems, inverse problems for linear and non-linear dynamics and vibration energy harvesting. He has obtained more than £1.5M of competitive research funding as a principal investigator, published four books, 275 international journal papers and over 175 conference papers in these areas. His works have been widely cited (over 10,000 citations and a H-index of 53 in Google scholar) in the scientific community. He was Wolfson Research Merit Award holder from the Royal Society, an Engineering and Physical Science Research Council (EPSRC) Advanced Research Fellow and winner of the Philip Leverhulme Prize (2007). He was a lecturer at the Bristol University and a Junior Research Fellow in Fitzwilliam College, Cambridge.nProfessor Adhikari is in the editorial board of 15 international journals, research grant reviewer of 20 funding councils and served in over 40 Scientific and Technical Committees. He is an associate Fellow of American Institute of Aeronautics and Astronautics (AIAA) and a Fellow of the Royal Aeronautical Society.

Fabio Casciati
University of Pavia
Italy

F. Casciati (born in Naples, January 16, 1949) had the degree in Civil Eng. cum laude on June 15, 1972, from the Univ. of Pavia, where he is Full Professor of "Scienza delle Costruzioni" since 1980.
He served as Institute and Department Chairman (1980-1983). He was member of the Faculty of the Ph.D Course on Structural Engineering ruled by the Polytechnic of Milan and the Univ. of Pavia in the period 1984-1994. Chairperson of the Civil Eng. Council in 1986-89, Responsible of the Infrastructure Engineering undergraduate school from 1993 to 2001, Coordinator of the Ph.D Course in Civil Eng. of the University of Pavia from 1994 to 2016.
He served as President of the European Association for the Control of Structures from 1993 to 2008, and as President of the International Association, IASC, from 2000 to 2004.
F. Casciati is editor of Smart Structures and Systems, and member of the Editorial Board of Structural Safety, J. of Structural Control & Health Monitoring, Computers & Structures, J. of Earthquake Engineering and Engineering Vibration.

Dominique Eyheramendy
Laboratoire de Mécanique et d"Acoustique (AMU-CNRS-ECM)
France

Dominique Eyheramendy, PhD is Professor of mechanics at Ecole Centrale de Marseille (France). He serves as Director of Laboratoire de Mécanique et d'Acoustique UMR7031 (Aix-Marseille Université, CNRS, Centrale Marseille). He formerly served as associate dean in charge of 1st and 2nd years curriculum. He graduated from the Ecole Normale Supérieure de Cachan (France) and received his PhD from the Swiss Federal institute Of Technology at Lausanne (Switzerland) in 1997. His main activities consist in developing models and methods at the border of numerical methods, software engineering and applications in mechanical engineering.

Roderick Melnik
Wilfrid Laurier University
Canada

Dr. Roderick Melnik has been Full Professor and Tier I Canada Research Chair in Mathematical Modelling in the Faculty of Science at the Wilfrid Laurier University in Waterloo, Canada since 2004. He is also affiliated with the Guelph-Waterloo Institute of Physics, University of Waterloo, and University of Guelph. Prior to his current appointment, Dr. Melnik held full professorial positions in the USA and Denmark. Starting his academic career in Europe, he continued it in Australia until in the late 1990s he took the position of senior scientist at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Sydney. Dr. Melnik has published extensively in a variety of fields with his major focus on mathematical modelling for challenging problems in science and technology. Dr. Melnik is the recipient of many awards, including a number of prestigious fellowships outside of Canada, in Italy, Denmark, England and Spain. He has served on editorial boards of many international journals and book series. Currently, Dr. Melnik is the Director of the MS2Discovery Interdisciplinary Research Institute in Waterloo, Canada.

Oral Programme

CST 2018 Presentation	ECT 2018 Presentation

Monday 03 September 2018					
15:00-18:30	Registration | *Hall Auditorium*				
18:30-20:00	Welcome drinks reception | *Hall Auditorium & Atrium*				
Tuesday 04 September 2018					
08:00-09:15	Registration | *Hall Auditorium*				
Room	*Auditorium*				
Session Chair	*Barry H.V. Topping*				
09:15-10:30	**Opening Session**: Welcome to ECT2018: **P. Ivanyi**, *University of Pécs, Hungary* Welcome to CST2018: **J. Kruis**, *Czech Technical University of Prague, Czech Republic* **Announcement of the K.J. Bathe Award 2018** Presentation by Carrie Christensen, *Publisher, Elsevier*				
09:30-10:30	Opening Plenary Address: Frontiers & challenges in CAE simulations **Klaus-Jürgen Bathe**, *MIT, USA*				
10:30-11:00	**Refreshment Break** | *Hall Auditorium & Atrium*				
Room	***Auditorium***				
Session Chair	*Professor J. Tedesco*		*Professor A. Zingoni*		
11:00-12:00	**Keynote Lectures**				
Room	*Auditorium*		*Garbi 1*		
11:00-11:30	**[KEY1] Active structural control in civil and infrastructural engineering: feasibility of a breakthrough** **F. Casciati**, *University of Pavia, Italy*		**[KEY3] Isogeometric analysis of coupled thermomechanical problems: Theoretical and implementation aspects** **D. Eyheramendy**, *Laboratoire de Mécanique et d''Acoustique (AMU-CNRS-ECM), France*		
11:30-12:00	**[KEY2] Dynamics and homogenised elastic properties of irregular cellular metamaterials** **S. Adhikari**, *Swansea University, United Kingdom*		**[KEY4] Computational treatment of instabilities of thin-walled structures under tension** **F.G. Rammersdorfer**, *Vienna University of Technology, Austria*		
12:00-13:00	**Lunch** | *Noray Restaurant*				
Room	*Garbi 1*	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chairs	*K.J. Bathe*	*M. Lombardo, G. Barone, A. Palmeri,*	*J.R. Torregrosa & A. Cordero*	*J.R. Banerjee & J. Naprstek*	*A. Csebfalvi & J. Logo*
13:00-14:15	**Computers and structures & advances in engineering software** ***Author Journal Publication: Seminar and Discussion***	**ECT2018: Computational studies for retrofitting**	**ECT2018: Special session: Iterative schemes for analyzing nonlinear problems: Numerical and dynamic**	**CST2018: Special session: Computational and nonlinear dynamics**	**CST2018: Special session: Structural topology optimization**
13:00-13:15	13:00-14:00 **"Developments in Publishing -**	**[O2.1] Computational issues toward the amelioration and retrofi tting of educational**	**[O3.1] On some nonlinear Newton-like methods for solving nonlinear equations**	**[O4.1] Novel devices with negative stiffness elements for seismic isolation of bridges on**	**[O5.1] Optimization of an upper structure of a curtain side trailer via genetic**

		The Publisher's perspective" C. Christensen, *Publisher, Elsevier, New York, USA* **"Getting Published – An Editor's perspective" Barry H.V. Topping,** *Co-Editor, Computers and Structures, Advances in Engineering Software* **Discussion Session**	**buildings** S. Casciati *University of Catania, Italy*	S. Busquier[1], S. Hernádez-Verón[2], A.A. Magreñan[3], S. Amat*[1] *[1]U.P.Cartagena, Spain, [2]U. La Rioja, Spain, [3]U. Internacional de La Rioja,, Spain*	**compliant base** P.G. Syrimi, E.J. Sapountzakis*, C.H.T. Alamir, I.A. Antoniadis *National Technical University of Athens, Greece*	**algorithm** M. Ramanagiri*, A. Kwan, G. Phillips, M. Bartlett, A. Clarke, M. Eaton *Cardiff University, UK*
			CST2018: Special Session: Dynamic interactions across the scales: recent advances & current challenges			
13:15-13:30			**[O2.2] Fatigue analysis of high-speed railway bridges using different moving load models** J. O'Nien*, A. Palmeri, M. Lombardo, S. Kasinos *Loughborough University, UK*	**[O3.2] New families of iterative methods for solving nonlinear systems** A. Cordero, C. Jordán, E. Sanabria, J.R. Torregrosa* *Universitat Politècnica de València, Spain*	**[O4.2] New concepts for high energy absorbing structures protected against birdstrike** B. Derias*[1,2], P. Spiteri[1], P. Marthon[1], L. Ratsifandrihana[2] *[1]INP Toulouse, France, [2]Segula Toulouse, France*	**[O5.2] Application of structural topology optimization to slender telecommunication lattice towers** K.D. Tsavdaridis*[1], A. Nicolaou[2], E. Efthymiou[3] *[1]University of Leeds, UK, [2]Ramboll, UK, [3]Aristotle University of Thessaloniki, Greece*
13:30-13:45			**[O2.3] Seismic performance of elastoplastic oscillators coupled with non-linear viscous dampers** R. Woodhouse[1], A. Palmeri*[1], N. Impollonia[1,2] *[1]Loughborough University, UK, [2]University of Catania, Italy*	**[O3.3] Jacobian free multistep iterative methods for solving nonlinear IVPs and BVPs** E. Martínez*, J.L. Hueso, D. Alarcón *Universitat Politècnica de València, Spain*	**[O4.3] Kdamper concept in seismic isolation of building structures with soil structure interaction** K.A. Kapasakalis, E.J. Sapountzakis*, I.A. Antoniadis *National Technical University of Athens, Greece*	**[O5.3] A new robustness measure for evaluating the optimal designs given by the commonly accepted algorithms in the volume-constrained robust topology optimization with uncertain loading directions** A. Csébfalvi*[1], J. Lógó[1] *[1]University of Pécs, Hungary, [2]Budapest University of Technology and Economics, Hungary*
13:45-14:00			**[O2.4] Numerical modelling of plants in blast wave propagation simulations** P. Warnstedt*[1,2], N. Gebbeken[1,2] *[1]University of the Bundeswehr Munich, Germany, [2]Research Center RISK, Germany*	**[O3.4] A family of optimal eighth order methods for multiple roots of non-linear equations** F. Zafar[1,2], A. Cordero*[1], J.R. Torregrosa[1], M. Junjua[2] *[1]Universitat Politecnica de Valencia, Spain, [2]Bahauddin Zakariya University, Pakistan*	**[O4.4] Accurate algorithms for a non-linear oscillatory system: van der Pol equation** M.A.E. Kaunda *Cape Peninsula University of Technology, South Africa*	**[O5.4] Topology optimization of elastoplastic structures: Stress intensity driven formulation and Functor-oriented implementation** B. Blachowski[1], P. Tauzowski[1], J. Logo*[2] *[1]Institute of Fundamental Technological Research, Polish Academy of Sciences, Poland, [2]Budapest University of Technology & Economics, Hungary*

14:00-14:15			**[O2.5] Passive control by seismic resistant design of double skin façades** G. Pipitone*, G. Barone, A. Palmeri *Loughborough University, UK*	**[O3.5] On a variational approximation of stiff systems of ODEs arising from chemistry kinetics** S. Amat[1], P. Pedregal[2], M.J. Legaz*[3], J. Ruiz[4] *[1]U.P. Cartagena, Spain, [2]Universidad de Castilla La Mancha, Spain, [3]Universidad de Cádiz, Spain, [4]Universidad de Alcalá, Spain*	**[O4.5] Development of numerical modelling technique to analyse the behaviour of cable supported facades under blast loading** R. Piyasena*, D. Thambiratnam, N. Perera, T. Chan *Queensland University of Technology, Australia*	**[O5.5] Topology optimization of truss structures using an improved crow search algorithm** M. Mashayekhi*, R. Yousefi *Vali-e-Asr University of Rafsanjan, Iran*
Session Chairs	*P. Coelho*		*M. Lombardo, G. Barone, A. Palmeri,*	*J.R. Torregrosa & A. Cordero*	*J.R. Banerjee & J. Naprstek*	*A. Csebfalvi & J. Logo*
14:15-15:00	**ECT2018** **Parallel and distributed computing**		**CST2018** **Special Session: Dynamic interactions across the scales: Recent advances & current challenges**	**ECT2018** **Special Session: Iterative schemes for analyzing nonlinear problems: numerical and dynamic (Contd.)**	**CST2018** **Special Session: Computational and nonlinear dynamics (Contd.)**	**CST2018** **Special Session: Structural topology optimization (Contd.)**
14:15-14:30	**[O1.1] Solution Speedup of the Laplace Equation Using FPGA Hardware** A. Ebrahimi, M. Zandsalimy* *Sharif University of Technology, Iran*		**[O2.6] Single and multiple nonlinear energy sinks configurations in 3D civil structures with random excitations** M. Oliva[1], G. Barone*[2], F. Lo Iacono[1], G. Navarra[1] *[1]University of Enna Kore, Italy, [2]Loughborough University, UK*	**[O3.6] On a class of Newton-type methods for implicit Runge-Kutta schemes** S. Amat*[1], J. Ruiz[2], S. Busquier[1] *[1]U. P. Cartagena, Spain, [2]Universidad de Alcalá, Spain*	**[O4.6] The Effects of engine mass and its location on the free vibration and flutter characteristics of a transport aircraft wing** A. Ananthapuvirajah[1], W.D. Gunawardana[2], J.R. Banerjee*[1] *[1]University of London, UK, [2]Open University (Quarles Campus), UK*	**[O5.6] Voxel-based smoothing of topology-optimized structures to fulfill design requirements** R. Bartz*[1], S. Fiebig[1], T. Franke[1], T. Vietor[2] *[1]Volkswagen AG, Germany, [2]Technische Universität Braunschweig, Germany*
14:30-14:45	**[O1.2] Voronoï cell volume approximation using parallel solution** J. Mašek*, M. Vořechovský *Brno University of Technology, Czech Republic*			**[O3.7] Increasing the efficiency of a third-order iterative scheme for solving nonlinear problems** F.I. Chicharro, A. Cordero*, N. Garrido, J.R. Torregrosa *Universitat Politècnica de València, Spain*	**[O4.7] A hybrid finte element-statistical energy analysis formulation accounting for nonlinearities** F.A. Fazzolari *University of Liverpool, UK*	**[O5.7] Optimum design of a cable stayed steel footbridge using semi-active and passive dampers considering three dimensional behaviour** F.L.S. Ferreira, L.M.C. Simões* *University of Coimbra, Portugal*
14:45-15:00	**[O1.3] Effectiveness of hybrid parallelization of splitting-up conjugate gradient method on supercomputers** A. Wakatani *Konan University, Japan*			**[O3.8] High order secant type methods free of derivatives** J.C. Trillo*[1], V. Candela[2], R. Peris[1] *[1]Universidad Politécnica de Cartagena, Spain, [2]Universidad de Valencia, Spain*	**[O4.8] Free vibration analysis of functionally graded beams using the dynamic stiffness method and a higher order shear deformation theory** H. Su[1], J.R. Banerjee*[1] *[1]University of Northampton, UK, [2]City, University of London, UK*	**[O5.8] Identification of critical local damage for robustness assessment of building structures using gradient-based optimisation** S. Grosman*, B.A. Izzuddin *Imperial College London, UK*

