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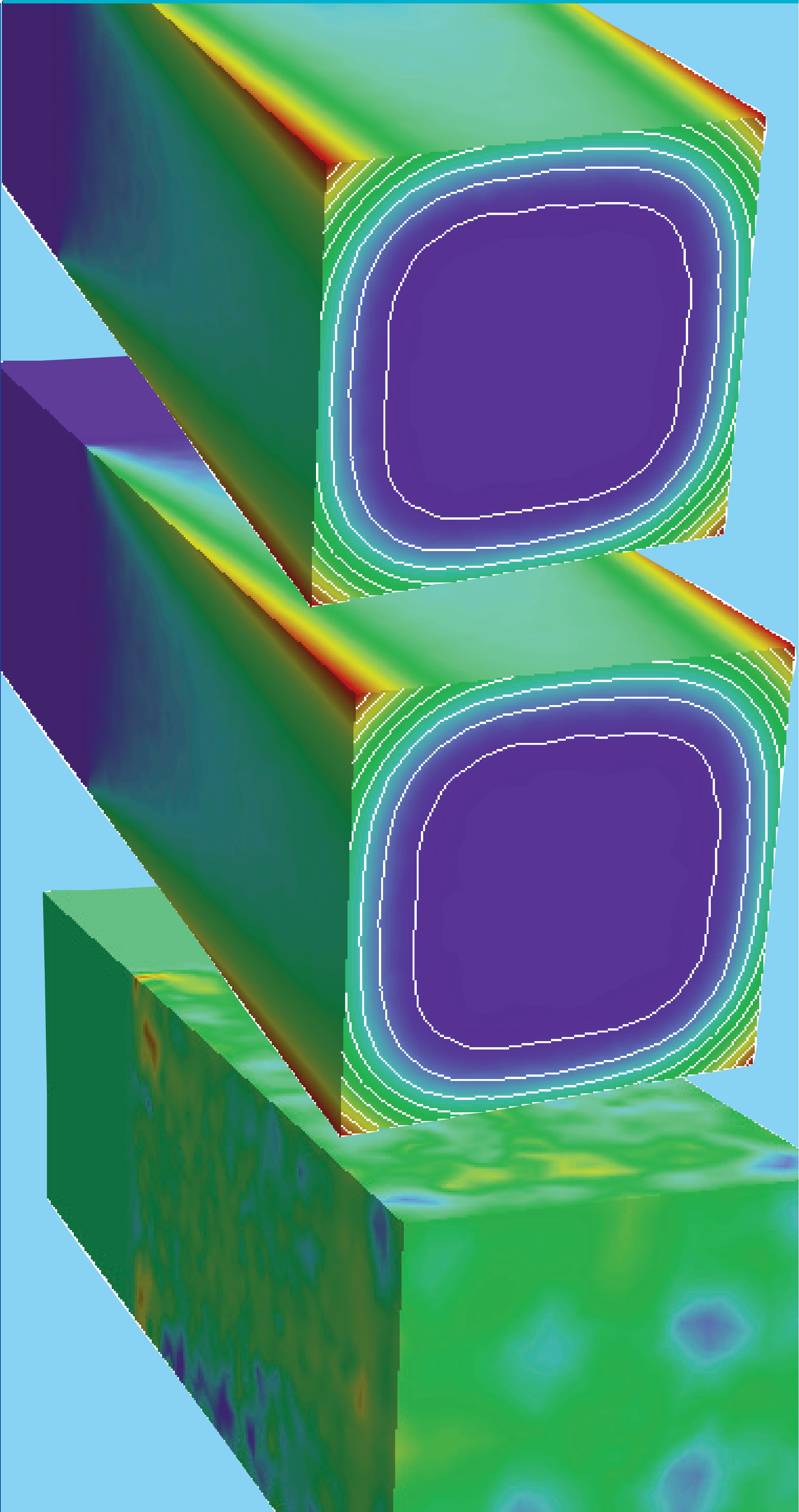

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editorial

The name Computational Mechanics was initially chosen in the early 1980´s to encompass a wide number of scientific and technological fields to which the application of numerical methods is of interest. The first article of the IACM Constitution states that "the International Association for Computational Mechanics comprises Mechanical, Civil, Aeronautic, Space, Naval, Biomedical, Chemical and Electrical Engineering and Material Sciences among other scientific and technical fields". To this long list we should clearly add today the areas of Food Engineering and Information and Communication Technologies (ICT), in the broad sense.

As many of the fundamentals of Computational Mechanics have become mature over the years the activities of many members of our community have shifted towards the application of existing computational methods for solving specific problems in each of the fields listed above. In many cases, numerical methods that are good for solving "academic" problems involving a few thousand unknowns are not suited for the analysis of real life situations that typically have millions, and even billions, of unknowns. The need for fast solutions of large practical problems requires reduced order model techniques, high performance computing (HPC) algorithms and codes using parallel computers and data mining techniques for handling the huge data sets efficiency at pre and post-processing level. All this together with the new storage and distributed computing facilities that the "cloud" is already offering.

Virtual reality (VR), on the other hand, introduces another possibility for bringing Computational Mechanics tools closer to the interests of the final users, either for academic or practical purposes. Coupling VR with numerical methods poses new challenges for more efficient and accurate HPC solvers. All this is evidences that the link of Computational Mechanics and ICT procedures is getting narrower, which opens many opportunities for developers and users.

This issue of Expressions tackles several of these topics. The three featured articles deal with important problems in very different fields of practical interest: topology optimization techniques for rigid-body mechanisms, computational transport oncophysics and the use of VR technology for noise evaluation. These three problems share a common need for solid mathematical models and efficient computational methods to reach useful solutions of practical interest. On the other hand, the book on reduced order modeling reviewed in this issue offers a timely introduction to this important field that aims to drastically bring down the cost of practical computation using a reduced set of unknowns.

The 12th World Congress on Computational Mechanics (WCCM XII) and the 6th Asia-Pacific Congress on Computational Mechanics (APCOM VI) took place in Seoul, Korea, on 24 – 29 July 2016. The joint event was very successful and attracted over 2000 participants from many different countries worldwide. I express my congratulation to the organizers for this success.

As in every odd year, a number of specialized events on different topics in Computational Mechanics will be held over the world in 2017. Some 45 international conferences are scheduled to take place in the five continents under the initiative of the IACM via its regional associations. We highlight the 35 Thematic Conferences promoted by the European Community for Computational Methods in Applied Sciences (ECCOMAS). All together these specialized conferences are a great initiative that anticipates a very interesting year for the scientific and engineering community. Please check the web pages of the IACM and its regional organizations for the details of these events.

The WCCM XII and XIV of the IACM will be held respectively in New York and Paris in 2018 and 2020. You can also check the IACM web page for the details. Good luck to the organizers of the large and the smaller IACM events.

Eugenio Oñate
Editor of IACM Expressions

Numerical Synthesis of Rigid-body Mechanisms by Topology Optimization

by
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A mechanism is a mechanical device to transform an input actuation motion into a desired motion at its end-effector. This article presents recent advances made for the numerical synthesis of rigid-body mechanisms by topology optimization after reviewing technical issues and difficulties appearing in the synthesis. Some demonstrative examples including the synthesis of automobile suspension mechanisms are also presented.

Introduction

The topology optimization method proposed for structural design about three decades ago [1] has now reached a level that several commercial software programs are available and many successful industrial applications are reported. Besides structural applications, the method has been used to design various coupled systems (see, e.g., [2]) and even to create artistic images [3]. Here, we consider the topology optimization of rigid-body mechanisms, which can serve as “design intelligence” for rigid-body mechanism synthesis. This article discusses a recent progress made towards the synthesis of rigid-body linkage mechanisms by a topology optimization and presents some design examples including the synthesis of an automobile suspension system.

> *“ Mechanism synthesis by topology optimization could offer new insight to design engineers. ”*

Problem definition and modeling

The left illustration in *Fig. 1* schematically describes the problem definition for mechanism synthesis by topology optimization. A design domain (the rectangular region in the illustration) is given, in which a mechanism to transform a given input motion into a desired output motion at its end effector is to be synthesized. No initial mechanism layout is given, but the application of a topology optimization method should be able to identify a mechanism such as the four-bar linkage shown in the right side of *Fig. 1.* Because topology optimization based synthesis should proceed without a specific baseline linkage layout, a model that can represent various mechanism configurations should be developed. One can discretize the design domain into a number of nonlinear elastic bars connected by revolute joints at their common nodes [4-6] as illustrated in *Fig. 2(a),* or into a number of rigid blocks that are connected by zero-length elastic springs [7,8] as depicted in *Fig. 2(b).* Other approaches are also possible [9-11]. The skeleton that fills the design domain is usually called the ground structure. The density design variables assigned to the bars express their existences, which determine mechanism layout as shown in *Fig. 3(a).* In the alternative model shown in Fig. 3(b), the spring stiffness design values determine block connectivity, i.e., the mechanism layout. We certainly prefer using continuous design variables in order to utilize

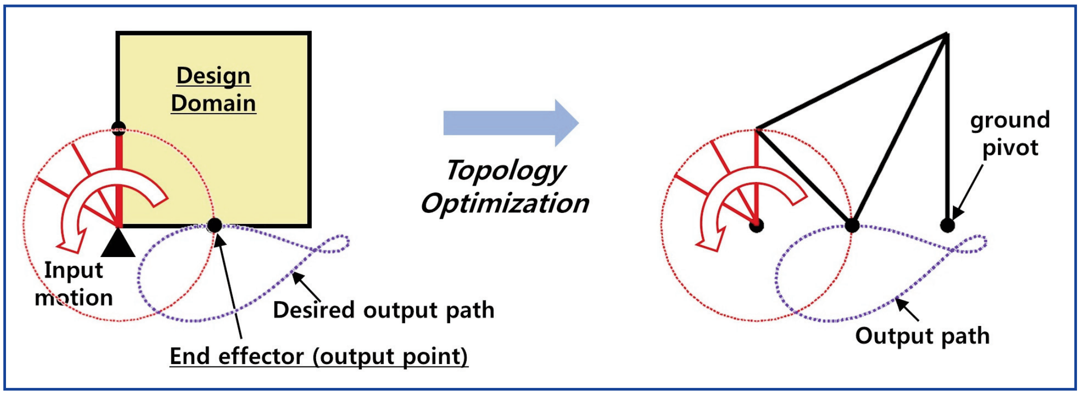

Figure 1: *Problem definition and a synthesized result by the topology optimization of rigid-body mechanisms*

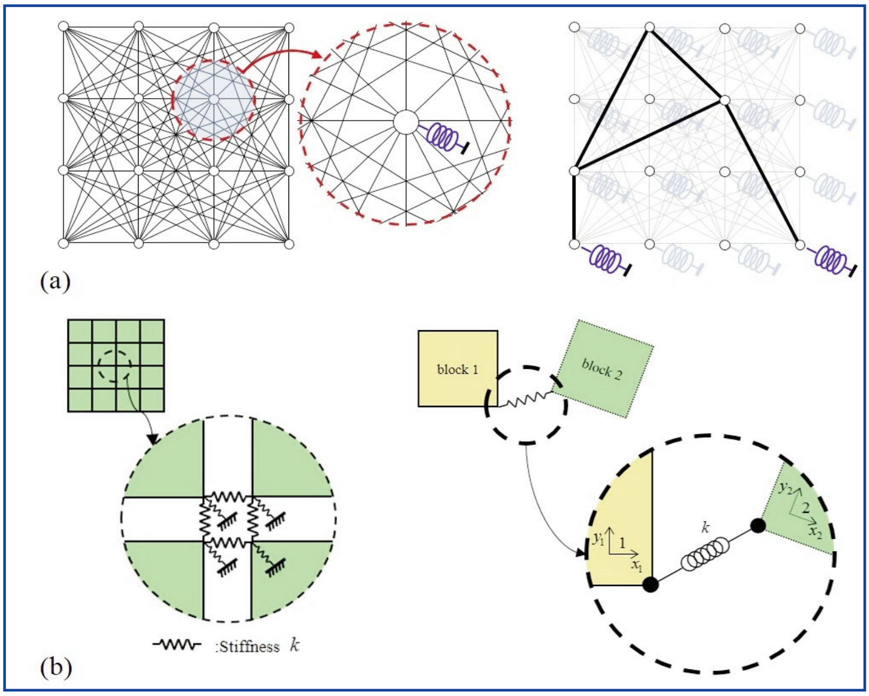

Figure 2: Design domain discretization by (a) a number of nonlinear bars connected by revolute joints (Reprinted with permission from [12], copyright 2017 Springer Fachmedien Wiesbaden) or (b) a number of rigid blocks connected by zero-length springs (Reprinted with permission from [14], Elsevier BV, 2016)

an efficient gradient-based optimizer. The variables ought to reach their upper or lower bounds; otherwise, real rigid-body mechanisms cannot be identified. When the topology optimization approach is used to synthesize a three-dimensional automobile suspension [12,13], the model in *Fig. 4(a)* can be employed where the three-dimensional space between a tire in *Fig. 4(a)* and an automobile frame (not shown) is discretized by nonlinear spatial elastic bars connected by spherical joints. *Fig. 4(b)* illustrates how a double wishbone suspension can be modeled by the model in *Fig. 4(a).*

Using the models shown in *Fig. 2* or *Fig. 4(a)*, one can set up a topology optimization problem to find a linkage mechanism that transforms a given input motion into a desired output motion. One of the main difficulties, especially for the mechanism synthesis by continuous variable based topology optimization methods, is to satisfy the exact (rigid-body) degree of freedom (DOF) of a mechanism to be synthesized because DOF is intrinsically discrete. To resolve this difficulty, various ideas have been suggested; the work-transmittance efficiency function based formulation [6] so far appears to be most effective. In this formulation, the objective function to be maximized is the efficiency function that measures how much input energy is converted to the output energy through an end-effector, while the condition to trace the desired output path is treated as constraint equations.

Design examples

As a design example, we consider the synthesis of a steering mechanism of an automobile. *Fig. 5(a)* sketches the desired motions of two front tires. The relation between the tire rotation angles is given by the Ackermann condition.

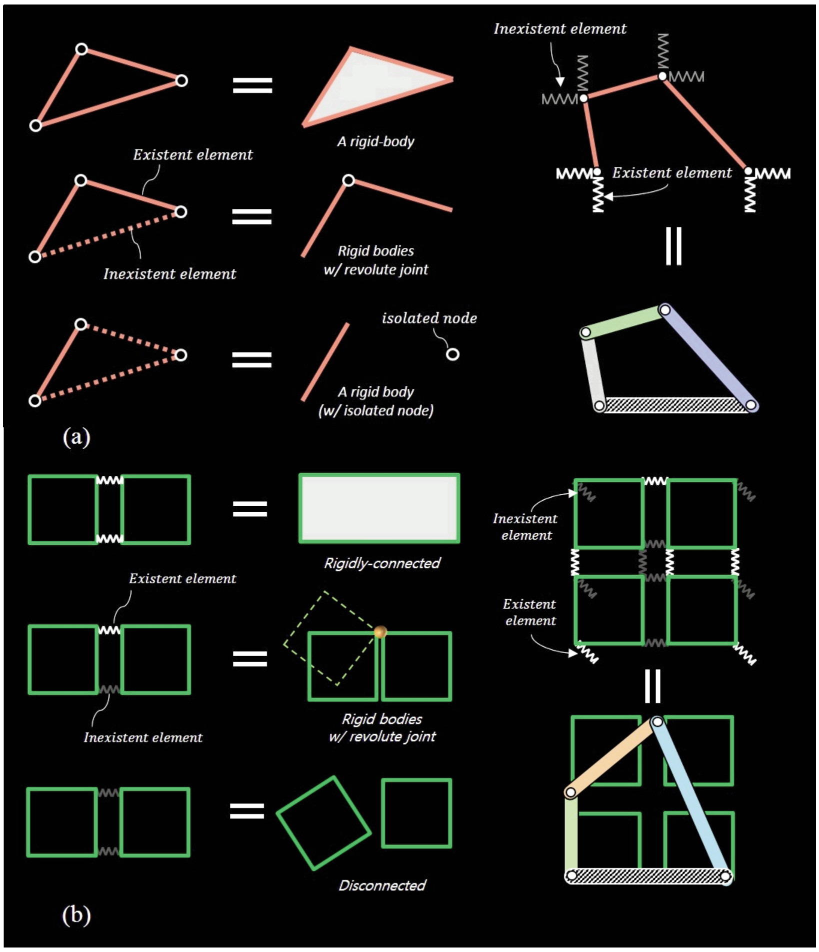

Figure 3: Representation of various joint connections by (a) the nonlinear bar model (Reprinted with permission from [12], copyright 2017 Springer Fachmedien Wiesbaden) and (b) the spring-connected rigid block model

Figure 4.a:
Three-dimensional ground structure formed by nonlinear bars for the synthesis of automobile suspension mechanisms.
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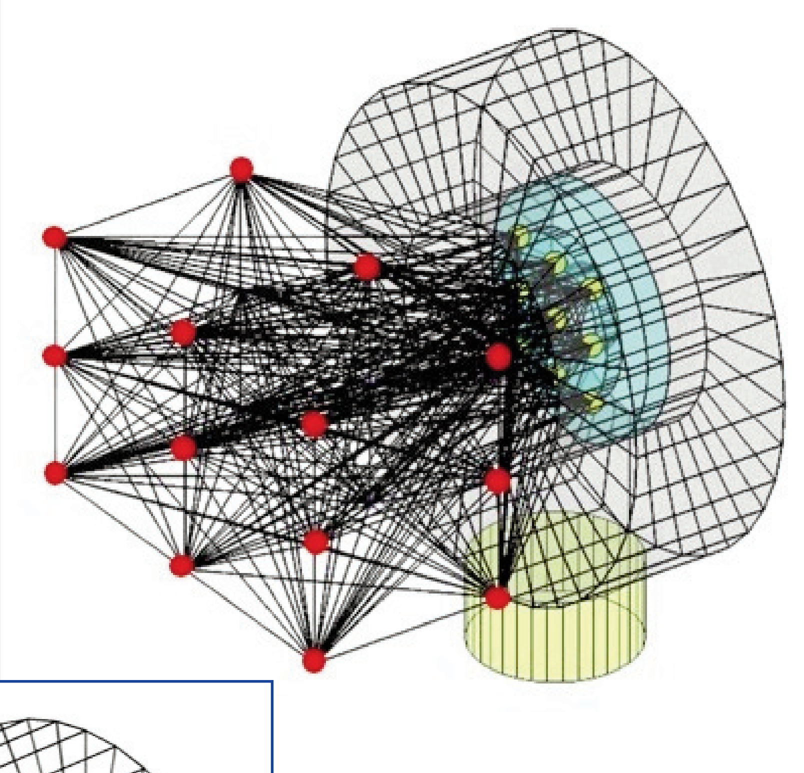

Figure 4.b:
A suspension mechanism realized by the ground structure model in Fig. 4(a).
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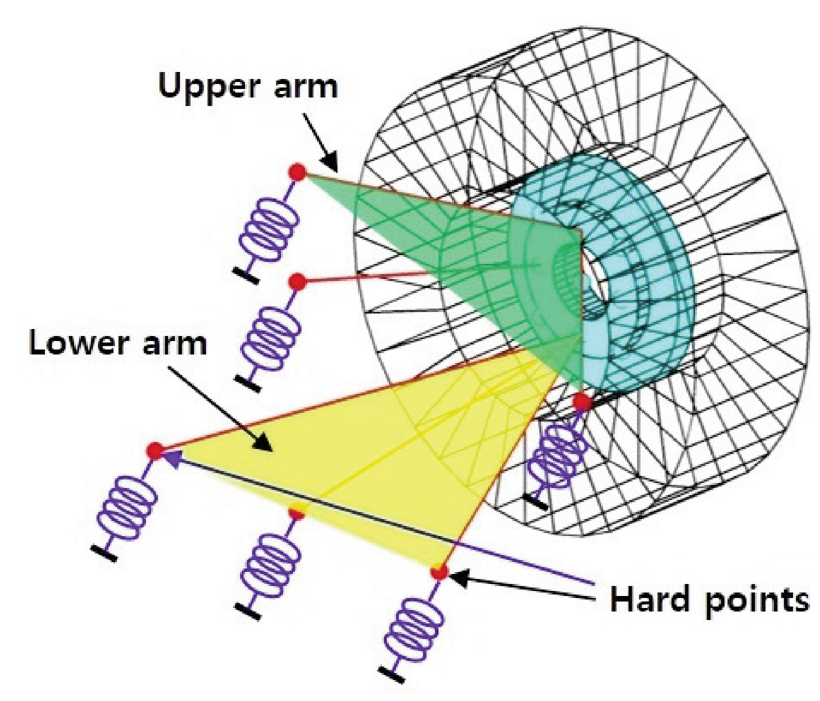

We aim to find a steering mechanism to produce the desired tire motions by the topology optimization method [6]. The design domain between two front tires is discretized by a 6 x 3 or a 7 x 3 ground structure. *Fig. 5(b)* shows how mechanism layouts evolve during topology optimization iterations. Since there is no mass constraint used for the formulation, some redundant elements that do not participate in the motion generation of a mechanism may also appear. Therefore, they are eliminated by a post-processing technique [6].

The second example is to synthesize a suspension mechanism of an automobile. The ground structure is depicted in *Fig. 4(a)*. Although new suspension mechanisms different from conventional suspensions such as double wishbone suspensions may be obtained[1], we here present the synthesis of a known suspension mechanism for a given set of ride and handling related requirements. Specifically, we check if the work-transmittance efficiency function based

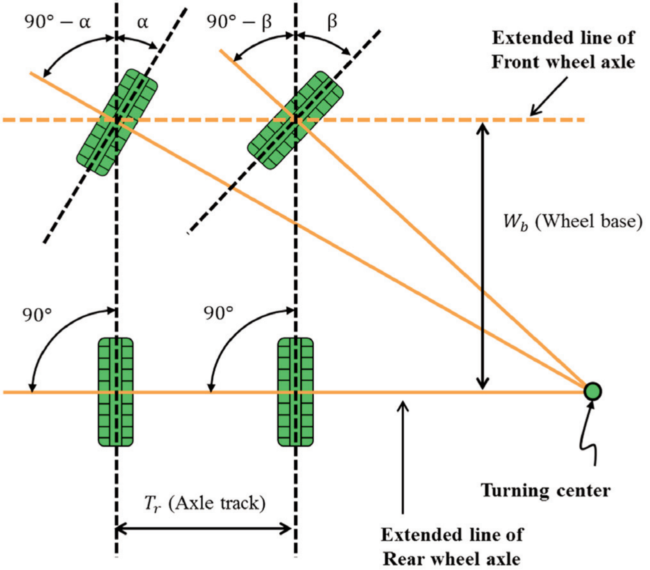

Figure 5.a:
Schematic illustration of the Ackermann condition
(Four tires and wheel axles are indicated in the figure).
(Reprinted with permission from [6], copyright 2014 John Wiley & Sons, Ltd.)