15:00-15:30	**Refreshment Break** | *Hall Auditorium & Atrium*				
Room	*Garbi 1*	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chairs	*L.M.C. Simoes & A. Myslinski*	*S. Caprilli, F. Morelli & G. Zanon*	*J.R. Torregrosa & A. Cordero*	*A.H.C. Chan & D. Rypl*	*G.S. Kamaris & N. Suksawang*
15:30-18:00	**CST2018: Special session: optimisation and design**	**CST2018: Special session: advanced solutions for the structural design and numerical modelling of steel racks**	**ECT2018: Special session: Iterative schemes for analysing nonlinear problems: Numerical and dynamic**	**CST2018: Discrete element methods**	**CST2018: Special session: Seismic assessment of new structures and vulnerability reduction of existing buildings: Advanced numerical modelling**
15:30-15:45	**[O1.4] Shape optimization of elasto-plastic contact problems using the level set method** A. Myslinski *Systems Research Institute, Poland*	**[O2.7] Design and modelling of Automated Rack Supported Warehouses** S. Caprili*[1], F.V. Lippi[1], F. Morelli[1], A. Natali[1], W. Salvatore[1], V. Falleni[2] *[1]University of Pisa, Italy, [2]System Logistics S.p.A., Italy*	**[O3.9] On a new Power ENO method for hyperbolic conservation laws** S. Amat[1], A.A. Magreñán*[2], J. Ruiz[3] *[1]Universidad Politécnica de Cartagena, Spain, [2]Universidad Internacional de La Rioja, Spain, [3]Universidad de Alcalá de Henares, Spain*	**[O4.9] Investigation of the influence of parameters on particle dampers** N. Meyer*, R. Seifried *Hamburg University of Technology, Germany*	**[O5.9] A strategy for reducing the vulnerability of structures under seismic loadings** F. De Angelis*, D. Cancellara *University of Naples Federico II, Italy*
15:45-16:00	**[O1.5] Hybrid optimisation of thin-walled laminated cylindrical shells dynamic behaviour** B. Miller*, L. Ziemianski *Rzeszow University of Technology, Poland*	**[O2.8] Calibration of finite element models of an innovative steel beam-to-column joint** F. Morelli*, A. Piscini, W. Salvatore *University of Pisa, Italy*	**[O3.10] Numerical simulation of detonation waves using nonlinear finite difference methods** S. Amat[2], A. Dávila[2], A. Perales[2], J. Ruiz*[1] *[1]Universidad Politécnica de Cartagena, Spain, [2]Universidad Politécnica de Cartagena, Spain*	**[O4.10] The use of discrete element modelling (DEM) in development of a novel concrete aggregate recycling technique** A. Ameel*, S. Debruyne, M. Versteyhe, L. Boehme *KU Leuven, Belgium*	**[O5.10] Analysis of base isolation systems in passive control of structures** F. De Angelis*, D. Cancellara *University of Naples Federico II, Italy*
				ECT 2018: Discrete Element and Particle Techniques	**ECT2018: Dynamics, seismic and construction**
16:00-16:15	**[O1.6] Reliability-based minimum cost design of a double box beam structure for an overhead travelling crane** L.M.C. Simoes*[1], K. Jarmai[1] *[1]University of Coimbra, Portugal, [2]University of Miskolc, Hungary*	**[O2.9] Sensitivity of numerical modelling approaches on the computed behaviour of steel racks under seismic loading** M. Pinkawa*, B. Hoffmeister, M. Feldmann *RWTH Aachen University, Germany*	**[O3.11] Iterative algorithms for car rental and car sharing transport management** J.A. Conejero*, C. Jordán, E. Sanabria-Codesal *Universitat Politècnica de València, Spain*	**[O4.11] A three-dimensional coupled Euler- PIC algorithm for penetration of reinforced concrete** X. Xu*, T. Ma, H. Liu, J. Ning *Beijing Institute of Technology, China*	**[O5.11] Seismic response simulation of complex site based on multi-transmitting formula and spectral element method** Y.Y. Yu*, H.P. Ding *Suzhou University of Science and Technology, China*
16:15-16:30	**[O1.7] Adjoint variable method for the sensitivity analysis of flexible multibody systems in**	**[O2.10] Definition of the loading models for automated steel racks warehouses considering logistics needs**	**[O3.12] A homotopy method for vibration analysis of magnetorheological fluid sandwich structures**	**[O4.12] Optimized rack-ladder structure for iron ore pellet buffer storage: DEM simulation and analytical**	**[O5.12] Control of vibrations and comparison of different base isolation systems for irregular structures**

	differential-algebraic form A. Azari Nejat*, A. Moghadasi, A. Held, R. Seifried *Hamburg University of Technology, Germany*	F. Morelli*[1], S. Caprili[1], M. Fabini[2], V. Falleni[3], A. Natali[1], A. Ori[3], W. Salvatore[1], S. Sesana[2], M. Terraneo[2], L. Vandini[3] *[1]University of Pisa, Italy, [2]SCL Ingegneria Strutturale, Italy, [3]System Logistics, Italy*	V. Ammovilli*[1], M. Bilasse[1], I. Charpentier[1] *[1]CNRS and University of Strasbourg, France, [2]École Catholique d'Arts et Métiers Strasbourg-Europe, France*	**model** A. Hossein Madadi Najafabadi*[1], A. Masomi[2] *[1]Mobarakeh Steel Company, Iran, [2]University of Tehran, Iran*	F. De Angelis*, D. Cancellara *University of Naples Federico II, Italy*
	CST2018: Civil engineering applications	**CST2018-21: Laser cutting technology**			
16:30-16:45	**[O1.8] Optimality in sewer network design** N. de Villiers*, G.C. Van Rooyen *University of Stellenbosch, South Africa*	**[O2.11] Thermal and mechanical modeling of laser cutting for structural steel grade materials for high-cycle fatigue applications** O. Bursi[1], P. Scardi[1], G. Zanon*[1], A. Valli[2], L. Monaco[1] *[1]University of Trento, Italy, [2]Addige Sys, Italy*	**[O3.13] Jacobian free multistep iterative method for solving nonlinear IVPs and BVPs** E. Martinez*, J.L. Hueso, D. Alarcón *Universitat Politècnica de València, Spain*	**[O4.13] Hybrid finite-discrete element modelling of the failure and collapse process of deep tunnels in rock masses under high in-situ stresses** H Han*, H.Y. Liu, H.C. Chan *University of Tasmania, Australia*	**[O5.13] Distributed multiple tuned mass dampers approach for vibration control of high-rise buildings in earthquake** H. Radmard Rahmani*, C. Könke *Universität Weimar, Germany*
				CST2018 & ECT2018: Software development: Tools, techniques and issues	
16:45-17:00	**[O1.9] An iot、plc、scada technologies and asm2d model based water treatment intelligent control system** C. Chen*[1], T. Bou[2], B. Ding[2] *[1]Beijing Institute of Technology, China, [2]Shenzhen Graduate School, China*	**[O2.12] Assessment of laser-cut, I-beam to CHS column joints by means of nonlinear finite element methods** J. Korndörfer*, B. Hoffmeister, M. Feldmann *RWTH Aachen University, Germany*	**[O3.14] On the local and semilocal convergence of a parameterized multi-step Newton method** S. Amat[1], I.K. Argyros[2], S. Busquier[1], M.A. Hernández-Verón[3], D.F. Yáñez*[4] *[1]Universidad de Cartagena, Spain, [2]Cameron University, USA, [3]Universidad de La Rioja, Spain, [4]Universidad Católica de Valencia, Spain*	**[O4.14] Easy pre-/post-processing of finite elements with Python: A descriptive programming approach** M. Yilmaz *Istanbul Technical University, Turkey*	**[O5.14] Performance of masonry infill wall in a reinforced concrete building under seismic load** O. Akyurek[1], N. Suksawang*[1], T. Go[1], H. Tekeli[1] *[1]Florida Institute of Technology, USA, [2]Suleyman Demirel University, Turkey*
		CST2018: Advanced solutions for the structural design and numerical modelling of steel			
17:00-17:15	**[O1.10] A rapid modeling method for fluid network** Y. Zhang*, Y. Men, Z. Dong *North China Electric Power University, China*	**[O2.13] A nonlinear connector element with physical properties for modelling bolted connections** R. Verwaerde*, P.A. Boucard, P.A. Guidault *LMT, ENS Cachan, CNRS, Université Paris-Saclay, France*	**[O3.15] Memory for a modified Newton Method** A. Cordero*[2], J.G. Maimó[1], J.R. Torregrosa[2], M.P. Vassileva[1] *[1]Instituto Tecnológico de Santo Domingo (INTEC), Dominican Republic, [2]Universitat*	**[O4.15] Synthesis of computational meshes of RVE with ellipsoidal inclusions using Wang cubes** D. Rypl*, M. Doškář *Czech Technical University in Prague, Faculty of Civil Engineering, Czech Republic*	**[O5.15] Damage evaluation of steel/concrete composite frames subjected to repeated earthquakes** E. Fanourgiakis[1], G.S. Kamaris*[1], G.D. Hatzigeorgiou[2], K.A. Skalomenos[3] *[1]Liverpool John Moores University, UK, [2]Hellenic Open*

			Politécnica de Valencia, Spain		*University, Greece, [3]Kyoto University, Japan*
17:15-17:30		**[O2.14] Numerical modelling of the self-loosening of a bolted assembly** V. Rafik*[1,2], C. Chirol[2], A. Daidie[1], B. Combes[1] *[1]Université de Toulouse, Institut Clément Ader, France, [2]Airbus Operations S.A.S, France*		**[O4.16] Scaled scrum framework for cooperative domain ontology evolution** W. Mohsen*, M. Aref, K. ElBahnasy *Ain Shams University, Egypt*	
17:30-17:45		**[O2.15] Conductive cables vibrations effect on lattice steel transmission towers** T.M. Ghazal*, E.M. Elkassas, M.I. Elmasry *Arab Academy for Science & Technology & Maritime Transport, Egypt*			
17:45-18:00		**[O2.16] Developing a neutral equilibrium device as dynamic virtual piers for an emergency relief bridge** M.H. Shih*[1], W.P. Sung[2] *[1]National Chi Nan University, Taiwan, [2]National Chin-Yi University of Technology, Taiwan*			

Wednesday 05 September 2018					
Room	*Garbi 1*	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chairs	*A. Zingoni & T. Abassy*	*G. Kosec & C. Anitescu*	*D. De Domenico, A. Gregori & F. De Angelis*	*F. Parisi & M. Scalvenzi*	*A. Sofia, G. Li, D. Yang, J. Chen & G. Cheng*
08.45-10.30	**CST2018: Numerical and computational techniques for mechanics**	**ECT2018: Computational Methods: including meshless and isogeometric methods**	**CST2018: Special Session: Seismic assessment of new structures and vulnerability reduction of existing buildings: advanced numerical modelling**	**CST2018: Structural Mechanics: Damage, NDT and characterisation**	**ECT2018: Uncertainty quantification and analysis in engineering: precise and imprecise probability approaches**
08:45-09:00	**[O1.11] The first and the second order sensitivity analysis for damped systems with repeated eigenvalues** M. Łasecka-Plura *Poznan University of Technology, Poland*	**[O2.17] Generic implementation of meshless local strong form method** J. Slak*, G. Kosec *Jožef Stefan Institute, Slovenia*	**[O3.16] An explicit-implicit method for nonlinear time-domain soil-structure interaction analysis** S.L. Chen*, H. Lv *Nanjin University of Aeronautics and Astronautics, China*	**[O4.17] Optimizing linear phased array transducers for detection of delamination defect in composites** M. Achbal*[1], A. Khamlichi[2], F. El Khannoussi[2] *[1]Faculty of Sciences at*	**[O5.16] Generalized pareto distribution for high reliability estimation based on radial basis function network** G. Li*, G. Zhao *Dalian University of Technology, China*