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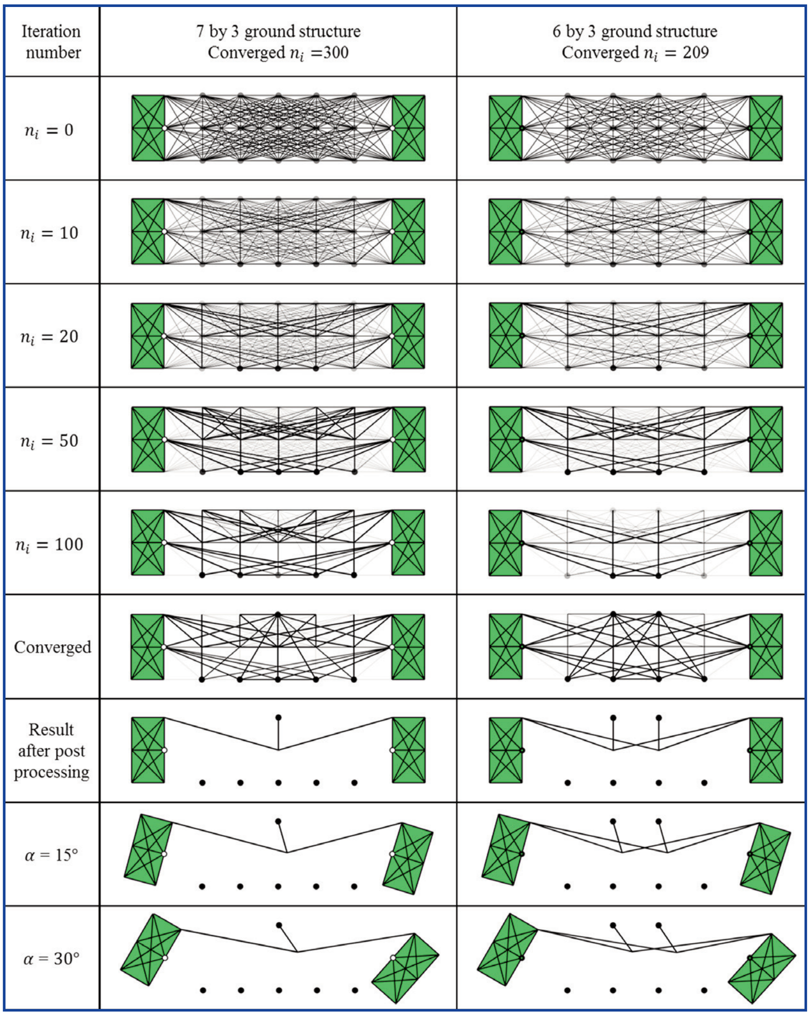
[1] *We were able to obtain a new type of suspension mechanisms with Hyundai motors by the method described here. Due to the intellectual property issue, they are not included here.*

Figure 5.b:
Intermediate and final layouts for the synthesis of steering systems that satisfy the Ackermann condition. (n_i : iteration number).
(Reprinted with permission from [6], copyright 2014 John Wiley & Sons, Ltd.)



formulation can successfully find the mechanism used to produce the target wheel trajectory and orientation angles when the bound and rebound strokes of its wheel are given. The target suspension mechanism is a 5-link suspension mechanism, which is widely used in luxury sedans. *Fig. 6* shows how our method yields the desired 5-link mechanism. It was confirmed that after eliminating redundant bar elements by the post-processing algorithm, the desired mechanism was obtained.

So far, the synthesis examples introduced above consider mechanisms that involve revolute (spherical) joints. Then, one may wonder if mechanisms that have general joints other than revolute (spherical) joints can be synthesized. Clearly, the bar-based ground structure models shown in *Fig. 2(a)* and *Fig. 4(a)* may not be used in this case because they are connected only by revolute (spherical) joints.

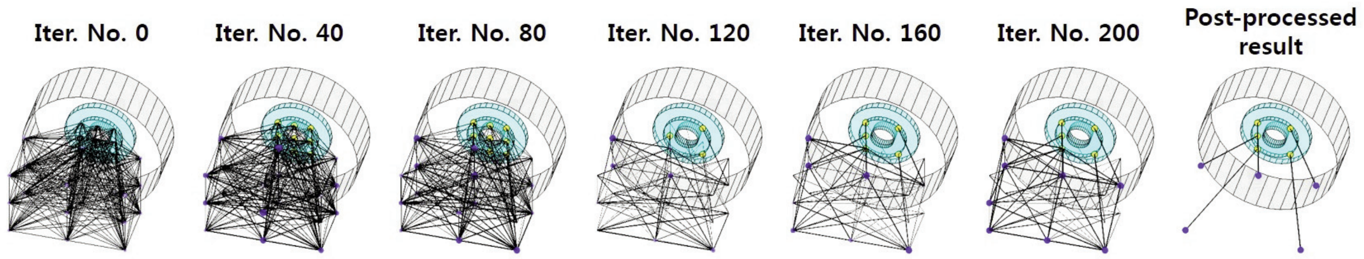


Figure 6:
Iteration history to synthesize a 5-link suspension mechanism by the topology optimization method of rigid-body mechanisms.
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So, we use the model in *Fig. 2(b),* more precisely, its extended version developed in [14]. Although we leave out a detailed description of this model, we emphasize that this new model can directly control the joint type. Therefore, the method can synthesize revolute, prismatic and other joints. *Fig. 7* shows a slider-crank mechanism that involves a prismatic joint in addition to

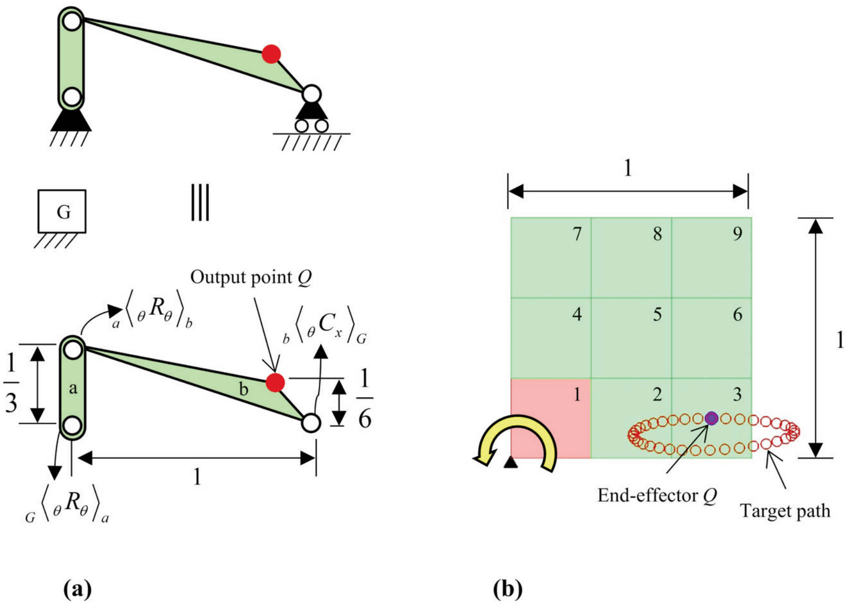
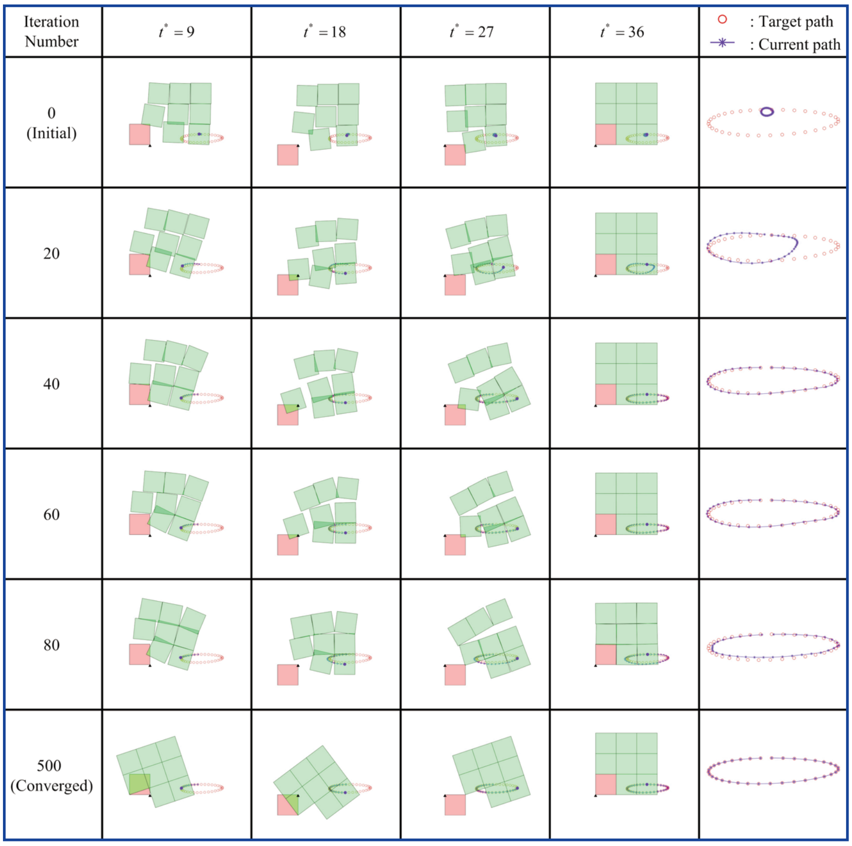


Figure 7:
Slider-crank mechanism synthesis problem. (a) The reference linkage mechanism that generates the target path at the output point. (b) Design domain discretization with the illustration of the target path of the end-effector.
(Reprinted with permission from [14], Elsevier BV, 2016)

revolute joints. *Fig. 8* depicts how the desired slide-crank mechanism is synthesized when a block model (similar to the one in *Fig. 2(b)*) is used.

Figure 8:
Output paths and configurations of the intermediate and final spring-connected rigid block models for the slider-crank mechanism synthesis problem defined in Fig. 7
(Reprinted with permission from [14], Elsevier BV, 2016)



Conclusions

Mechanism synthesis by topology optimization could offer new insight to design engineers. It could serve as "design intelligence" to synthesize rigid-body mechanisms needed in automobiles and robots. There still remain many issues to be further resolved before the mechanism synthesis method is widely used in industry, but the progress being made is very promising and new exciting results are expected to come.