				Tetouan, Morocco, [2]ENSA Tetouan, Morocco	
09:00-09:15	**[O1.12] Solving nonlinear 2nd order differential equations using piecewise analytic method (Pendulum Equations)** T. Abassy[1,2] *[1]Prince Sattam Bin Abdulaziz University, Saudi Arabia, [2]Benha University, Egypt*	**[O2.18] Numerical simulation of overhead power line cooling in natural convection regime** G. Kosec*, J. Slak *Jozef Stefan Institute, Slovenia*	**[O3.17] A probabilistic approach for the determination of the in-plane elastic response of RC frames accounting for the uncertain stiffening contribution of the masonry infills** D. De Domenico, G. Falsone*, R. Laudani *University of Messina, Italy*	**[O4.18] Occurring characteristics of asphalt pavement distresses based on statistics and association rules mining** J. Li*, G. Liu, T. Yang, J. Zhou, Y. Zhao *Southeast University, China*	**[O5.17] Robust design of a solution for reducing vibration of light assembled structures** M. Ghienne*[1,2], C. Blanzé[1], L. Laurent[1] *[1]Conservatoire National des Arts et Métiers, France, [2]Institut supérieur de mécanique de Paris – Supméca, France*
09:15-09:30	**[O1.13] A hybrid numerical-analytical approach to the dynamic analysis of helical gear excitations due to varying mesh stiffness** M. Zarnekow*, T. Grätsch, F. Ihlenburg *Hamburg University of Applied Sciences, Germany*	**[O2.19] Homogenization based interface coupling with constrained microscopic displacements for the global-local analysis of heterogeneous structures** M. Wangermez*[1,2], O. Allix[1], P-A. Guidault[1], O. Ciobanu[2], C. Rey[2] *[1]LMT Cachan (ENS Paris-Saclay/CNRS/Université Paris-Saclay), France, [2]Safran Tech, France*	**[O3.18] Comparing deterministic and affidabilistic assessment of the seismic vulnerability of an existing RC building** A. Gregori*, M. Angiolilli *University of L'Aquila, Italy*	**[O4.19] An integrated damage approach for effective modelling of high cycle fatigue in metals** A. Soyemi*, B.A. Izzuddin *Imperial College London, UK*	**[O5.18] Studies of vehicle loading on highway bridges and their reliability** Q. Guo*[1], X. Yang[2], J. Gong[1] *[1]Dalian University of Technology, China, [2]Ningbo Institute of Technology, China*
				CST2018: Special Session: Computational modelling of progressive collapse	
09:30-09:45	**[O1.14] An innovative approach to testing tendons in shear** N. Aziz*[1], A. Mirzaghorbanali[2,1], G. Yang[1], S. Khaleghparast[1], J. Nemcik[1], H. Rasekh[3,1] *[1]University of Wollongong, Australia, [2]University of Southern Queensland, Australia, [3]University of New South Wales, Australia*	**[O2.20] Isogeometric lumped mass matrices using a dual basis construction and the Petrov-Galerkin method** C. Anitescu*[1], C. Thanh Nguyen[2], T. Rabczuk[1], X. Zhuang[2] *[1]Bauhaus-Universität Weimar, Germany, [2]Leibniz Universität Hannover, Germany*	**[O3.19] Calibration of cohesive elements for modelling the bond between concrete and deformed reinforcement bars** S. Alkhawaldeh*, J.A. El-Rimawi, A. Palmeri *Loughborough University, UK*	**[O4.20] Analytical model for multi-hazard resistant prefabricated concrete frame substructures considering earthquake and column removal scenarios** K.Q. Lin*[1], X.Z. Lu[1], Y. Li[2], L.P. Ye[1] *[1]Tsinghua University, China, [2]Beijing University of Technology, China*	**[O5.19] Combining density forecasts for concrete creep prediction under model uncertainty** S.S. Jin, S.L. Cha*, H.K. Ju *Korea Advanced Institute of Science and Technology, Republic of Korea*
09:45-10:00	**[O1.15] On the most appropriate symmetry group for group-theoretic computational schemes in structural mechanics** A. Zingoni	**[O2.21] Space-time isogeometric solvers for coupled multiphysics: A preliminary study** C. Saadé*, S. Lejeunes, D. Eyheramendy, L. Zhang, R.	**[O3.20] The use of cohesive elements to model the behaviour of reinforced concrete beam-to-column joints under monotonic loading** S. Alkhawaldeh*, J.A. El-	**[O4.21] Performance limit states of reinforced concrete buildings subjected to single-column loss scenarios** F. Parisi*, M. Scalvenzi, E. Brunesi	**[O5.20] Lattice dome reliability response functions using analytical integration and finite element method** B. Pokusinski*, M. Kaminski *Lodz University of Technology, Poland*

	University of Cape Town, South Africa		Saad *Aix-Marseille University, France*	Rimawi, A. Palmeri *Loughborough University, UK*	*University of Naples, Federico II, Italy*	
						CST2018-1: Uncertainty Analysis and Design Optimization of Structures
10:00-10:15	**[O1.16]** Repetitive skeletal structures controlled by bracing elements G. Nagy Kem *Szent István University YMÉK, Hungary*		**[O2.22] Using results on zeros of symmetric polynomials for design comb decimators** G. Jovanovic Dolecek *Institute INAOE, Mexico*	**[O3.21] New methodology to generate Roof Design Spectra (RDS) directly from Uniform Hazard Spectra (UHS)** A. Asgarian*, G. McClure *McGill University, Canada*	**[O4.22] Mitigation of blast load risk on reinforced concrete structures considering different structural design alternatives** M.K. Almustafa*, Y.E. Ibrahim *Prince Sultan University, Saudi Arabia*	**[O5.21] A line search method for non-linear data assimilation via random steepest descent approximations** E. D. Nino-Ruiz, C. J. Ardila-Hernández, J. R. Capacho-Portilla, J. D. Estrada-DeLaHoz* Universidad del Norte, Colombia
10:15-10:30					**[O4.23] Progressive collapse assessment of gravity-load designed reinforced concrete buildings through nonlinear time history analysis** F. Parisi, E. Brunesi, M. Scalvenzi* *University of Naples, Federico II, Italy*	**[O5.22] Response statistics of structures with uncertainties described by imprecise probability density functions** G. Muscolino*[1], A. Sofi[2], F. Giunta[1] *[1]University of Messina, Italy, [2]University Mediterranea of Reggio Calabria, Italy*
10:15-10:45	**Refreshment Break** | *Hall Auditorium & Atrium*					
Room	*Garbi 1*		*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chairs	*A. Eriksson & D. Eyheramendy*		*W. Habchi & E. Deletombe*	*G. Li, D. Yang, J. Chen & G. Cheng*	*D. Roose & N. Biba*	*J. Kruis & J. Bai*
10.45-12.45	**Keynote lectures**		**ECT2018: Computational multiphysics**	**CST2018: Uncertainty analysis and design optimization of structures**	**ECT2018: Special Session: Computational Modelling of Industrial Metal Forming Processes**	**CST2018: Uncertainty and reliability**
10:45-11:00	10:45-11:15	**[KEY5] Assessment of the reflection-transmission error for reciprocal mass matrices** **A. Tkachuk**, *University of Stuttgart, Germany*	**[O2.23] A Schur-complement method for the reduced order finite element modeling of transient elastohydrodynamic lubrication problems** W. Habchi *Lebanese American University, Lebanon*	**[O3.22] Discontinuous Galerkin-based probability density evolution method for dynamic reliability analysis of building structures** G.H. Chen*, D.X. Yang *Dalian University of Technology, China*	**[O4.24] Similitude for vibration assisted cold forward extrusion** A. Al-tamimi*, R. Darvizeh, K. Davey University Of Manchester, UK	**[O5.23] Reliability estimation using conditional Gaussian sub-structuring** B. Radhika *IIT Tirupati, India*
						CST2018: Special session: Degradation of reinforced

						concrete elements: From mathematical modelling to assessment through structural
11:00-11:15			**[O2.24] Ensemble probabilistic forecasting in the microscale** A. Oliver*, L. Mazorra-Aguiar, E. Rodríguez, G. Montero *University of Las Palmas de Gran Canaria, Spain*	**[O3.23] Dynamic reliability analysis of nonlinear building structures subject to near-fault ground motions** D.X. Yang*, G.H. Chen *Dalian University of Technology, China*	**[O4.25] Numerical experimentation of global finite similitude scaling in die compaction process** M. Moghaddam[1], R. Darvizeh*[2], K. Davey[2,3], A. Darvizeh[1] *[1]University of Guilan, Iran, [2]The University of Manchester, UK, [3]University of Strathclyde, UK*	**[O5.24] Corrosion of steel bars in reinforced concrete columns: the effect of the cover concrete spalling on strength deterioration in axially loaded columns** R. Greco[1], M. Morga*[2] *[1]Technical University of Bari, Italy, [2]Anglia Ruskin University, UK*
			ECT2018: Crash and impact computational mechanics			
11:15-11:30	11:15-11:45	**[KEY6] Strain control of engineering band structures of graphene nanoribbons** **R. Melnik,** *Wilfrid Laurier University, Canada*	**[O2.25] On discontinuous boundary elements in the mechanics of solid bodies loaded by explosion** P.P. Prochazka*, M.J. Valek *Czech Technical University in Prague, Czech Republic*	**[O3.24] A new development of sequential approximation programming for reliability-based design optimization** P. Yi[1], G. Cheng*[1], M. Zhou[2], Z. Luo[2] *[1]Dalian University of Technology, China, [2]Altair Engineering, Inc., USA*	**[O4.26] Strain rate sensitivity in scaling of dynamic structural systems** H. Sadeghi[1], R. Darvizeh*[2], K. Davey[2,3], A. Darvizeh[1] *[1]University of Guilan, Iran, [2]The University of Manchester, UK, [3]University of Strathclyde, UK*	**[O5.25] Numerical modelling of chloride extraction from concrete structures with the help of electric field** J. Kruis*, J. Nemecek *Czech Technical University in Prague, Czech Republic*
11:30-11:45			**[O2.26] Study and characterization of abrasion phenomena for organic matrix composite and metallic materials in A/C emergency landing situations** L. Bigault[1,2], E. Deletombe*[1], Y. Desplanques[2] *[1]ONERA - The French Aerospace Lab, France, [2]University of Lille, France*	**[O3.25] Cohesive discrete element method to simulate Young's modulus variability effect on a natural fibre-reinforced composite performance** D. Moukadiri*[1], W. Leclerc[1], M. Guessasma[1], F. Druesne[2], E. Bellenger[1] *[1]University of Picardie Jules Verne, France, [2]University of Technology of Compiègne, France*	**[O4.27] Elastic-plastic formulation and damage prediction in forming processes with highly localized large strain** A. Vlasov[1], N. Biba*[2], s. Stebunov[1] *[1]QuantorForm Ltd, Russia, [2]MICAS Simulations, UK*	**[O5.26] Vulnerability assessment for the reinforced concrete beam exposed to monotonic loading using different damage indexes** M. Nasim*, S. Setunge *RMIT, Australia*
						CST2018: Artificial neural networks in computational mechanics
11:45-12:00	11:45-12:15	**[KEY7] An equation-free, nested, concurrent multiscale approach**	**[O2.27] The crash analysis of electric multiple unit driver's cab** P. Watroba, M. Pawlak*, D. Gasiorek	**[O3.26] Risk-based probabilistic seismic hazard analysis considering parameter uncertainties** L. Hofer*, M.A. Zanini, F. Faleschini, K. Toska, C.	**[O4.28] Investigating macrosegregation and inclusion-front interaction in continuously-cast steel slabs** S. Chaube *T.R.D.D.C, India*	**[O5.27] A comparative study of neural network model and LOLIMOT for self-compacting concrete containing supplementary cementitious materials**

		without scale-separation **L. Beex**, *University of Luxembourg, Luxembourg*	*Silesian University of Technology, Poland*	Pellegrino *University of Padova, Italy*		S. Dadsetan[1], K. Mehrzad[2], J. Bai*[3], S. Ataei[2] *[1]Ryerson University, Canada, [2]Iran University of Science and Technology, Iran, [3]University of South Wales, UK*
12:00-12:15			**[O2.28] Charpy Impact Testing Machine in modelling of vehicle frontal crash with street lights** W. Danek, M. Pawlak* *Silesian University of Technology, Poland*	**[O3.27] The conjugate gradient step length adjustment method for calculation of probabilistic performance measure** P. Yi*, D. Xie *Dalian university of technology, China*	**[O4.29] Approaches to modelling flow forming process** B. Krishnamurthy*[1], O. Bylya[1], R. Vasin[2] *[1]University of Strathclyde, UK, [2]Lomonosov Moscow State University, UK*	**[O5.28] Prediction of pile bearing capacity of replacement piles in un-cemented soils based on neural networks approach** A. Benali*[1], A. Bouafia[2], B. Boukhatem[3], A. Nechnech[4] *[1]University of Science and Technology Algiers, Algeria, [2]University of Khemis Miliana, Algeria, [3]University of Blida, Algeria, [4]University of Sherbrooke, Canada*
			ECT2018: Multiscale splitting methods: theory and applications in engineering problems			
12:15-12:30			**[O2.29] Investigation of static and dynamic behaviour of joint interface in multi-scale finite element models** W. Bingyan*, L. Hongjing, S. Guangjun *Nanjing Tech University, China*	**[O3.28] Proper orthogonal decomposition-based random function representation for non-stationary stochastic ground motion processes** Z.X. LIU*, Z.J. LIU *China Three Gorges University, China*	**[O4.30] Improving mechanical properties of billets made of titanium alloy by means of torsion extrusion** V. Titov*[1], N. Biba[2], S. Stebunov[1] *[1]QuantorForm Ltd., Russia, [2]MICAS Simulations, UK*	**[O5.29] Non-destructive identification of the interlayer bond between repair overlay and concrete substrate using artificial intelligence** S. Czarnecki*, L. Sadowski, J. Hola *Wroclaw University of Science and Technology, Poland*
						ECT2018: E-Evolutionary computing
12:30-12:45					**[O4.31] Dynamic split-and-merge based spatial clustering for efficient multi-scale modelling in metal forming** M. Khairullah, J. Gawad, A. Van Bael, D. Roose* *KU Leuven, Belgium*	**[O5.30] Design of robot vehicle control program using grammatical evolution** E. Kito*, R. Sato *Nagoya University, Japan*
12:45-13:45	**Lunch** | *Noray Restaurant*					
Room	*Garbi 1*		*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*

Session Chairs	*M. Bradford & L.M.C. Simoes*	*F.J. Montans & M. Sejnoha*	*J. Bull & M. Saka*	*Z.M. Zondi & A. Eriksson*	*L. Fenu & P. Ivanyi*
13:45-15:45	**CST2018: Timber structures**	**ECT2018: Material modelling: Timber**	**CST2018: Special session: Structural computational engineering design**	**Keynote Lecture**	**ECT2018: Structural Engineering design tools**
13:45-14:00	**[O1.17] Computational modelling of glued-in-rod timber joints** M.A. Bradford*[1], A. Hassanieh[1], H.R. Valipour[1], R. Jockwer[2] *[1]UNSW Sydney, Australia, [2]ETH Zurich, Switzerland*	**[O2.30] Moisture induced strains in wood - measurements and numerical prediction** M. Šejnoha*, J. Sýkora, L. Kucíková, Z. Pavlík, J. Pokorný, J. Antoš *CTU in Prague, Czech Republic*	**[O3.29] Database-assisted design of high-rise buildings for wind** S. Park, D. Yeo, E. Simiu* *National Institute of Standards and Tachnology, USA*	13:30-14:00 **[KEY8] Pre- and post- buckling analysis of beams employing higher order beam theory** **E. J. Sapountzakis**, *National University of Athens, Greece*	**[O5.31] Parametric vault design tools based on formex algebra** P. Sárközi*, P. Iványi, A. B. Széll *University of Pécs, Hungary*
	ECT2018 and CST2018: Bridge engineering				**ECT2018: Optimization driven architectural design of structures**
14:00-14:15	**[O1.18] Span influence in the optimum design of three dimensional cable stayed bridges subject to earthquakes using active and passive dampers** F.L.S. Ferreira, L.M.C. Simões* *University of Coimbra, Portugal*	**[O2.31] Bayesian inference as a tool for improving the prediction of effective elastic properties of wood** T. Janda*, L. Kucíková, J. Vorel, J. Antoš, V. Hrbek, E. Šmídová, M. Šejnoha *Czech Technical University in Prague, Czech Republic*	**[O3.30] The development of computer programmes for the eurocodes** J.W. Bull *Northumbria University, UK*		**[O5.32] Cable load-optimization in a hybrid bending-active structure** K. Alexandrou*, M.C. Phocas *University of Cyprus, Cyprus*
		CST2018: Materials, composites and microstructures		**CST2018: Buckling and post-buckling of structures**	
14:15-14:30	**[O1.19] Damage identification of deck type arch bridges using vibration data and computational simulations** N. Jayasundara*, D.P. Thambiratnam, T.H.T. Chan *Queensland University of Technology, Australia*	**[O2.32] Homogenization-based multiscale evaluation of equivalent mechanical properties of nonwoven carbon-fiber fabric composites** H.S. Lee*[1], C.W. Choi[1,2], J.W. Jin[3], M.Y. Huh[1], S.P. Lee[4], J.K. Park[1], K.W. Kang[2] *[1]Korea Institute of Carbon Convergence Technology, Republic of Korea, [2]Kunsan National University, Republic of Korea, [3]Jeonbuk Institute of Automotive Convergence Technology, Republic of Korea, [4]Iljin Global Co., Ltd, Republic of Korea*	**[O3.31] Optimum design of tied-arch bridges under AASHTO LRFD Code Provisions using some of recent metaheuristic algorithms** M. A.Latif*, M.P. Saka *University of Bahrain, Bahrain*	**[O4.32] Buckling under tensile dead load, effects of the constraint's curvature and multiple bifurcations** D. Misseroni*[1], D. Bigoni[1], G. Noselli[2] *[1]DICAM, University of Trento, Italy, [2]SISSA–International School for Advanced Studies, Italy*	**[O5.33] Curved pedestrian bridge supported by an optimised anticlastic grid-shell** L. Fenu*[1], E. Congiu[1], B. Briseghella[2], G. Carlo Marano[2] *[1]University of Cagliari, Italy, [2]University of Fuzhou, Italy, [3]Technical University of Bari, Italy*

					CST2018: Special session: Optimization driven architectural design of structures
14:30-14:45	**[O1.20] Hydrodynamic analysis of a long span cable-stayed bridges with floating towers** S. Kim*[1], M.S. Jang[2], Y.W. Lee[2], S. Min[1], D.H. Won[2], Y.J. Kang[2] *[1]Daejeon University, Republic of Korea, [2]Korea University, Republic of Korea, [3]Korea Institute of Ocean Science and Technology, Republic of Korea*	**[O2.33] A study on equivalent mechanical properties and electric conductivity prediction of intermediate material by weight change of carbon nanotubes using homogenization method** J.W. Jin*[1], C.W. Choi[2], H.S. Lee[3], K.W. Kang[2] *[1]Jeonbuk Institute of Automotive convergence Technology, Republic of Korea, [2]Kunsan National University, Republic of Korea, [3]Korea Institute of Carbon Convergence Technology, Republic of Korea*	**[O3.32] Digital workflows for structural design optimization and rapid conceptualization** E.P.G. Bruun*, S. Cerri, D. de Koning *Arup Canada Inc., Canada*	**[O4.33] Nonlinear buckling analysis of single-layer graphene sheets by the molecular mechanics method** S.N. Korobeynikov*[1,2], V.V. Alyokhin[1], A.V. Babichev[3] *[1]Lavrentyev Institute of Hydrodynamics, Russia, [2]Novosibirsk State University, Russia, [3]Sobolev Institute of Geology and Mineralogy, Russia*	**[O5.34] Deep learning assisted topology optimization** N.A. Kallioras*, G. Kazakis, N.D. Lagaros National Technical University of Athens, Greece
14:45-15:00	**[O1.21] Probabilistic modelling of spectrum stress range for fatigue analysis of a crane bridge** P. Lehner[1], M. Krejsa*[1], V. Krivy[1], P. Parenica[1], J. Brozovsky[1], J. Kozak[2] *[1]VSB-Technical University of Ostrava, Czech Republic, [2]Vitkovice Machinery Limited, Czech Republic*	**[O2.34] Stochastic multiscale modelling and analysis of multi-phase composite materials using many random parameters** N. Takano *Keio University, Japan*	**[O3.33] A machine learning-based approach to the preliminary design of high-rise buildings** A. Rajbhandari[1], N. Anwar*[1], J. Castillo[1], F. Najam[2] *[1]Asian Institute of Technology (AIT), Thailand, [2]National University of Sciences and Technology (NUST), Pakistan*	**[O4.34] Constrained stability of structures** A. Eriksson *KTH Royal Institute of Technology, Sweden*	**[O5.35] Conceptual design by means of topology optimization** S. Sotiropoulos*, G. Kazakis, N. Lagaros *National Technical University of Athens, Greece*
	CST2018: Railway technology			**ECT2018 and CST2018: Bio-mechanics**	
15:00-15:15	**[O1.22] Analysis of bifurcation and chaos of high-speed railway vehicle** Y. Yan*, J. Zeng, L. Wei, C.H. Huang *Southwest Jiaotong University, China*	**[O2.35] A microstructure-based WYPiWYG constitutive model for soft materials** J.M. Benitez, F.J. Montáns* *Universidad Politecnica de Madrid, Spain*	**[O3.34] Buckling assessment of portal frames through overall imperfection method** G. László*, F. Papp, M.R. Majid *Széchenyi István University, Hungary*	**[O4.35] Data mining the effects of testing conditions and specimen properties on brain biomechanical properties under high strain rate compression** F. Crawford[1,2], O. Abuomar*[3], R. Prabhu[1,2] *[1]Department of Agricultural and Biological Engineering, USA, [2]Center for Advanced*	**[O5.36] A digital tool to design structurally feasible semi-circular masonry arches composed of interlocking blocks** C. Casapulla*1, E. Mousavian1 1University of Naples Federico II, Italy, 2Iran University of Science and Technology, Iran

				Vehicular Systems, USA, [3]Coastal Carolina University, USA	
15:15-15:30		**[O2.36] Shape and topology optimization of inclusions in periodic material microstructures with control over the micro-stress distribution** P.G. Coelho*[1], D.B. Palma[1], D.M. Negrão[1], J.M. Guedes[2], H.C. Rodrigues[2], J.B. Cardoso[1] *[1]NOVA University of Lisbon, Portugal, [2]University of Lisbon, Portugal*	**[O3.35] Structural development for solar-powered HALE UAV** T.U. Kim*, S.J. Kim, J.W. Shin, S.W. Lee *Korea Aerospace Research Institute, Republic of Korea*	**[O4.36] Implementation of an external fixator in knee arthrodesis - a numerical evaluation** L.R. Roseiro*[1,2], M.A.N. Neto[1], M.S. Samarra[1], A.B.A. Amaro[1], A.G. Garruço[3] *[1]University of Coimbra, Portugal, [2]Polytechnic Institute of Coimbra, Portugal, [3]Centro Hospitalar e Universitário de Coimbra, Portugal*	**[O5.37] A digital tool to design structurally feasible hemispherical masonry domes composed of interlocking blocks** E. Mousavian*[1], C. Casapulla[1] *[1]Iran University of Science and Technology, Iran, [2]University of Naples Federico II, Italy*
				Fluid Structure Interaction	
15:30-15:45				**[O4.37] Application of SPH-FE method for fluid-structure interaction using immersed boundary method** F. Kalateh*, A. Koosheh *University of Tabriz, Iran*	**[O5.38] Curved pedestrian bridge supported by an optimised anticlastic grid-shell** L. Fenu*[1], E. Congiu[1], B. Briseghella[2], G.C. Marano[2,3] *[1]University of Cagliari, Italy, [2]University of Fuzhou, China, [3]Technical University of Bari, Italy*
15:45-16:15	**Refreshment Break | *Hall Auditorium & Atrium***				
Room	*Garbi 1*	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chairs	*V.Dias da Silva & A. Heydari*	*E. Rohan & F.J. Montans*	*P. Ivanyi & T. Fukui*	*B. Izzuddin & M. Girardi*	*M. Zawidzki & G. Pavone*
16:00-18:15	**CST2018: Modelling and simulation for engineering design**	**CST2018: Materials, composites and microstructures**	**ECT2018 and CST2018: Computational fluid dynamics**	**ECT2018: Finite element techniques**	**ECT2018: Engineering modelling, design and optimisation**
16:15-16:30	**[O1.23] Kinematic simulation of angulated scissor structures** H. Zieneldin*[1], E. Elkordi[1], M. Elkatt[1], N. Elshabasy[2] *[1]Alexandria University, Egypt, [2]Consolidated Contractor Company, Qatar*	**[O2.37] Development of hybrid model based on Lattice Boltzmann Method and Cellular Automata devoted for phase transformation - simulation of transformation controlled by diffusion** Ł. Łach*, D. Svyetlichnyy, J. Nowak AGH University of Science and Technology, Poland	**[O3.36] Bubble Population Balance Modelling for stationary and rotating columns in zero gravity** Y. Alhendal*, A. Turan *Public Authority for Applied Education and Training, Kuwait*	**[O4.38] Parametric study on the vibration characteristics of bias ply autorikshaw tyres** S. Patil*, L. Biddappa, S. Nagesh *PES University, India*	**[O5.39] Comparison of different multi-objective evolutionary algorithms applied to benchmark problems** C. Lucia De Pascalis*, T. Donateo, A. Ficarella *University of Salento, Italy*