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> *" ... the progress being made is very promising and new exciting results are expected ... "*

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Computational Transport Oncophysics

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> *"… allow for a better understanding of tumor growth and therapeutic efficacy of anticancer drugs…"*

Transport Oncophysics

Cancer is an extraordinarily complex disease. It is now recognized that methods commonly used in physics can help reducing the complexity of cancer to a manageable set of underlying principles and phenomena [1, 2]. Physical properties of biological barriers control cell, particle, and molecule transport across tissues and this transport and its deregulation play an overarching role in cancer physics. According to [1], tissue invasion can be seen as mass transport deregulation at the interface between the cell and the microenvironment; metastasis is a deregulation of local and distant cellular transport at the scale of the organism; tumor-associated angiogenesis completely alters mass and fluid exchange across the microcirculation; alterations in the signaling pathways that accompany the evasion of apoptosis, growth signal dependence and growth inhibitory messages from the immediate environment are also disruptions in molecular transport since molecular signaling depends directly on the transport of signaling molecules. Transport aspects further control delivery of therapeutic agents (e.g. chemotherapeutics or molecularly targeted therapeutics such as T cells, antibodies, particles) which must pass through different and heterogeneous tumor and healthy compartments (e.g. vascular, stroma) with distinct physical properties [3, 4]. Delivery of drugs is an extremely complex procedure involving different spatial and temporal scales and taking place over several levels ranging from the organism to the intercellular environment. The underlying transport phenomena at individual tumor compartments may act as transport barriers possibly contributing to poor survival rates in cancer therapy [5]. The Mononuclear Phagocyte System (MPS) belongs to these barriers, removing foreign substances from the body such as Nano Particles (NP) in the blood plasma. A second obstacle is given by the tumor neovasculature, which is tortuous, distorted and shows large fenestrations, leading to poor perfusion of the tumor tissue, chaotic blood flow and uneven supply of nutrients [6]. However these fenestrations allow also for the Enhanced Permeability and Retention Effect (EPR) discovered by Matsumura and Maeda [7] and Maeda et al. [8] representing a potential for increased accumulation of long-circulating macromolecules and NP by extravasation through fenestrated blood vessels in the tumor. The EPR effect may still be hindered because of the altered gradients of the interstitial fluid pressure in the local tumor environment. Further the limited drainage of the interstitial fluid linked to the extensive fibrosis and dense extracellular matrix of the tumor brings about pressure rises reducing the extravasation of therapeutic molecules through advection [9]. Hence poor perfusion in the local tumor environment hinders diffusion of therapeutic agents in the interstitium of the extracellular matrix and affects ultimately the cellular uptake of NP [10]. This uptake occurs generally through endocytosis; only successively the payload of the NP may be released into the cytoplasm. The concept of biological barriers and their effect on transport has brought a new understanding of how transport can modulate cancer biology and therapeutic efficacy [2]. Several studies [11-14] have in fact confirmed that transport plays a crucial role in cancer and drug delivery, including resistance [1, 3, 15-17]. **Transport Oncophysics** views hence cancer as a disease of multiscale mass transport deregulation involving biological barriers [1]. **Computational Transport Oncophysics** provides the computational tools which, together with imaging, analysis and quantification, will contribute to rationalize the delivery of therapeutic agents forming an oncophysical modeling framework. This framework should complement classical tools used to study pharmacokinetic (PK) and efficacy relations, and create novel precision tools to rationally tailor individual treatments of patients. The computational tool for evaluating drug efficiency should comprise a tumor growth model within the local tumor environment, coupled with a patient specific biodistribution model.

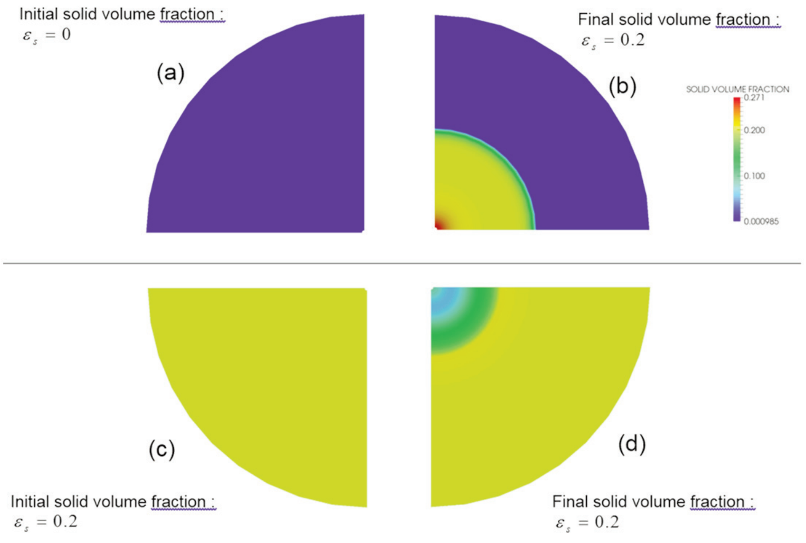
Tumor growth model and its solution

We concentrate here on tumor growth models. Such models involve tumor cells, both viable and necrotic, healthy cells, extracellular matrix (ECM), interstitial fluid, neovasculature and co-opted blood vessels, nutrients, signaling factors, waste products, and their interaction and evolution. There are many models available, often based on simplifying assumptions. Several of the above mentioned components may be neglected resulting in different types of models comprised of diffusion, single phase flow, and multiphase flow with or without a solid phase. More recent models are discussed in Roose et al. [18], Lowengrub et al. [19], Deisboeck et al. [20] and Sciumè et al. [21] and three major classes can be found: discrete, continuum, and hybrid models. Discrete models follow the fate of a single cell, or a cohort of cells, over time. As such, they cannot capture aspects of tissue mechanics, nor are the modeled subdomains representative of the whole tumor. However, discrete models explain cell-to-cell cross signaling and cell response to therapeutic molecules (Perfahl et al. [22]). On the other hand, continuum models describe cancerous tissues as domains composed of multiple fluid and solid phases interacting one with the other. Differential equations based on conservation laws and thermodynamics describe the spatiotemporal evolution of the system, but no direct information is provided at the single cell level.

Finally, hybrid models incorporate different aspects of discrete and continuum models, depending on the problem of interest. For instance they may represent cells individually; but interstitial fluid is modeled as a continuum. Within the continuum models we encounter solid-fluid models where the extracellular matrix is lumped with the cells and the fluid is the interstitial one (Ehlers et al. [23], Mascheroni et al. [24]), and multiphase flow models possibly in a deforming porous medium (ECM), see e.g. Oden et al. [25]. Among this last class we have developed a very general multiphase flow model in an extracellular matrix (ECM), dealt with as a deforming porous solid which may undergo remodeling; it comprises three fluid phases, i.e. tumor cells (TCs), divided into living and necrotic cells, healthy cells (HCs) and interstitial fluid (IF) [25-31]. The IF transports chemical species such as tumor angiogenic factor (TAF), nutrients and therapeutic agents. Transport of these species within extravascular space takes place by convection and diffusion. Coopted blood vessels are included as line elements with blood flow exchanging nutrients and therapeutic agents with the IF. Angiogenesis is represented by the blood vessel density (density of newly created endothelial cells). The model accounts not only for growth and necrosis [26, 29] but also for migration of cells through the ECM [30], for different stiffness of the cell population with respect to the ECM, build-up of cortical tension between healthy and tumor tissues and possible invasion of the tumor tissue by the healthy tissue or vice versa, mediated by these cortical tensions [27, 28]. Further it allows for modeling lysis and connected lymphatic outflow from the tumor [30], adhesion of the cells to their ECMs as well as adhesion among cells (through the dynamic viscosity) and possible detachment.

The model comprises the mass balance equations of the ECM, the tumor cells, healthy cells and interstitial fluid, the diffusion-advection equations of all transported species, the linear momentum balance equations of the phases, including the solid one and the necessary constitutive equations [30, 31]. The ECM is Green-elastic or elasto-visco-plastic. The weak form of the balance equations is obtained by means of the standard Galerkin procedure and is then discretized in space by means of the Finite Element Method. Integration in the time domain is carried out by the Finite Difference Method adopting the θ-Wilson method. Within

Figure 1:
Solid volume fraction distribution at initial (a) and final (b) stage of a MTS growing in a ECM deposited by TCs and solid volume fraction distribution at initial (c) and final (d) stage of a MTS growing in a remodeling ECM scaffold.
Redrawn with permission from Santagiuliana et al. 2015



each time step the equations are linearized by the Newton–Raphson method. The system of equations has been introduced in the 3D finite elements code CAST3M (http://www-cast3m.cea.fr) of the French Atomic Energy Commission. A staggered scheme is adopted with iterations within each time step to preserve the coupled nature of the system. Three numerical units are used, one for the transported species, another for the pressures of the cell populations and the interstitial fluid and the third one for the solid matrix.
The model has been extensively validated with respect to experiments either from literature or carried out at the Houston Methodist Research Institute.

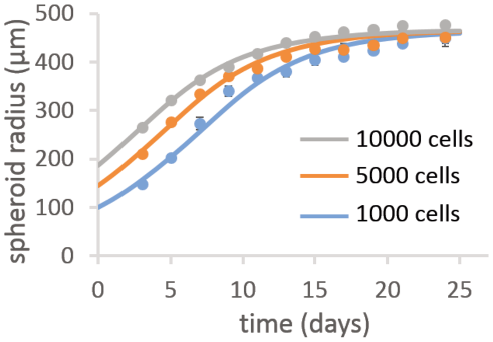


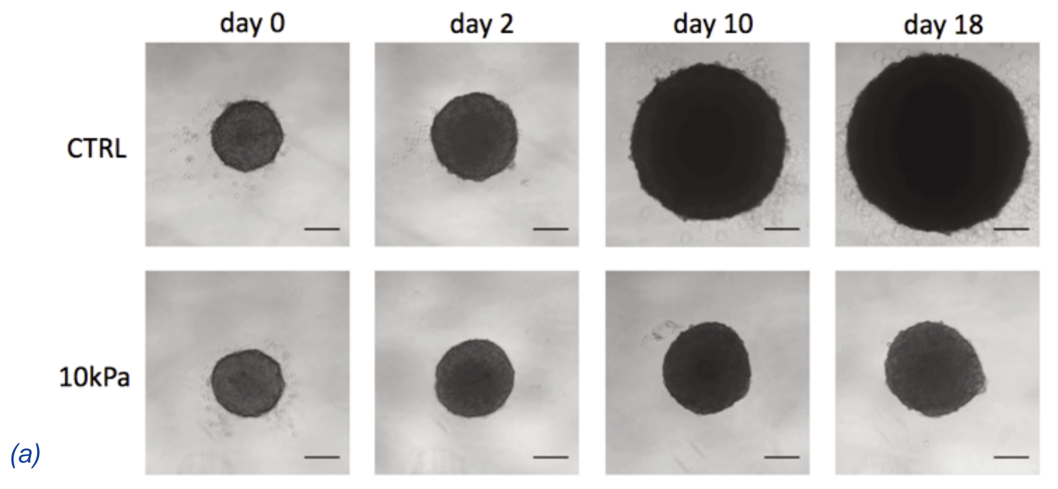
Figure 2:
Growth curves recorded from the free growth experiments. Each curve represents a different initial condition in terms of seeded cells. In the experiment N ≥ 4 spheroids are considered for each condition. Points are experimental data, and error bars are the standard deviations of the measurements; solid lines are the results of fits with the mathematical model. Redrawn with permission from Mascheroni et al. 2016

Applications

We show now a few applications. The first case deals with a Multicellular Tumor Spheroid growing *in vitro* and *ex vivo* [30]. In vitro the tumor cells deposit their own ECM since it is not present in the culture medium while in the ex vivo case the tumor cells are seeded in a de-cellularized ECM to mimic the in vivo environment. This has been carried out successfully by Mishra et al. [32] for an ex vivo 3D lung model where it was possible to grow perfusable lung nodules. *Figure 1* shows the evolution of the solid volume fraction; on the top is the case of ECM deposited by TCs and at the bottom for the case of a remodeling ECM scaffold. In the first case the initial solid volume fraction is 0 because there is no solid phase. At the final stage the solid volume fraction differs from 0 in the zone where the TCs have grown and have deposited their ECM.
In the second case the initial and final average solid volume fraction is fixed at 0.2 because the ECM scaffold is always present (de-cellularized matrix). The case of total absence of ECM gives an intermediate answer. This situation could also be used for modeling liquid tumors.