16:30-16:45	**[O1.24] Analysis of tensile force on mooring lines for a submerged floating tunnel (SFT)** G.J. Kim*, H.G. Kwak Korea Advanced Institute of Science and Technology, Republic of Korea	**[O2.38] Homogenization of large deforming porous materials with contact in the microstructure** E. Rohan*, V. Lukeš, J. Heczko, R. Cimrman University of West Bohemia, Czech Republic	**[O3.37] Piston effect analysis for the metro ventilation** O.A. Lanchava*[1,2], G.C. Nozadze[1] *[1]LEPL G. Tsulukidze Mining Institute, Georgia, [2]Georgian Technical University, Georgia*	**[O4.39] Laser scanning-based 3D modeling for structural analysis of the spire of the Senlis cathedral** R. Rolin*, E. Antaluca, J-L. Antaluca, F. Lamarque *University of Technology of Compiègne, France*	**[O5.40] Parametric analysis of the self-stress for innovative V-Expander tensegrity cells** A. Fraddosio, G. Pavone*, M. Daniele Piccioni *Politecnico di Bari, Italy*
16:45-17:00	**[O1.25] On the performance of light aircraft landing gears rolling on different types of runway** N. Arif*, I. Rosu, F. Lebon, H.L. Elias-Birembeaux *Aix-Marseille University, France*	**[O2.39] A computational algorithm for cyclic plasticity at large strains** M. Zhang, F.J. Montáns* *Universidad Politécnica de Madrid, Spain*	**[O3.38] Numerical study on the inertial effects of particles on the rheology of a suspension** T. Fukui*, M. Kawaguchi, K. Morinishi *Kyoto Institute of Technology, Japan*	**[O4.40] Numerical modeling approach for the assessment of elastic properties of bi-layer thin films measured by bulge test** H. A. Tinoco*[1], J. Holzer[1], T. Pikálek[1], T. Fort[1], J. Sobota[1], Z. Buchta[1] *[1]Brno University of Technology, Czech Republic, [2]Czech Academy of Sciences, Czech Republic, [3]Universidad Autónoma de Manizales, Colombia*	**[O5.41] The ideal house - multicriterial optimization of a single family house** M. Zawidzki*, J. Szklarski *Polish Academy of Sciences, Poland*
	ECT2018 and CST2018: Shell plate structures: Analysis and design				
17:00-17:15	**[O1.26] Dynamic and post-buckling analysis of structures like-shell using a quadrilateral shell element with in-plane rotational degree of freedom and a conservative implicit time integration scheme** D. Boutagouga*[1], S. Mamouri[2] *[1]University of Tebessa, Algeria, [2]Université se Tahri Mohamed -Bechar, Algeria*	**[O2.40] On macro-, multi-, and micro-scale material responses** M. Grigoriu *Cornell University, USA*	**[O3.39] Numerical simulation for non conservative hyperbolic system. application to transient two-phase flow with cavitation phenomenon** A. Qadi El Idrissi*1, B. Achchab1, A. Agouzal2 1Université Hassan 1er, Morocco, 2CNRS - Institut Camille Jordan, France	**[O4.41] Motion analysis of thin shell structure with large displacement and rotation by the VFIFE method** C-Y. Wang*, S-H. Chen, C.C. Lin *National Central University, Taiwan*	**[O5.42] Form-finding structural optimization for architectural design** I.N. Tsiptsis*, J. Niiranen, T. Kotnik *Aalto University, Finland*
				ECT2018: Numerical Techniques for Engineering	
17:15-17:30	**[O1.27] Performance of different temporal integration methods in dynamic responses of nonlinear 2D-Frame with large displacements**	**[O2.41] Determination of the hardness of a steel SAE 4140 using the finite element method** R. Sánchez[1], M. Martínez[2], R. Güiza*[2], R. Jaimes[2]	**[O3.40] A Mathematical model for a laminar spiral flow to approximate fire whirl** E. Morishita*, I. Kumagai, K. Onodera, R. Kubota, Y.	**[O4.42] Piecewise Analytic Method (PAM) is a new step in the evolution of solving nonlinear differential equations** T. A. Abassy	**[O5.43] Shape synthesis based on integral and multi-patch NURBS surfaces** M. Ćurković*, D. Vučina *University of Split, Croatia*

	R.L. Silva[1], J.P.B. Cavalcante[1], R. Barros[1], D.N. Maciel*[1] *[1]Federal University of Rio Grande do Norte, Brazil, [2]Federal University of Rio Grande do Norte, Brazil, [3]Federal University of Rio Grande do Norte, Brazil, [4]Federal University of Rio Grande do Norte, Brazil*	*[1]Universidad de Carabobo, Venezuela, [2]Universidad Industrial de Santander, Colombia*	Moriyama, T. Yamazaki *Meisei University, Japan*	*Prince Sattam Bin Abdulaziz university, Saudi Arabia*	
17:30-17:45	**[O1.28] A meta-element approach to linear buckling analysis for thin cylindrical shells** A. Boyez*, A.J. Sadowski, B.A. Izzuddin *Imperial College London, UK*	**[O2.42] The analytical solution for wave equation in the piezoelectric porous material with charge density in fluid** Y.J. Yoon *Hanyang University, Republic of Korea*	**[O3.41] Nonlinear buckling dynamical analysis of stiffened panels Composite Materials for structures** O. Mouhat*, A. Khamlichi *Mohammed V University, Morocco*	**[O4.43] Equivalent local flexibility for neutral surface mirror symmetry structure** R. Li*, J. Xuan, T. Shi, S. He *Huazhong University of Science and Technology, China*	**[O5.44] Modelling and simulation of multi-robot system and control methods developments** M.R. Hayajneh*, S. BaniHani, K. Al-Widyan, S. Mutawe *The Hashemite University, Jordan*
			CST2018: Improved understanding of wind-structure interactions in flexible structures		
17:45-18:00	**[O1.29] Nodal resolution of discontinuity in shell models of folded plates** Q. Fang*, B.A. Izzuddin *Imperial College London, UK*	**[O2.43] Transition between plane stress - plain strain conditions and the effect of plate thickness in extra deep drawn V-notch steel sheets** A. Kamath*, D.M. Kulkarni *Birla Institute of Technology and Science, Pilani, India*	**[O3.42] Insights into suppression of wind-induced vibrations on overhead transmission power lines** M.A.E. Kaunda[1], Z.M. Zondi*[2] *[1]Cape Peninsula University of Technology, South Africa, [2]Mangosuthu University of Technology, South Africa*	**[O4.44] A two-phase numerical investigation of falling film absorption inside a vertical channel** R. Abbasi Havestini*, S.J. Ormiston *University of Manitoba, Canada*	**[O5.45] Modelling and performance study of electrically-coupled microbeams subject to shock load for MEMS applications** M. Ghommem*[1], M. Ahmed[1], A. Abdelkefi[2] *[1]American University of Sharjah, United Arab Emirates, [2]New Mexico State University, USA*
18:00-18:15	**[O1.30] Buckling of circular BFG arbitrary tapered plate rested on nonlinear elastic foundation** A. Heydari*[1,2], A. Negahdar[3] *[1]Sharif University of Technology, Iran, [2]University of Tabriz, Iran, [3]University of Mohaghegh Ardabili, Iran*	**[O2.44] Simulation of reinforced concrete sections with different confining materials by means of a plastic-damage model with variable dilatancy** M. Poliotti*, J.M. Bairán *Technical University of Catalonia, Spain*		**[O4.45] The operation of convolution: An algorithm using differential quadrature method and its application to dynamic analysis** H. Li*, Y. Mei, Y. Ren *Nanjing Tech University, China*	**[O5.46] Influence of driving pattern factors on energy efficiency of plug-in hybrid electric vehicles** K. Sim*, C. Park, S.H. Hwang *Sungkyunkwan University, Republic of Korea*
19:00-22:00	**Conference Dinner -** *Can Laury Restaurant* *All ticket holders to meet in the Hotel Lobby at 18:45 for a swift 18:50 departure by foot*				

Thursday 06 September 2018					
Room	*Garbi 1*	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chairs	*J. Brozovsky & R.A. Hawileh*	*J. Naprstek & J.R. Banerjee*	*N.L. Rizzi & G. Salerno*	*F. Rackwitz, Y. Petryna & J. Bencat*	*A. P Chassiakos & M.Matheou*
09:00-10:45	**CST2018: Reinforced concrete structures: Analysis and design**	**ECT2018: Composite structures**	**Analysis, Modelling and design for manufacturing**	**CST2018: Special session: Modelling, assessment and monitoring of dam structures including soil-structure interaction**	**ECT2018: Building and construction engineering**
09:00-09:15	**[O1.31] The improvements of the Korozeeneck corrosion initiation model** P. Konecny[1], P. Lehner[1], J. Brozovsky*[1], P. Gosh[2] *[1]VSB - Technical University Ostrava, Czech Republic, [2]California State University Fullerton, USA*	**[O2.45] Computational challenges of electro-mechanical composite structures** B. Rammohan*, A. George *PES University, India*	**[O3.43] Numerical study of the internal flow characteristics in a free-piston stirling engine** L. Solomon*, S. Qui *West Virginia University, USA*	**[O4.46] Structural health monitoring of the Kurpsai dam in the Kyrgyz Republic** Y. Petryna*[1], F. Rackwitz[1], M. Pilz[2], J. Alberding[3], O. Lang[4], S. Orunbaev[5] *[1]Technische Universität Berlin, Germany, [2]German Research Center for Geosciences, Germany, [3]Alberding GmbH, Germany, [4]Airbus Defence and Space GmbH, Germany, [5]Central Asian Institute for Applied Geosciences, Kyrgyzstan*	**[O5.47] Evolutionary algorithm performance evaluation in project time-cost optimization** A.P. Chassiakos*, G. Rempis *University of Patras, Greece*
		CST2018: Multi-body methods			
09:15-09:30	**[O1.32] Modeling influencing factors during chloride penetration in concrete** P. Travnicek*, J. Kruis, J. Nemecek *Czech technical university in Prague, Czech Republic*	**[O2.46] Dynamic model of a washing machine during the transient period** R. Latre Abadia*[2], J. Lladó Paris[1], B. Sánchez Tabuenca[1], C.A. Albero Posac[1] *[1]University of Zaragoza, Spain, [2]BSH Electrodomésticos España S.A., Spain*	**[O3.44] Optimized manufacture to improve operating characteristics of gears** V. Dr. Simon *Budapest University of Technology and Economics, Hungary*	**[O4.47] Finite element model validation and update for the Kurpsai dam** Y. Petryna, W. Elsesser*, P. Kähler *Technische Universität Berlin, Germany*	**[O5.48] Risk evaluation of renovating buildings** R. Gupta*, M.S. Deshmukh *Birla Institute of Technology and Science, India*
		CST2018: Analytical and numerical dynamics			
09:30-09:45	**[O1.33] Structural behaviour of insulated nano-concrete formwork composite slabs using finite element analysis** A. Binsanad*[1], E. Aghababa[2], M.P. Saka[1] *[1]University of Bahrain, Bahrain, [2]Ministry of Municipality, Research and Development Section,, Bahrain*	**[O2.47] The differential transformation finite element method in forced vibration analysis of beams with nonlinear damping** R. Holubowski *Wroclaw University of Science and Technology, Poland*	**[O3.45] Time series forecasting using an ARIMA model in machining process** A. Jimenez Cortadi*[1], I. Irigoien[2], F. Boto[1], B. Sierra[2], G. Rodriguez[1] *[1]Tecnalia, Spain, [2]UPV/EHU, Spain*	**[O4.48] Seismic soil-structure interaction analysis of concrete gravity dam considering stochastic variation of material parameters** I-K. Fontara*, W. Elsesser, Y. Petryna, F. Rackwitz *TU Berlin, Germany*	**[O5.49] Building information modelling within AEC industry in saudi arabia, potential and barriers** Y.R. Almutiri *Albaha University, Saudi Arabia*

				CST2018: Geotechnics, foundation engineering and soil-structure interaction	
09:45-10:00	**[O1.34] Finite element modeling of strengthened RC beams with side-bonded CFRP laminates** R.A. Hawileh*, H. Musto, J.A. Abdalla *American University of Sharjah, United Arab Emirates*	**[O2.48] Super and subharmonic synchronization in generalized van der Pol oscillator** J. Naprstek*, C. Fischer *Institute of Theoretical and Applied Mechanics, Czech Republic*	**[O3.46] Operational modal analysis of front load washing machine** H. Patil*, D. Shah, A.A. Rao, B. Rammohan, S.S. Patil *PES UNIVERSITY, India*	**[O4.49] Dynamic analysis of turbo-generator foundation structure** J. Bencat*[1], M. Tomko[2], M. Lukac[1] *[1]University of Zilina, Slovakia, [2]Technical University Kosice, Slovakia*	**[O5.50] Project management company selection model for construction companies** S.M. El-Sayegh*, Y. Nattat *University of Sharjah, United Arab Emirates*
10:00-10:15	**[O1.35] Inelastic response of 3D reinforced concrete infilled frames subjected to earthquake** H. Singh*[1], D.K. Paul[1] *[1]Guru Nanak Dev Engineering College, India, [2]IIT Roorkee, India*	**[O2.49] Dynamic model of ultrasonic impact system with a gap between two coaxial longitudinal waveguides** M.M. Ganiev*, I.K. Vagapov, I.M. Ganiev *Kazan Federal University, Russia*	**[O3.47] Proposition of a customized design process of a hybrid prototyping machine** J. El Mesbahi*[1], R. Ahmed[1], A. El Mesbahi[1], J. Kojmane[2] *[1]Faculty of Sciences and Techniques of Tangier, Morocco, [2]Faculty of Sciences and Techniques of Fes, Morocco*	**[O4.50] Numerical modelling of radiating boundary conditions combined with modified absorbing boundary condition for viscoelastic wave propagation** R. Badry*[1,2], P. Ramancharla[1] *[1]Arup India Pvt Ltd., India, [2]IIIT Hyderabad, India*	**[O5.51] Adoption of a Semantic Web-based approach for capturing parametric building models** F. Sadeghineko*, B. Kumar, W. Chan *Glasgow Caledonian University, UK*
10:15-10:30	**[O1.36] Nonlinear sectional analysis of reinforced concrete beams and shells subjected to pure torsion** A. Kuan*[1], E.P.G. Bruun[1,2], E.C. Bentz[1], M.P. Collins[1] *[1]University of Toronto, Canada, [2]Arup Canada, Canada*	**[O2.50] Dynamic characteristics of structures equipped with inerters and viscoelastic dampers** Z. Pawlak*, R. Lewandowski *Poznan University of Technology, Poland*	**[O3.48] A computational innovation transition-based recovery policy for flexible manufacturing systems** Y-L. Pan*[1,2], C-Y. Tseng[1] *[1]Air Force Academy, China, [2]University of Science and Technology, China*	**[O4.51] Numerical 3D modeling of bridge multi pile foundation in the geotechnical design practice** J. Szép*, M. Movahedi Rad *Széchenyi István István University Győr, Hungary*	**[O5.52] Analysis and development of an adaptive façade system integrated on a multi-storey office building** A. Couvelas*[1], M. Matheou[1], M.C. Phocas[1] *[1]University of Cyprus, Greece, [2]Couvelas Architects, Greece*
10:30-10:45	**[O1.37] Finite element modelling of large reinforced concrete structures using the novel hybrid panel truss element** M.E. Nuh*[1], E.P.G. Bruun[2] *[1]University of Toronto, Canada, [2]Arup Canada Inc., Canada*	**[O2.51] Analytical beam model for the dynamic analysis of bridge girders** J. Serra*, R. Vieira, F. Virtuoso *Instituto Superior Tecnico, Portugal*			
10:45-11:15	**Refreshment Break** | *Hall Auditorium & Atrium*				
Room	*Garbi 1*	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*
Session Chair	*N.L. Rizzi & G. Salerno*	*J. Naprstek & D. Kennedy*	*E. Sapountzakis & R.A. Hawileh*	*M. Pawlak & J. Szep*	*S.M. Hashemi, M. Bruggi & E. Barkanov*

11:15-13:00	CST2018: Special session: Continuum and discrete modelling of nanomaterials: Theory and applications	CST2018: Special session: Vibration based damage detection in structures using the dynamic stiffness method and other approaches	CST2018: Special session: Structural analysis of steel and steel-concrete composite structures	ECT2018: Geomechanics, geomaterials and geoinformation	ECT2018: Finite element techniques
11:15-11:30	**[O1.38] The non linear mechanical behaviour of single layer graphene sheets from atomistic simulation to continuum models** A. Genoese*, A. Genoese, N.L. Rizzi, G. Salerno *Department of Architecture, University Roma Tre, Italy*	**[O2.52] Natural frequency modelling to identify material properties of crush damaged corrugated fibreboard** C.S.L. Kueh*[1], M.A. Jamsari[1], K. Dahm[2], S. Ilanko[3], J.E. Bronlund[1] *[1]Massey University, New Zealand, [2]Callaghan Innovation, New Zealand, [3]The University of Waikato, New Zealand*	**[O3.49] A simplified finite element model of steel-concrete composites with partial interactions** W.H. Lee*, H-G. Kwak *Korea Advanced Institute of Science and Technology, Republic of Korea*	**[O4.52] Study of geofoam-filled trench to mitigate ground vibration using computational simulation** P. Jayawardana*, D. Thambiratnam, T. Chan, N. Perera *Queensland University of Technology, Australia*	**[O5.53] Multi-physical finite element analysis of microwave assisted pultrusion processes** E. Barkanov*[1], P. Akishin[1], R. Emmerich[2], M. Graf[2] *[1]Riga Technical University, Latvia, [2]Fraunhofer Institute for Chemical Technology ICT, Germany*
11:30-11:45	**[O1.39] Influence of temperature on mechanical properties of hexagonal lattice nanosheets: Finite element prediction** A. Tsiamaki*, N. Anifantis *University of Patras, Greece*	**[O2.53] Spectral dynamic stiffness formulation for the cross-sectional vibration of composite solids with cracks and mass attachments** X. Liu*[1,2], C. Xie[1,2], J.R. Banerjee[3] *[1]Key Laboratory of Traffic Safety on Track (Central South University), China, [2]Central South University, China, [3]University of London, UK*	**[O3.50] Structural performance of Reinforced Concrete buildings with enhanced steel reinforcing bars** S. Caprili*[1], W. Salvatore[1], F. Mattei[2], R. Gigliotti[2] *[1]University of Pisa, Italy, [2]Sapienza University of Rome, Italy*	**[O4.53] Numerical simulation of liquefiable soil-structure interaction system in a shaking table test based on a loos-coupled effective stress approach** D.F. Zhao*, G.X. Chen, S.D. Zhu, R.R. Sun *Nanjing Tech University, China*	**[O5.54] Comparative study of local defect correction method and h-adaptive methods** D. Koliesnikova*[1,2], I. Ramière[1], F. Lebon[1] *[1]CEA, France, [2]LMA, France*
11:45-12:00	**[O1.40] Buckling of single-wall carbon nanotubes from molecular mechanics to continuum models** A. Genoese, A. Genoese*, N.L. Rizzi, G. Salerno *Department of Architecture, University of Roma Tre, Italy*	**[O2.54] Modelling and vibration based detection of cracks in plate structures** Y. Luo, D. Kennedy*, C.A. Featherston, A. Labib *Cardiff University, UK*	**[O3.51] Local buckling analysis of thin- or thick-walled beams employing advanced beam elements** A. Argyridi, E. Sapountzakis*, Z. Chatzopoulos *National Technical University of Athens, Greece*	**[O4.54] Numerical analysis for the wave-induced liquefaction of seabed around an immersed tunnel** W. Chen*[1], D. Jeng[1] *[1]Nanjing Tech University, China, [2]Griffith University Gold Coast Campus, Australia*	**[O5.55] Analysis of no-tension bodies through the API of a conventional FEM software package** D. Briccola, M. Bruggi* *Politecnico di Milano, Italy*
12:00-12:15		**[O2.55] A parametric investigation into the free vibration characteristics of a cracked beam by applying the dynamic stiffness method** J.R. Banerjee*, A. Ajandan *City, University of London, UK*	**[O3.52] Analysis of the behaviour of an innovative removable joint using clamps in connections of structural steel square tubes** M. Cabaleiro*, J.C. Caamaño, B. Riveiro, B. Conde *University of Vigo, Spain*	**[O4.55] The wheel-surface model for all terrain vehicle dynamics simulation** T. Czapla, M. Pawlak* *Silesian University of Technology, Poland*	**[O5.56] Static and modal analysis of non-pneumatic tyres** P. Kranthi, P. Babu Rao, P. Sharanabasappa S* *PES University, India*

12:15-12:30			**[O3.53] Finite element model development of composite steel beams pre-damaged in flexure** R.A. Hawileh*[1], E. Karam[1], J.A. Abdalla[1], T. El Maaddawy[2] *[1]American University of Sharjah, United Arab Emirates, [2]United Arab Emirates University, United Arab Emirates*	**[O4.56] Development geoinformation system for designing supports for underground workings** N.B. Bakhtybayev*, S.P. Olenyuk, A.S. Bakhtybayeva, D.K. Takhanov *Karaganda state Technical University, Kazakhstan*	**[O5.57] Numerical model of point thermal bridges** M. Gaši*, B. Milovanović, M. Bagarić *University of Zagreb, Croatia*
12:30-12:45			**[O3.54] Overall Imperfection Method for tapered beam-columns** G. Hajdú*, F. Papp *Széchenyi István University, Hungary*		**[O5.58] A symbolic dynamic finite element formulation for multilayered thin Rectangular plates** S. Jayasinghe, S. M. Hashemi* *Ryerson University, Canada*
12:45-13:00			**[O3.55] Enhanced Dual-Phase steel reinforcing bars for RC buildings** S. Caprili*[1], W. Salvatore[1], R. Valentini[1], C. Ascanio[2], G. Luvara[2] *[1]University of Pisa, Italy, [2]Ferriere Nord S.p.A, Italy*		
13:00-14:00	**Lunch** | *Noray Restaurant*				
Room	*Llevant 1*	*Llevant 2*	*Llevant 3*	*Llevant 4*	
	D. Giagopoulos & G.A. Abu-Farsakh	*G. Milani & L.M.C. Simoes*	*M. Girardi & G. Milani*	*J. Heinonen & K. Maslo*	
14:00-16:30	**CST2018: Developments in finite element methods**	**CST2018: Special session: Seismic assessment of new structures and vulnerability reduction of existing buildings: Advanced numerical modelling**	**CST2018: Special session: Recent advances on vibration-based structural health monitoring of age-old masonry buildings**	**ECT2018: Engineering modelling and simulation**	
14:00-14:15	**[O2.56] Finite element model updating of large scale nonlinear systems** D. Giagopoulos*, A. Arailopoulos *University of Western Macedonia, Greece*	**[O3.56] Damage assessment through nonlinear analyses of five masonry churches hit by central Italy earthquake in 2016** F. Clementi, E. Giordano, A. Ferrante, V. Gazzani*, M. Poiani, S. Lenci *Polytechnic University of Marche, Italy*	**[O4.57] Investigations on the dynamic behaviour of the Clock Tower in Lucca** R.M. Azzara[1], M. Girardi*[2], C. Padovani[2], D. Pellegrini[2] *[1]Istituto Nazionale di Geofisica e Vulcanologia (INGV) - Seismological Observatory of Arezzo, Italy, [2]Institute of Information Science and Technologies "A. Faedo" (ISTI-CNR), Italy*	**[O5.59] Comparative simulations of rail and road infrastructure with the transportation of liquid cargoes** J.A. Romero*[1], F. Otremba[2], A.A. Lozano-Guzmán[3] *[1]Queretaro Autonomous University, Mexico, [2]Federal Institute of Materials Research and Testing (BAM), Germany, [3]Applied Science and Advanced Technology (CICATA-Qro), Mexico*
14:15-14:30	**[O2.57] Performance of the enriched 8-node 3D solid finite element free**	**[O3.57] The NSCD method for dynamic analyses of ancient**	**[O4.58] Bayesian updating of model parameters of the Maddalena bridge**	**[O5.60] Model-based determination of grinding tool wear in double face**	