In the second example a reduced computational model is validated against data from tumor spheroid cultures [24]. U87-MG cells, a human glioblastoma cell line, are cultured with a standard protocol [24]. Cells are seeded at different initial numbers (1000, 5000, 10,000) and rapidly form spheroids suspended in standard culture medium. The evolution of the spheroid radii is then recorded over time via optical microscopy and the results are shown in *Figure 2* where points are experimental data, and error bars are the standard deviations of the measurements. The solid lines in *Figure 2* are the results of fits with the mathematical model.
The model reproduces the same behavior of the experiments with the steady state being reached after 2 days from cell seeding. As the spheroids grow freely in the culture medium, the only mechanism to stop cell proliferation is nutrient deprivation which appears sufficient to explain the growth saturation and the existence of an asymptotic radius for the spheroid. The application of a constant mechanical stress on the surface of the growing spheroids is then investigated. Dextran is added to the cell culture medium producing an osmotic pressure on the outermost layer of cells located on the spheroid surface. Three pressure conditions are explored following the approach described in [24] namely 1, 5, and 10 kPa, plus a control experiment with no external pressure. The growth of the spheroids is followed for 18 days after the addition of Dextran. *Figure 3a* shows optical images of sample spheroids referring to the control and to the most compressed condition for different time instants. The comparison between experimental data and numerical values are shown in *Figure 3b.* Points with error bars are experimental values while the solid lines are the results of fits with the mathematical model. As shown by yet unpublished results in silico, compression hinders also the uptake of therapeutic substances.

As last example we show melanoma growth with angiogenesis [31]. The endothelial cell density is assumed proportional to the density of new vessels. It is recalled that the outer structure of skin is layered and three compartments can be evidenced: the epidermis, an outer



Scalebar: 200µm, initial seeding: 5000 U87-MG cells

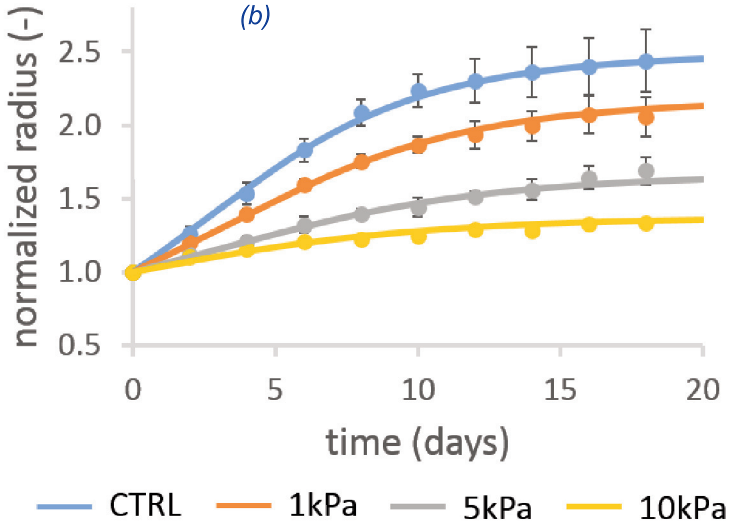


Figure 3:
a) Optical images of U-87 MG spheroids grown under the effect of the Dextran solutions. The first row shows the control experiments and the second row a spheroid under the highest compression. The scale bar is 200 µm, and the initial seeding is 5000 tumor cells.
b) Experimental results for the compression experiments. The points are the experimental data, and the error bars represent the standard deviations of the measurements. For each condition, N = 5 spheroids are considered.
Redrawn with permission from Mascheroni et al. 2016

epithelium of stratified cells; the dermis, an intermediate cushion of vascularized connective tissue; and the hypodermis, the lowermost layer made of loose tissue and adipose cells [33].

The dermis is separated from the epidermis by the basement membrane or basal laminae, a tough sheet of ECM. Two well defined clinical stages characterize the progression of a melanoma: first there is radial expansion in the epidermis; then the tumor may switch to vertical growth penetrating the basement membrane. Angiogenesis occurs during this penetration. The blood vessel is here assumed at the base of the dermis as shown in *Figure 4* which depicts the simulated domain. *Figure 5* shows the resulting volume fractions of TCs after 10 and 20 days. At the beginning the growing TCs deform the ECM and create a ‘hill’ on the skin surface [31].

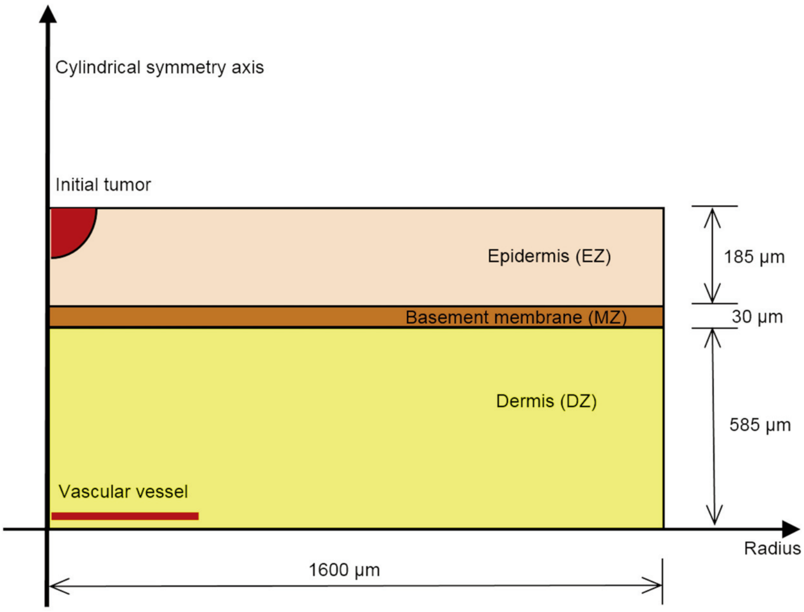


Figure 4:
Skin structure and geometry of the modeled case.
Redrawn with permission from Santagiuliana et al. 2016

Once the base membrane is reached, the growth pattern changes into a more complex configuration. TCs consume oxygen due to growth and to their metabolism. Oxygen consumption leads to a decrease of its mass fraction in the tumor area depicted in *Figure 6*. In the central zone of the tumor, necrosis appears. The living tumor cells, before necrotizing, are in hypoxia when the mass fraction of the oxygen is not sufficient for their life. Living tumor cells in hypoxia produce the tumor angiogenic factor (TAF) that diffuses into the domain. *Figure 7* shows this diffusion after 10 and 20 days. The ensuing diffusion of endothelial cells up the chemotactic and haptotactic gradients is depicted in *Figure 8*. After 10 days the distribution of the mass fraction of the endothelial cells evidences a higher concentration near the tumor, where the TAF concentration is larger. This behavior is highlighted in the drawing for 20 days.

Conclusions

The tumor growth model has been extensively validated. It is now being coupled with biodistribution models of the groups of M. Kojic [34] and W. Wall [35-37] to simulate growth of tumors and transport in patient specific vasculature in a unique computational tool. This will allow to investigate different numerical approaches to the global solution of this rather complicated problem. The aim of the integrated computational tool will be to predict the biological distribution of therapeutic agents in tumors following their systemic injection, tumor growth, and herapeutic response. Together with imaging, and quantification of in vivo studies this will allow for a better understanding of tumor growth and therapeutic efficacy of anticancer drugs.

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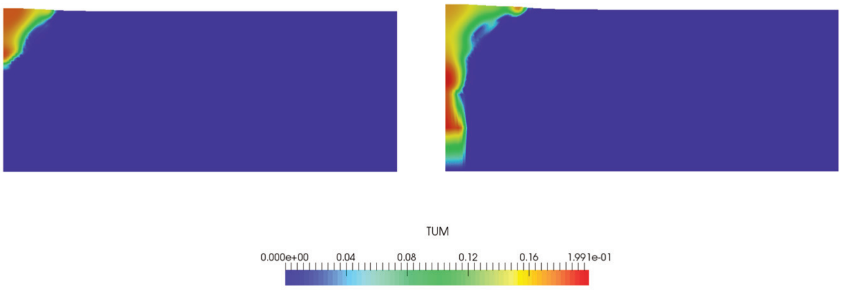

Figure 5:
Volume fractions of TCs
after 10 and 20 days.
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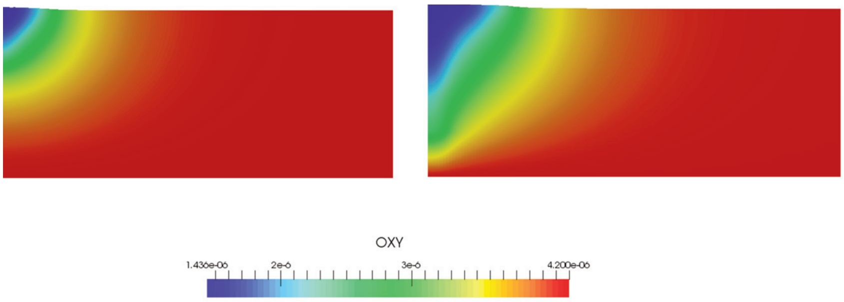

Figure 6:
Mass fractions of oxygen
after 10 and 20 days.
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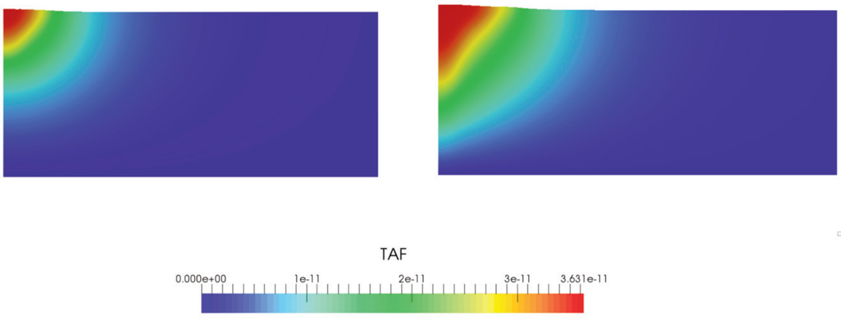

***Figure 7**:*
Mass fractions of TAF
after 10 and 20 days.
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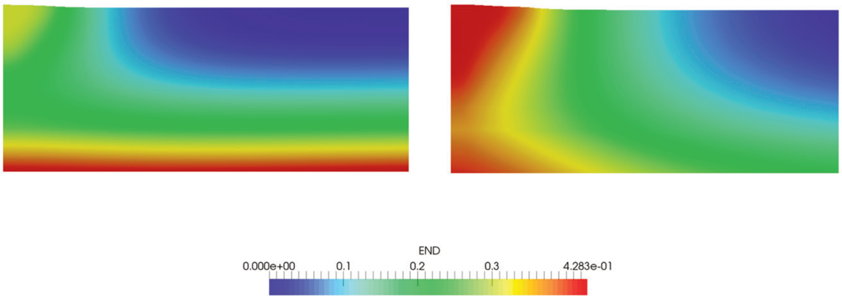

Figure 8:
Mass fractions of endothelial cells
after 10 and 20 days.
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Experience-Based Noise Evaluation System Using VR Technology

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> *“… easily understand the noise level by present systems using both visual and auditory information.”*

The evaluation of noise is very important for planning and designing of various construction works in an urban area. There have been presented a number of evaluation methods for noise simulation. Based on the frame of reference used, those methods can be classified into two categories:

1) Methods based on the geometrical acoustic theory and
2) Methods based on the acoustic wave theory.