	from the linear dependence problem S. Kim*, P.S. Lee *Korea Advanced Institute of Science and Technology, Republic of Korea*	**masonry churches damaged during the last central Italy earthquakes of 2016** F. Clementi, A. Ferrante, E. Giordano, M. Poiani*, V. Gazzani, S. Lenci *Polytechnic University of Marche, Italy*	**in Borgo a Mozzano (Italy)** A. De Falco[1], M. Girardi[2], D. Pellegrini[2], G. Sevieri*[1] *[1]University of Pisa, Italy, [2]ISTI-CNR, Italy*	**grinding processes with planetary kinematics** E. Uhlmann, M. List* *Technische Universitaet Berlin, Germany*
14:30-14:45	**[O2.58] Surface coupling along a line with non-matched meshes** A.N. Nordas*, B.A. Izzuddin, L. Macorini *Imperial College London, UK*	**[O3.58] Effective numerical strategies for the seismic vulnerability mitigation of masonry towers** G. Milani[1], J.M. Adam[2], F. Clementi[3], M. Valente[1], R. Shehu*[1] *[1]Politecnico Di Milano, Italy, [2]Universitat Politècnica de València, Spain, [3]Polytechnic University of Marche, Italy*	**[O4.59] Finite element models for the Guglie bridge in Venice based on non-destructive testing: sensitivity to design shape** A. Manzato*, S. Trevisani, A. Cecchi *Università I.U.A.V. di Venezia, Italy*	**[O5.61] Attribute management system for digital mock-up** A. Couvelas*, M. Matheou, M.C. Phocas *University of Cyprus, Cyprus*
			CST2018: Computational modelling of masonry structures	
14:45-15:00	**[O2.59] Comparative analysis of the nonlinear mixed finite element formulations for the in-plane curved beams** A.N. Doğruoğlu, S. Kömürcü* *Istanbul Technical University, Turkey*	**[O3.59] Study of the dynamic behaviour of medium-rise modular structures using dynamic computational simulation** S.V. Sendanayake*, D.P. Thambiratnam, N. Perera, T. Chan *Queensland University of Technology, Australia*	**[O4.60] Numerical simulations of full scale FRCM reinforced masonry panels out-of-plane loaded via a simplified two-step homogenization model** E. Bertolesi[1], G. Milani*[2], B. Ghiassi[3] *[1]ICITECH, Spain, [2]Politecnico di Milano, Italy, [3]Delft University, The Netherlands*	**[O5.62] Simulation engine for on-line Dynamic Stability Assessment** K. Máslo *ČEPS, a.s., Czech Republic*
15:00-15:15	**[O2.60] Direct dynamic infinite element in time domain** Y. Bakhtaoui*[1,2], A. Chelghoum[2] *[1]National Center of Studies And Integrated Research On Building, Algeria, [2]University of Science and Technology H. Boumediene, Algeria*	**[O3.60] Seismic assessment of a masonry church using rigid block limit analysis and continuos finite element modelling** F. Portioli*[1], R. Gagliardo[1], L. Cascini[2], R. Landolfo[3], M. Malena[3], G. Tomaselli[3], G. de Felice[1] *[1]University of Naples Federico II, Italy, [2]University of Genoa, Italy, [3]University of Roma Tre, Italy*	**[O4.61] Multi-scale modelling of masonry influenced by temperature and moisture changes on PC clusters** T. Krejčí*, J. Kruis, M. Šejnoha *Czech Technical University in Prague, Czech Republic*	**[O5.63] Simulation of three-dimensional nonlinear sloshing in tanks using the Peridynamic differential operator mesh-free method** S. Bazazzadeh*[1,2], A. shojaei[1,2], M. Zaccariotto[1,2], U. Galvanetto[1,2] *[1]University of Padova, Italy, [2]Center of Studies and Activities for Space, Italy*
		CST2018: Seismic engineering and control		
15:15-15:30	**[O2.61] Numerical prediction of blast-induced ground vibrations - numerical modelling of the source** L. Ducarne*, D. Ainalis, O. Kaufmann, J-P. Tshibangu, O. Verlinden, G.	**[O3.61] Optimization of concrete cable-stayed bridges under seismic action** A.M.B. Martins, L.M.C. Simões*, J.H.J.O. Negrão *University of Coimbra, Portugal*	**[O4.62] Historical masonry influenced by weathering and non-uniform settlement** E. Susanti, P. Kuklík, M. šejnoha* *CTU in Prague, Czech Republic*	**[O5.64] Study on connections in RBM with information gain** M. Wang*, C. Xiao, Y. Zhang, Z. Ning *Beijing University of Technology, China*

	Kouroussis *Université de Mons, Belgium*			
	CST2018: Application of finite element methods			
15:30-15:45	**[O2.62] Three-dimensional finite element analysis of O-ring metal seals considering different seal diameters** L. Qiao*, C. Keller, U. Zencker, H. Völzke *Bundesanstalt für Materialforschung und -prüfung, Germany*	**[O3.62] Optimal length scale in dimensional analysis for seismic responses of bilinear SDOF systems** G.Q. Guo*, D.X. Yang *Dalian University of Technology, China*	**[O4.63] Simulating shear-compression behaviour of historical masonry panels: sensitivity of numerical models to input parameters** A. Gregori*, M. Angiolilli *University of l'Aquila, Italy*	**[O5.65] Post-processing routine for fire-spotting modelling in fire front propagation** V.N. Egorova*[1], A. Trucchia[1,2], G. Pagnini[1,3] *[1]BCAM – Basque Center for Applied Mathemetics, Spain, [2]University of the Basque Country UPV/EHU, Spain, [3]Ikerbasque – Basque Foundation for Science, Spain*
15:45-16:00	**[O2.63] Model – Based diagnosis of metallurgical ladle refractory lining** I. Petrova*, E. Mihailov *University of Chemical Technology and Metallurgy (UCTM) – Sofia, Bulgaria*	**[O3.63] Comparison of methods for assessing the influence of mining shocks on masonry residential buildings using finite element method** F. Pachla*, T. Tatara *Cracow University of Technology, Poland*		**[O5.66] Visualization of 3D explosion and impact problems** K. Zheng*, H.Y. Liu, H.L. Ren *Beijing Institute of Technology, China*
16:00-16:15	**[O2.64] Research on the thermal shock of ice-melting to two kinds of asphalt pavement by using ABAQUS finite element software** J. Zhou*, T. Yang, J. Li, G.Q. Liu *Southeast University, China*	**[O3.64] Configuration of Multi Tuned Mass Dampers (MTMDs) for asymmetric buildings subject to earthquakes** Y. Arfiadi *Universitas Atma Jaya Yogyakarta, Indonesia*		**[O5.67] Modelling structural performance of offshore wind turbine support structures in ice-infested waters by using design load portal** J. Heinonen*, P. Klinge, K. Kolari, J. Kurkela *VTT Technical Research Centre of Finland Ltd, Finland*
16:15-16:30	**[O2.65] Effect of a central square hole on stress-concentration in an open cylindrical composite panel subjected to uniform axial tension loading** G.A. Abu-Farsakh*, S.R. Al-Rousan *Jordan University of Science and Technology, Jordan*	**[O3.65] Seismic response control with multiobjective optimization using genetic algorithm** R.S. Desai*, S.N. Tande *Walchand College of Engineering, Sangli, India*		

CST Keynote Speaker Abstracts

A nested, concurrent multiscale approach without scale-separation

Lars Beex*[1], Pierre Kerfriden[2]
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[2]*Cardiff University, Wales, UK*

Nested multiscale approaches based on computational homogenisation rely on the appropriate coupling between macroscale finite elements (FEs) and microscale representative volume elements (RVEs). This involves applying the average macroscale deformation appropriately to the microscale RVEs, for instance by using periodic boundary conditions. It also involves extracting the average microscale stress and sending it back to the macroscale FEs. For linear macroscale FEs the formulation and implementation are not particularly complex, but they become involved if higher-order macroscale FEs are used. The reason is that then not only the macroscale deformation and the average microscale stress must not be transferred between the scales, but also their spatial gradients. Another disadvantage is that scale-separation must hold, which makes the approach computationally expensive if used concurrently (i.e. by using the microscale model in a part of the domain, whilst coarse-graining the remainder).

In this talk, a new multiscale approach is presented that does not rely on macro-to-micro and macro-to-micro relations. This makes its implementation relatively straightforward. It also makes the implementation and formulation as straightforward for linear macroscale FEs as for higher-order macroscale FEs (we show examples for cubic macroscale FEs which are never been used for multiscale approaches based on computational homogenisation to the best of our knowledge). Scale-separation is also not required to hold. This has the advantage that a gradual transition of macroscale FEs towards regions in which the microscale model is fully resolved can be obtained, entailing a reduction of the computational costs compared to approaches based on homogenisation.

These two important advantages are not for free, as their price is paid by additional computational costs in coarse-grained regions, relative to approaches based on computational homogenisation. First, the number of degrees of freedom (DOFs) is considerably higher, because many microscale DOFs appear in the macroscale computation. Second, the number of RVEs that must be considered per macroscale FE is larger than for traditional multiscale approaches based on computational homogenisation. Consequently, the approach is particularly useful if, (i) scale-separation does not hold (in a part of the domain or in the entire domain), (ii) the microscale model needs to be fully resolved in a part of the domain (which is strongly related to point (i)), and/or (iii) if higher-order macroscale FEs are required.

The presentation starts with an explanation of the approach by considering a string of 20 springs and finishes with a network of more than 80M beams and 233M DOFs.

Computational treatment of instabilities of thin-walled structures under tension

F.G. Rammerstorfer
Vienna University of Technology (TU Wien)

Structural instability is typically associated with buckling under compression loading. However, especially in lightweight structures, in some situations instabilities, such as buckling or wrinkling, appear under tensile loads.

As some examples, buckling analyses of beams, plates – with and without cut-outs – rolled metal strips, thin cell walls of metal foams and of thin metallic films on polymer substrates, all under tensile loading are treated in this presentation. It is shown that in all these cases eventually compressive stresses, activated by tensile loads are responsible for the loss of stability.
However, another kind of instability is really caused by tensile stresses, namely material instabilities. It is shown that elastic plastic conical formation of relatively thin tubes may lead to material instabilities

due to circumferential tensile stresses, associated with periodic patterns of localized deformation as eigen-modes.

Experimental observations are presented, in which tensile loading of beams, plates – with and without cut-outs – rolled metal strips, thin cell walls of metal foams, and thin metallic films on polymer substrates show typical buckling under tensile loading.

Although for thin plated structures in most cases the bifurcation analyses can be performed by applying 2nd order theory,i.e., critical load intensities are determined directly by solving linear eigenvalue problems, the presented studies of buckling under tensile loading are based on geometrically nonlinear finite element analyses. This is because most interesting is the sometimes unexpected post-buckling behaviour which requires at least geometrical nonlinear approaches. The formulation of the eigenvalue problem requires specific attention. This is because buckling under tensile loading appears at much higher critical load intensities than – under compression loading, i.e., if just the sign of the loading is changed. Not taking care of this would lead to a series of negative eigenvalues, which all are associated with critical compressive loads.
In order to provide computed results more general applicability, in many cases (especially buckling of beams and plates under tensile loading) dimensionless quantities are determined by using Buckingham's Pi-theorem.

Regarding material instabilities due to tensile stresses during forming processes, fully nonlinear finite element analyses have been performed, and the results are compared to experimental findings. This is especially shown by the widening of rings and the conical expansion of tubes.
Buckling of tensile loaded continuous beams require specific load introduction, and it can be shown that, although the beam is under tension buckling is due to compression of the load introducing attachments. Similarly, buckling of rectangular plates, loaded by tension at two opposite clamped edges buckle by formation of cross compression stresses caused by the Poisson effect, and local buckling of stretched plates with cut-outs or through-cracks is caused by local compressive stress fields around portions of the free edges at the cut-outs or cracks.

Nevertheless, in lightweight structure design of such configurations it is important to know the critical tensile loading in order to prevent the lightweight structure from instabilities which lead to stiffness reduction and, eventually, to catastrophic failure. Hence, based on eigenvalue analyses diagrams are derived, which show the dimensionless critical tensile load intensity in dependence of dimensionless parameters of the structures. Similar observations can be made, when closed cell metallic foams are subject to global tension.

In the so far mentioned cases, the amplitudes of the buckling pattern start growing in the post-buckling regime with growing tensile loading. However, from a certain tension intensity on the amplitudes decrease.

The latter mentioned observation is not observable when thin metallic films on polymer substrates buckle, when the film-substrate system is stretched above the tension that has led to transverse cracking of the brittle film. In these situations, buckling is associated with debonding of the film from the substrate. Combined computational buckling analyses and experimental observations allow the indirect determination of interface strength parameters by solving an inverse problem.

Furthermore, thin rolled metal strips may contain residual stresses from the rolling process. As long as the strip is under sufficient global tension, it is flat as it should be. However, if the distribution shape and the intensity of the residual stresses are in an unfavourable range, it happens the reduction of the global tension results in buckling with a quite strange post-buckling behaviour.

As long as structural instability under tensile loading is concerned, typically local compressive stresses, caused by geometric effects or by Poisson effects are responsible for loss of stability of the trivial equilibrium path. Whereas material instabilities as appearing during forming processes are typically caused by tensile strains. Not only critical load configurations are of interest but also the behaviour in the post critical domain, showing sometimes rather strange effects.