Both methods have advantages and disadvantages. For the methods based on the geometrical acoustic theory, the CPU time is very short but the numerical accuracy is low comparing with the methods based on the acoustic wave theory. On the other hand, the method based on the acoustic wave theory gives accurate solutions but the simulation becomes a large scale simulation.

In the conventional studies, the computed noise level is described by the visualization using computer graphic such as iso-surface. Although the visualization is a powerful tool to understand the distribution of noise, it is difficult to recognize the noise level intuitively.

The authors have developed experience-based interactive noise evaluation systems using vertical reality (VR) technology [1], [2], [3], [4]. The system exposes to the users the computed noise level with both the auditory information using sound source signal and the visual information using CG image. This article introduces several noise evaluation systems which use VR technology.

Experience-Based Noise Evaluation System

Figure 1 shows the flow chart of our system. The system consists of three parts, computation part, visualization part and auralization part. The present system is designed for the use of environments based on the immersive projection technology (IPT) such as CAVE. *Figure 2* shows the exterior view of the VR system “Holostage” of Chuo University, which consists of a PC cluster, three projectors, three large screens, a position tracking system and a sound system [7.1 ch.]. This system provides two presentation functions,

a) auralization function, which presents the stereoscopic sound of the noise level in VR space, and
b) visualization function, which presents the stereoscopic iso-surface of the noise level by CG image.

Users can easily understand the computed noise level by both functions. The sound signal for VR space is generated by the method named “ambisonics” [5], which is a full-sphere surround sound technique based on the spherical surface function expansion, using computational results and sound source data. For the creation of stereoscopic CG image, the Open GL and CAVE library are employed and the software Max is employed for the creation of stereoscopic sound.

Figure 1:
Flow chart

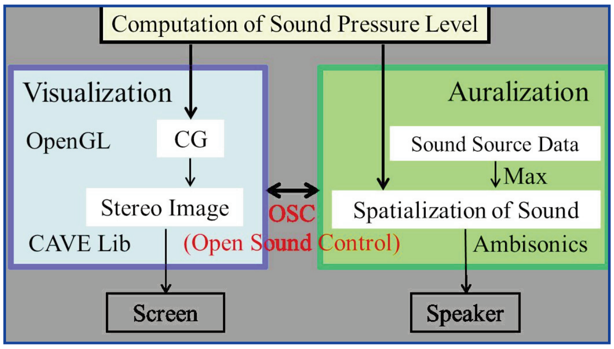


Figure 2:
CAVE system

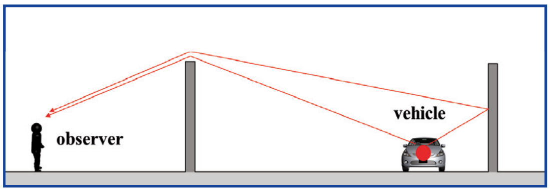


Figure 3: *Geometrical acoustic theory*

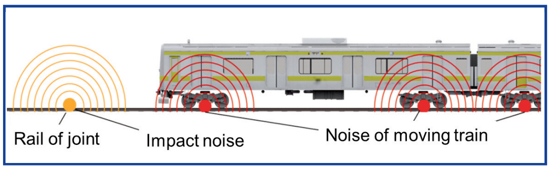


Figure 4: *Position of sound source*

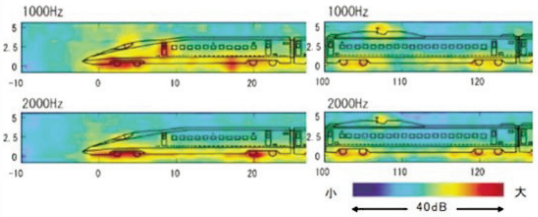


Figure 5: *Distribution of sound source [7]*

Figure 6: *Studied area (CAD model)*

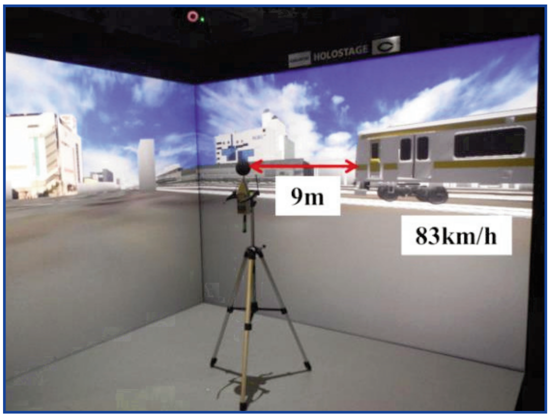


Figure 7: *Observation in VR space*

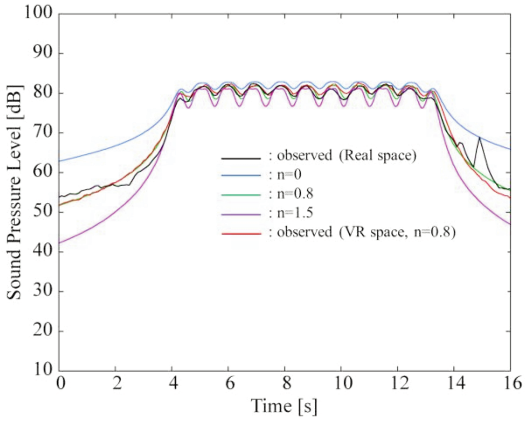


Figure 8: *Comparison of sound pressure*

The presentation of the CG image and the sound is performed using OSC (Open Sound Control) with the synchronization of both visual and auditory information.

Applications

Traffic noise simulation based on geometrical acoustic theory

The noise level is computed by the acoustic geometrical model, ASJ RTN-Model 2013 [6] which is developed by the Acoustic Society of Japan. *Figure 3* shows the image of the computations for road traffic noise. The sound waves are modeled with rays carrying acoustical energy. The computation can be performed in real time using the position data of sound source and the observer. The sound pressure level (A-weighted) at observer's position is computed by the combination of direct and reflection sounds as shown in *Figure 3*.

In case of railway noise, the noise can be classified into two categories;

1) noise from moving train such as rolling noise, earodynamic noise, motor and so on,
2) noise from joint of rail (impact sound by the passing of wheel) as shown in *Figure 4.*

Figure 5 shows the distribution of sound source in case of the high-speed train [7]. From this figure, it can be seen that the sound from bogie is the most prominent, followed by the sound from the pantograph. The effect of directivity of sound is important for the railway noise. In this system, the directivity model proposed by Japan Railway Research Institute is employed [8]. *Figure 6* shows the studied area, around Oyama station of Tohoku Shinkansen. The computation is performed for a regular local train and a high-speed train. The passing speed of local train is assumed to be 83km/h which is same as the observed train. *Figure 7* shows the scene for the simulation in VR space. *Figure 8* shows the comparison of computed sound pressure with observed results. From this figure, it can be seen that the computational results are in good agreement with observed results by using the appropriate parameter for sound directivity n=0.8, which is related to the train speed. The observed results in VR space are in good agreement with the computed results with n=0.8. From the results, it can be seen that the reproducibility of the stereoscopic sound field is sufficient. *Figure 9* shows the effect of sound noise barrier on the user experience for the high speed train (263km/h) [9]. The present system is also applied to the noise problem of aircraft around the Tokyo International Airport as shown in *Figure 10* [9].

Construction noise simulation based on acoustic wave theory

A system based on the acoustic wave theory is developed in order to improve the numerical accuracy. The three dimensional wave equation is employed as the governing equation. For the numerical method, the CIP method with adaptive mesh refinement is used [3]. The propagation analysis for the impulse wave is performed. The sound pressure level can be obtained by the convolution of the computed impulse response and input sound signals. The noise simulation by a pile driver is performed. *Figures 11* and *12* show the sound source signal for a pile driver and the computational model. The fully reflecting condition is assumed on the wall and bottom boundaries and non-reflecting condition is employed for other boundaries. We employed the pseudo impulse at the sound source point [3] .

Figure 12:
Computational model

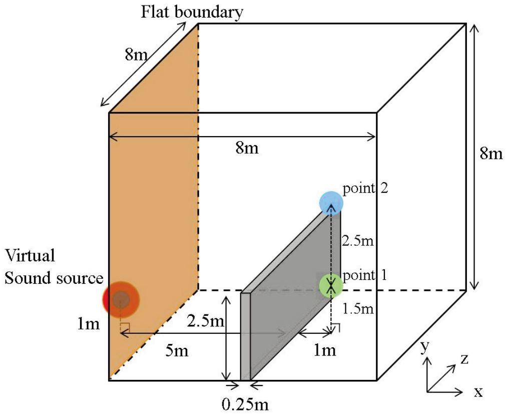


Figure 13 shows the computed wave sound pressure with adaptive mesh at the vertical center section (x-y coordinate). The minimum mesh size is 0.0125m. *Figure 14* shows the computed sound pressure at Point 1 and 2 by the convolution of the impulse response and sound source signal. *Figure 15* shows the observed user experience the present system. The user can easily understand the effect of the sound noise barrier by the auralization of sound noise [9].