Pre- and post- buckling analysis of beams employing higher order beam theory

Evangelos J. Sapountzakis*, Amalia K. Argyridi

Computational Structures Technology 2018

Both Euler – Bernoulli beam and Timoshenko beam theories (classical beam theories) maintain the assumptions that plane cross-sections remain plane (no out-of-plane deformation) and that their shape does not change after deformation (no in-plane deformation). In order to take into account shear lag effects in the context of a beam theory, the inclusion of non-uniform warping is necessary, relaxing the assumption of plane cross section. The shear flow associated with non-uniform warping leads also to in plane deformation of the cross section, relaxing the assumption that the cross section shape does not change after deformation. For this purpose, the so-called higher order beam theories have been developed taking into account shear lag (warping effects – out-of-plane deformation) [1] and distortional (in-plane deformation) [2] effects.
In this paper, a higher order beam theory is employed for pre- and post- buckling analysis [3] of beams of arbitrarily shaped, homogeneous cross-section, taking into account warping [4] and distortional [5] phenomena due to axial loading, shear, flexure and torsion. The beam is subjected to arbitrary axial, transverse and/or torsional concentrated or distributed load, while its edges are restrained by the most general linear boundary conditions. The analysis consists of two stages. In the first stage, where the Boundary Element Method is employed, a cross sectional analysis is performed based on the so-called sequential equilibrium scheme establishing the possible in-plane (distortion) and out-of-plane (warping) deformation patterns (axial, flexural and torsional modes) of the cross section [5]. In the second stage, where the Finite Element Method is employed, the extracted deformation patterns are included in the post-buckling analysis multiplied by respective independent parameters expressing their contribution to the beam deformation. The four rigid body displacements of the cross section together with the aforementioned independent parameters consist the degrees of freedom of the beam. The finite element equations are formulated with respect to the rigid body displacements and the independent warping and distortional parameters. The influence of shear lag and distortional phenomena in post-buckling analysis of beams is investigated through numerical examples with practical interest. Comparisons with 3d solid models and classical beam theories are conducted.

Assessment of the reflection-transmission error for reciprocal mass matrices

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The majority of methods for wave propagation relies on compatible finite elements with a diagonal mass matrix or a discontinuous approximation, e.g. hybridizable discontinuous Galerkin, where sparsity of a mass matrix does not play a role. Recently, several methods were proposed to directly construct a sparse inverse of a mass matrix also called reciprocal mass matrix. This matrix facilitates direct computation of acceleration from the force vector. This enables efficient explicit computation for compatible finite elements that does not have accurate diagonal mass matrices. Initial analysis showed that these reciprocal mass matrices may be optimized for a low dispersion error inside a homogeneous domain. In case of heterogeneous domains, reflection and transmission on the interfaces may be a source of a leading term in the overall error of the discretization. In this contribution, the reflection-transmission error is studied for several formulations of the reciprocal mass matrix for 1D, which includes two different constructions for dual spaces and usage of localized Lagrange multipliers for coupling subdomains with different material properties.

The reflection-transmission error is assessed with one analytical and two numerical methods. The analytical method considers equilibrium and continuity equations on the interface between to subdomains with constant element sizes and different material properties. Substitution of the general solution in form of monochromatic propagating and evanescent waves into the interface conditions yields a system of equations with respect to the amplitudes of the waves. Comparison of the amplitudes with known analytical expression allows isolation of the leading term of the reflection-transmission error. In the first numerical approach, the convergence of several lowest eigenfrequencies for heterogeneous structures is studied. In the second numerical approach, a transient wave propagation problem is solved and errors in the arrival time and amplitudes of arrived signal are computed.

Analytical approach for the reflection-transmission error assessment for two-node rod element showed that the construction of dual spaces without density leads to an error in the first order term whereas the construction of dual spaces with density and a formulation using localized Lagrange multipliers lead to an error in the second order term. The latter error term is equal for both formulations, it is proportional to a difference of squares of phase speeds and drives the asymptotic convergence rate. The convergence study of several lowest eigenfrequencies for heterogeneous structures confirms the finding of the analytical error assessment. Furthermore, a preasymptotic superconvergence is observed for heterogeneous material with similar phase speeds. This phenomena is explained by prevailing dispersion error over reflection-transmission error for coarse meshes. The transient wave propagation results also support the analytical error assessment in terms of delay in the arrival time of signals and the error of amplitudes of reflected and transmitted waves.

Reciprocal mass matrices using the construction of dual spaces with density or using localized Lagrange multipliers on an interface result in second order error term and they can be used for heterogeneous wave equation problems. No preference can be given to one of these formulation based on the size of the reflection-transmission error.

ECT Keynote Speaker Abstracts

Dynamics and homogenised elastic properties of irregular cellular metamaterials

Sondipon Adhikari
Swansea University, UK

Metamaterials based on hexagonal periodic cells (honeycombs) have gained considerable attention in recent years. This can be an advanced material due to its capability of meeting high performance requirements in various critically desirable application-specific parameters [1]. These structural assemblies not only make an efficient use of material but are also characterized by interesting dynamic and wave propagation properties. A semi-analytical formulation has been developed for wave propagation in irregular honeycombs. Spatial structural irregularity of hexagonal lattices has been considered. There are few scientific literatures available concerning analysis of wave propagation in regular honeycombs [2]. However, due to inevitable uncertainties associated with manufacturing and service conditions, honeycomb lattices may not be always perfectly regular. The effect of spatially random structural irregularity in wave velocities of such irregular honeycombs will be discussed. Dynamic homogenisation of the metamaterials leads to some unusual properties such as negative elastic modulus at certain frequencies. New derivations are proposed to quantify and demystify such observations.

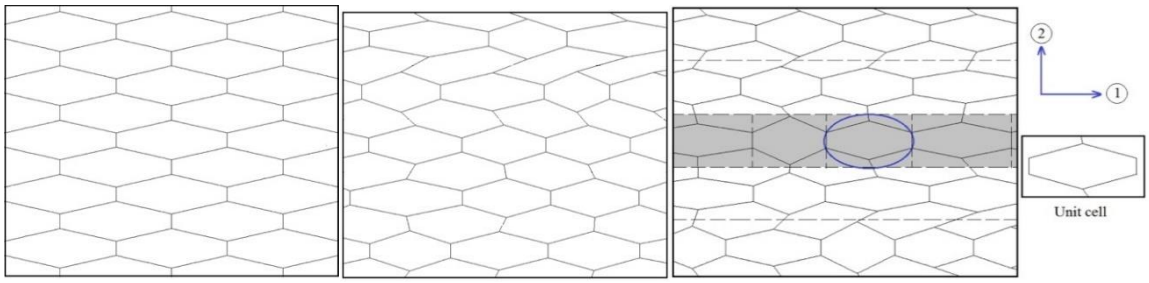

Figure 1 Irregular cellular metamaterials.

Active structural control in civil and infrastructural engineering: feasibility of a breakthrough

Fabio Casciati, *University of Pavia, Italy*

Abstract unavailable at time of print

Isogeometric analysis of coupled thermomechanical problems: Theoretical and implementation aspects

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Isogeometric Analysis has probably open a new area in the design of simulation tools as an attempt to reduce the gap between CAD and CAE. From an industrial point of view, it makes sense to keep a same geometric primitive all along the design and production processes. The fundamental concept formalized by T.J.R Hughes & al in [1] was to base the discretization of the unknowns in the FEM on basis functions usually used for geometric description. Until now this method has been applied in many contexts in fluid, solid and structural mechanics. The key issue for simulation is to have a convenient computational tool that enables the engineer/researcher to develop a fast and accurate solutions. Today, from both, a practical and industrial point of view, the question remaining is the application of isogeometric analysis in the context of complex coupled physics in computational mechanics, e.g. at large strains for strongly nonlinear material. The second aspect is the implementation of these complex structures. During the recent 50's, the developments of FEM (including material models, problem formulation and resolution algorithms, etc.), numerous reliable and efficient tools where developed in the industry and academic researches. In the 90's object-

oriented programming has proven its capability to deal with complexity. It brought modularity to codes and enabled the programmer fast extendibility and maintenance. We propose an original implementation of the IGA based on the object Field describe in [2]. From a mathematical point of view, the basic variational framework of IGA and FEM are similar. The design of stable combinations of interpolation for different fields in the context of coupled multiphysics is an important issue for IGA such as e.g. incompressibility, mixed character of formulations… In this contribution, we address first, some theoretical results involving mixed formulations for incompressible material, and second, an object-oriented design of IGA that enables us to take into account stable NURBS/BSpline interpolation choices for mixed formulation in the context of incompressible media and thermomechanics.

The curing of stability problems for IGA formulations in the context of incompressibility and mixed thermal and mechanical problem is not straightforward. In FEM, various strategies have been used for incompressible material: selective reduced integration, B-Bar approach, 2-fields or 3-fields mixed formulations, stabilized Galerkin Least-Squares methods… For IGA, similar ideas can be developed (see [2] for a state of the art). Here, we studied a class of mixed formulations displacement-pressure that have the advantage to be extended to thermomechanical formulations. We have proposed solution to deal with incompressibility based on varying the inter-element continuity into the patch, and using subdivision schemes for displacements fields. This study has been held at small and large strains. Similar strategies have been developed in the context of thermoelasticity.
From the implementation point of view, the variational framework is similar to the FEM. The main problems for the integration of IGA and FEM in the same framework remains the fact that the discretization is encompassed into the definition of the geometry whereas in the FEM the discretization is defined on the element coming from the decomposition of the domain. In general, in classical approaches in these both concepts are considered at different level in the software architecture.

From a theoretical point of view, we have proven numerical stability of IGA mixed formulations at small and large strains. Stability is achieved through the use of either inter-element continuity or using subdivision schemes for displacements. Convergences tests and numerical inf-sup condition verifications in various situations are shown. Similar tests are held for 2-Fields displacements-temperature. This offers a preliminary framework for multiphysics problems.
From object oriented programming point of view, the isogeometric Galerkin method's implementation has very limited difference from the traditional finite element method. Therefore, in this section, we demonstrate that it is straightforward to integrate IGA to the previously introduced code FEMJava which is initially designed for FEM. The main differences between IGA and FEM implementation in the framework of FEMJava lie in the data structure of discretization and the field creation basing on discretized mesh. The FEM has two spaces: physical space where the problem is defined and the reference space in which the shape function and numerical integration are evaluated. But for NURBS based isogeometric Galerkin method, we need a third parametric space between the reference space and physical space. The isoparametric basis functions stay in this parametric space. The FEMJava framework's multiple levels (geometry, mesh and field) data structure, and its OOP characteristics (encapsulation, inheritance and polymorphism) make it possible to bridge the divides without radical changes in code architecture.

In this paper, we propose stable IGA mixed formulations for incompressible or quasi-incompressible material and for mixed displacement-temperature formulations. An original and general and seamless object model including FEM and IGA is proposed.

Strain control of engineering band structures of graphene nanoribbons

Roderick Melnik, *Wilfrid Laurier University, Canada*

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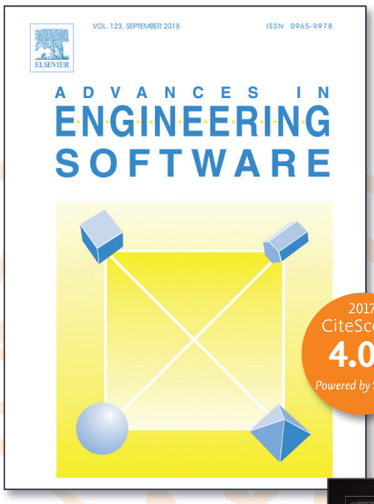

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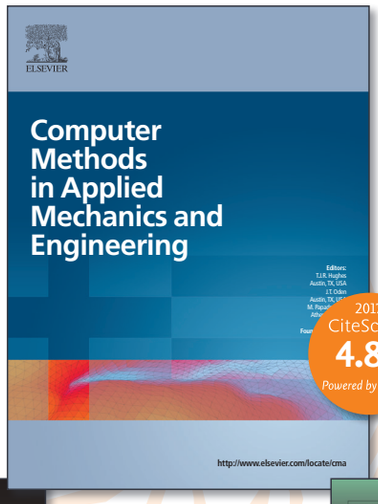

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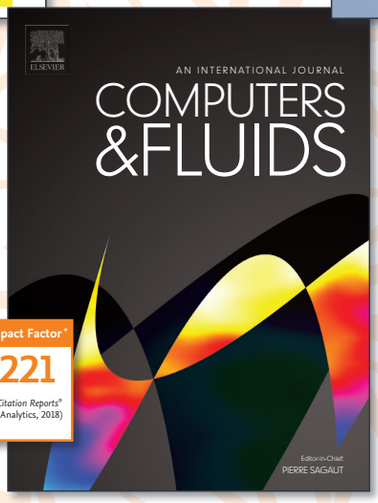

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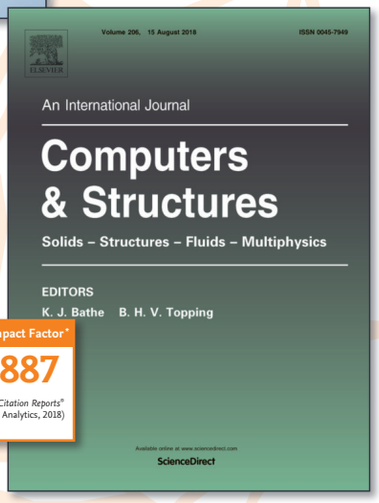

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