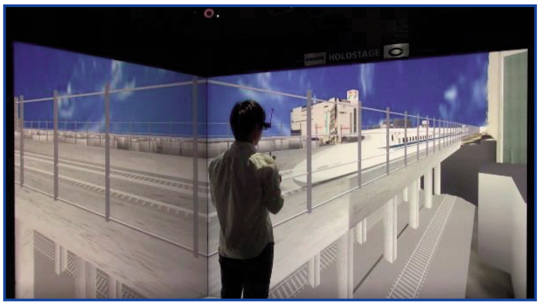


Figure 9:
Application to high speed train

Figure 10:
Application to aircraft noise

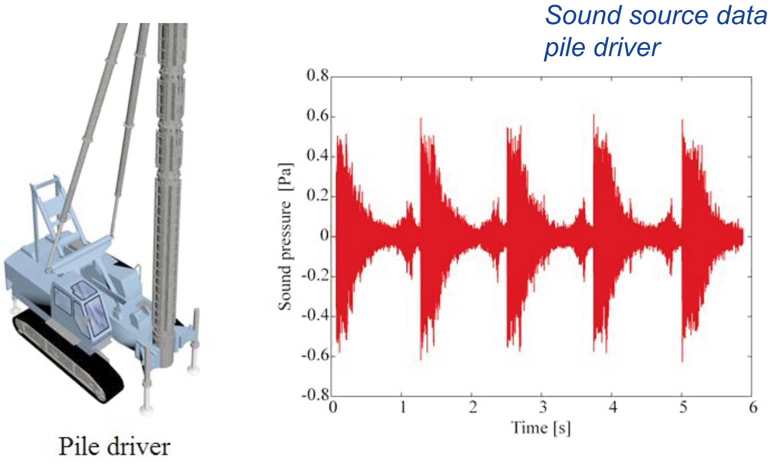


Figure 11:
Sound source data for a pile driver

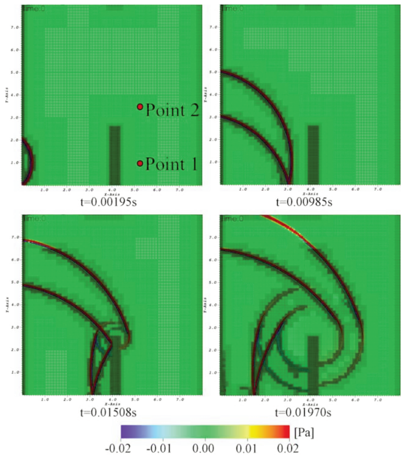


Figure 13:
Propagation of impulse wave

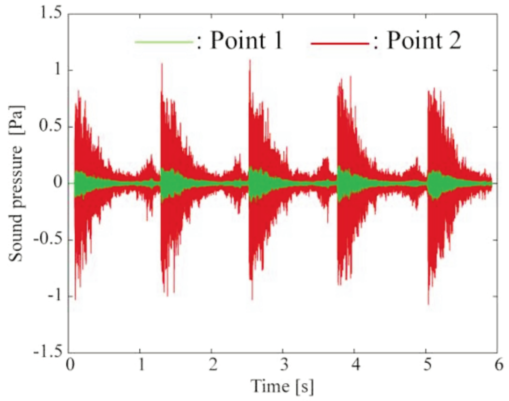
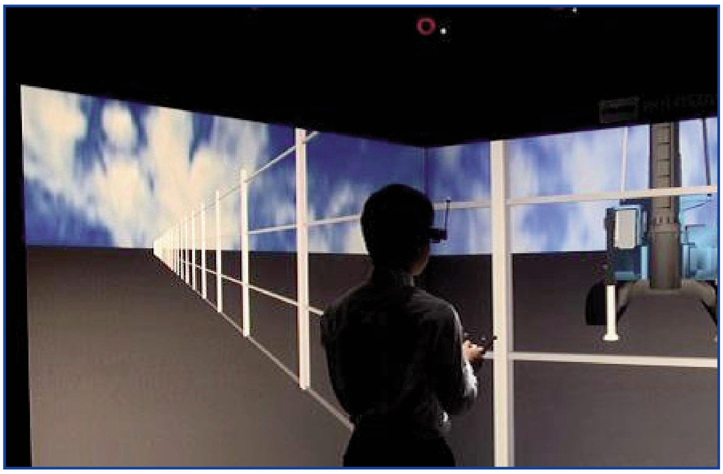


Figure 14:
Computed sound pressure

Figure 15:
Application to construction noise



Portable system

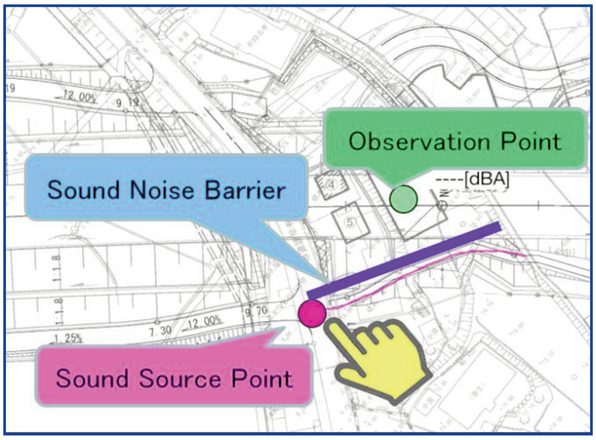
A portable system using iPad computer is also developed for easy portability [4]. *Figure 16* show the system. The user can set the numerical condition by the touch operation as shown in *Figure 17*. In order to realize the real time simulation, the geometrical acoustic theory is employed. The system is useful for the consensus building at the construction site, especially in meetings with local residents.

Conclusions

Several experience-based interactive noise evaluation systems based on VR technology have been introduced. Users can easily understand the noise level by present systems using both visual and auditory information. The present systems are useful for planning and designing tools for various constructions works in an urban area, and also for consensus building for designers and the local residents. ●

Figure 16:
Portable system

Figure 17:
Interactive data input



> *"... useful for the consensus building at the construction site, especially in meetings with local residents.."*

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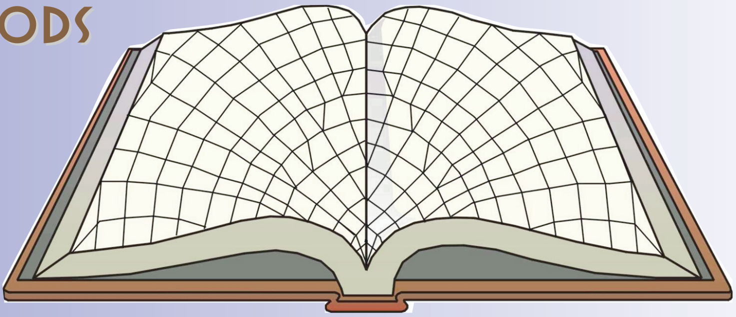
CERTIFIED REDUCED BASIS METHODS FOR PARAMETRIZED PARTIAL DIFFERENTIAL EQUATIONS

Jan Hesthaven, Gianluigi Rozza
& Benjamin Stamm
Springer, New York, 2016



BOOK REVIEW

ISBN: 978-3-319-22469-5

131 pages, soft cover, $70 (List Price).

Contents: Preface; 1: Introduction; 2: Parametrized Differential Equations; 3:Reduced Basis Methods; 4:Certified Error Control; 5: The Empirical Interpolation Method; 6: Beyond the Basics; Appendix A: Mathematical Preliminaries; Index.

Here is another book from the Springer Briefs series. As the other books in the series, its purpose is to introduce the reader in a concise way to a specific topic, in this case Reduced Basis (RB) methods for parametrized PDEs. The authors do an admirable job in presenting the topic in an interesting and clear way, focusing on the main ideas yet providing practical algorithms with full details, summarized in "boxes". The book is well written, with a good dosage of rigor and discussion. I enjoyed a lot reading this little book.

As the preface explains, certified RB methods for parametrized PDEs constitute a branch within the larger area of Reduced Order Modeling (ROM). The latter has become a major area of interest in recent years, which many research papers and conference sessions are dedicated to. The general idea of ROM is replacing a "heavy" numerical (e.g., finite element) model, called here "the truth problem", with a much more efficient model which retains the same level of accuracy for a chosen quantity of interest (the "output"). This general setup has several variants, one of which is the subject of this book.

The particular scenario under investigation here is that of a boundary-value problem which involves a set of parameters. One is interested in solving the problem and finding its predefined "output" for many different values of these parameters. The computational cost of solving all these many problems using a standard numerical model with appropriate resolution is assumed to be prohibitive. The book discusses RB methods for solving these problems efficiently, in a variational setting, while still obtaining accurate outputs. The word "certified", appearing in the title, implies that the accuracy of the proposed methods can be well controlled via reliable and easily computable *a posteriori* error estimates.

As indicated on p. 5, regarding the target audience of this book, "a solid background in finite element methods for solving linear PDEs is needed, and an elementary understanding of linear PDEs is clearly beneficial." (Incidentally, this statement brings to mind the thought that one does not have to understand something in order to solve it!) In most cases the mathematical exposition would be clear to engineers with mathematical orientation, but here and there some more abstract concepts or terminology are used, which may be more difficult for non-mathematicians to digest.

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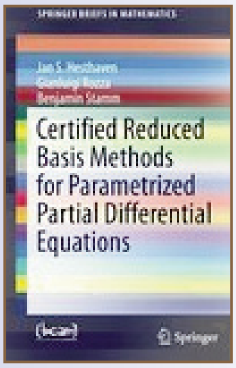
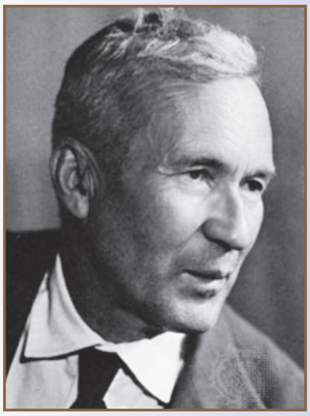


Certified Reduced Basis Methods for Parametrized Partial Differential Equations

An example is the definition of the Kolmogorov N-width, on p. 30, which measures the efficiency in which a problem lends itself to reduction. This is the smallest distance between the truth solution and functions spanned by the RB, for the "worst" truth solution and the "best" N-dimensional RB space. In mathematical terms, we have an inf-sup-inf here, which is one layer of abstraction deeper than the Babuška-Brezzi inf-sup concept (no connection between the two concepts). However, such abstract notions do not constitute major obstacles for non-mathematicians in reading and understanding the main ideas in this book. Moreover, these ideas lead to well-defined algorithms, which are summarized very clearly in "boxes", throughout the book.



Andrey Kolmogorov

After Chapter 1, which gives a historical background to the topic, with many references, as well as a list of 8 available software libraries with support for RB algorithms, Chapter 2 discusses parametrized linear PDEs. The parametrized problem is defined, and a number of basic assumptions are stated, which are taken to hold throughout most of the book. These assumptions (some of which are explicitly stated in later chapters) are as follows:

(a) The geometry is fixed. (b) The problem is time independent (elliptic; steady state). (c) The bilinear form associated with the operator appearing in the PDE is coercive for any parameter value. (d) This bilinear form is symmetric for any parameter value. (e) The output functional, which defines the quantity of interest for which we wish the accuracy of the reduced model to be retained, is identical to the load/source functional. (f) The linear and bilinear forms allow an affine decomposition, i.e., can be written as a sum of products of a function of the parameters times a function of the trial and test variables.

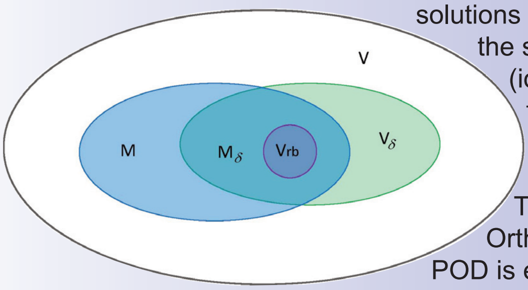
Assumptions (d) and (e) together are called "compliance". The removal of each of the assumptions (a)-(f) is considered (some of them briefly) in chapters 5 and 6.

Assumption (e) requires special attention, since it seems quite limiting. We may wonder under what circumstances the desired output functional would coincide with the source functional. This question is not answered in the text, but here are two examples: (1) the load or source is concentrated at a point, and the desired output is the primary variable (temperature or displacement) at this single point, and (2) the load or source is distributed uniformly over a certain domain, and the desired output is the integral (or average) of the primary variable over this domain. Indeed, these examples are far from representing the typical output in most applications, but we have to remember that in such an introductory short book only the basic ideas can be discussed in detail. Section 6.3 briefly discusses the non-compliant case.

Chapter 2 ends with the description of two example problems, which serve as a uniform testbed for the various techniques presented throughout the book. This in itself is a very nice idea, which not many books adopt. The first example is that of heat conduction in a square domain. The second example is said to represent linear elasticity, with a domain consisting of 9 materials. Unfortunately, the physical modeling of this second example is wrong: one mistake has to do with traction-free boundary conditions, and another is in the way the Young moduli appear in the definition of the main bilinear form. I suggest to the reader to regard this example as purely mathematical, without a physical interpretation, aimed at demonstrating the various techniques for a system of PDEs. Hopefully, the elastic example will be corrected in the second edition of the book.

Chapter 3 presents the basics of RB methods. The essential idea is explained very nicely at the beginning of the chapter. The RB method consists of two stages. In the "offline stage" , one solves *N* truth problems, each of which has *M* degrees of freedom (*M* is typically very large), and constructs from their solutions an *N*-dimensional RB. This stage is potentially very costly, but it serves as an "infrastructure" which allows to find many other solutions very efficiently. The "online stage" consists of a Galerkin Projection onto the space spanned by the RB. This stage is inexpensive, since its cost is (ideally) independent of *M*. Incidentally, such a two-stage procedure is typical to other variants of ROM as well; the first stage is a costly investment, but one enjoys the fruits in the second stage.

Figure 1:
Some of the spaces related to POD



The authors discuss two procedures for the offline stage: Proper Orthogonal Decomposition (POD) and Greedy Basis Generation (GBG). POD is explained nicely, although one has to be careful not to be confused with the many spaces defined in the process. *Figure 1* (not from the book) illustrates five of these spaces. GBG is an iterative method which has a few important advantages over POD. Section 3.3 explains how to exploit the affinity property (assumption (f) above) to make the online stage much more efficient. Two numerical examples follow; see *Figure 2*.

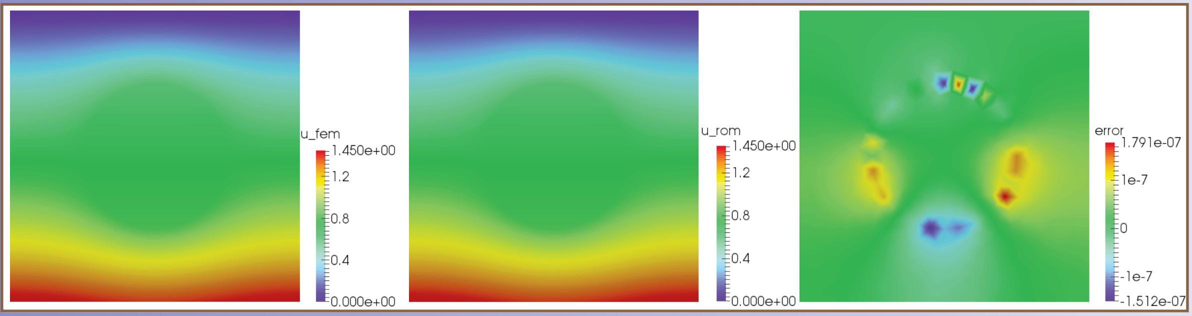


Figure 2:
A heat conduction example.
Left: solution of the truth problem
Middle: the RB approximation
Right: The error
This is Figure 3.2 from the book

Chapter 4 provides *a posteriori* estimates for the model reduction errors, which give the adjective “certified” to the RB methods presented here. To be useful, the error estimates have to be not only accurate, but also computable in an efficient manner. Much of this chapter is devoted to this important issue.

In Chapter 5, the authors discuss a technique, called the Empirical Interpolation Method (EIM), which allows the omission of assumption (f) above, namely allows the treatment of problems with non-affine forms. The idea, based on a paper by Barrault, Maday, Nguyen and Patera from 2004, is to construct a separable approximation to a multi-variable function. The examples given here include a nonlinear problem. Chapter 6 extends the basic methods to cases where either one of the assumptions (a)-(e) above does not hold. An extension which I found to be particularly interesting is the one where the varying parameters are geometrical quantities, and thus the geometry of the problem is not fixed (in contrast to assumption (a)). *Figure 3* is an example taken from the book for this case. The chapter ends with a complicated 3D engineering example of heat conduction in a Graetz channel. *Figure 4* shows a result obtained for this example.

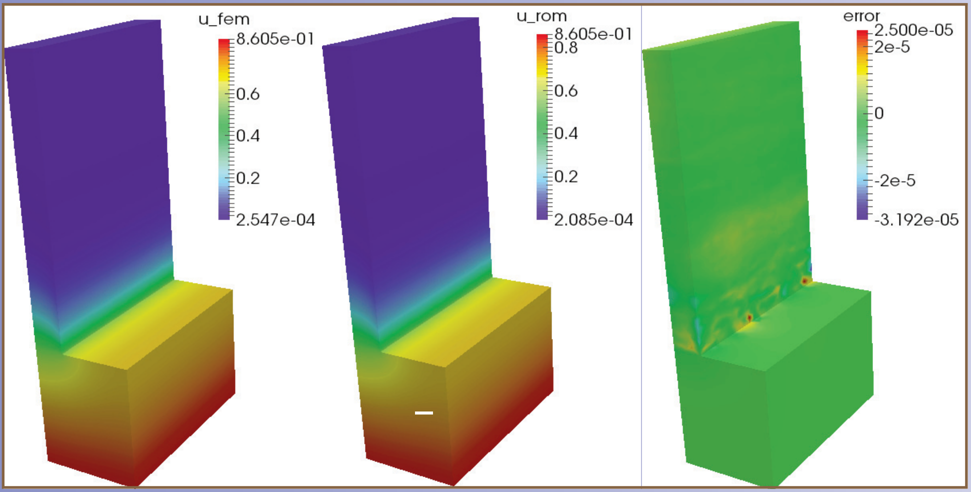


Figure 3: *(right)*
A geometric parametrization example
Left: solution of the truth problem
Middle: the RB approximation
Right: The error
This is Fig. 6.11 from the book

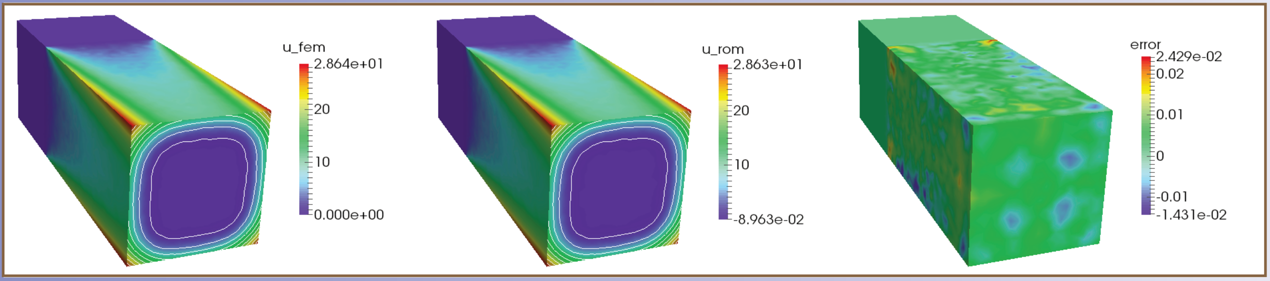


Figure 4: *(below)*
A 3D heat conduction example
Left: solution of the truth problem.
Middle: the RB approximation
Right: The error
This is Figure 6.20 from the book

In summary, this is a highly recommended introductory text on reduced basis methods for an important class of problems, namely those governed by parametrized PDEs. The material covered is very relevant to researchers and students interested in ROM in general, and is presented in a clear and attractive way. I believe that the mathematically oriented reader will enjoy reading this book as I did. ●

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2nd Association of Computational Mechanics Taiwan (ACMT) Conference

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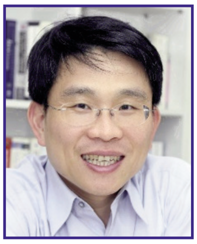

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The Association of Computational Mechanics Taiwan (ACMT) was founded in 2007 to strengthen the development and collaboration between researchers in the field of computational mechanics in Taiwan. Many members of ACMT are also regular minisymposium organizers and speakers for WCCM and APCOM events. Starting from last year, ACMT holds an annual meeting on October to furthermore promote the field of computational mechanics in Taiwan. The second conference of the association was held in Taipei, Taiwan during October 20-21, 2016. The

Figure 1: *Welcome speech by the Conference Chair, Prof. YB Yang*

event attracted more than 170 participants from universities, research institutes and industries. In addition to domestic participants from Taiwan, invited speakers and participants from USA, Japan, Singapore, Indonesia, India, Italy, Russia, Australia etc. attended the conference.

The conference emphasized on the synthesis of theoretical and pragmatic computational mechanics. It featured 4 plenary speeches, which were given by Prof. Shigeru Obayashi (Tohoku University, Japan) on multi-objective design exploration and Mitsubishi Regional Jet, Dr. Eliot Fang (Sandia National Laboratories, U.S.A.) on the advance of capability and creating credibility for computational solid mechanics analyses of Sandia, Prof. Jeng-Zong Chen (National Taiwan Ocean University, Taiwan) on dual BEM development in Taiwan, and Prof. Chao-An Lin (National Tsing Hua University, Taiwan) on Lattice Boltzmann simulations on multi-GPU cluster, respectively. The conference also featured 33 session keynote lectures, 49 invited lectures and 63 regular presentations. There were 18 minisymposia for topics of methods and applications related to various aspects of computational mechanics and interdisciplinary topics, including meshless method, biomechanics, CFD, multi-phase flow, bridge structures, large-scale landslides, etc.

Figure 2:
Plenary speech by Prof. Shigeru Obayashi

Figure 3:
Plenary speech by Prof. Chao-An Lin

Figure 4:
Plenary speech by Dr. Eliot Fang

Figure 5:
Plenary speech by Prof. Jeng-zong Chen

The 2nd ACMT Conference was a great success, which is an excellent continuation of the 1st conference. We appreciate the support of plenary speakers and the minisymposia organizers and strong involvement of the participants.
The 3rd ACMT Conference in 2017 and the 5th ACMT Conference in conjunction with the 7th Asia-Pacific Congress on Computational Mechanics (APCOM) in 2019 are now in preparation. The 3rd ACMT conference will be held in Tainan in the southern part of Taiwan on October 19-20, 2017. The 5th ACMT Conference will be held in conjunction with the 7th Asia-Pacific Congress on Computational Mechanics (APCOM) on December 18-21, 2019. We look forward to these events and opportunities to give impetus for a strong computational mechanics community in Taiwan. ●

Contributions of AACM towards the success of the combined APCOM/WCCM Congress 2016, Seoul, Korea

The joint Asia Pacific - World Congress was organised very successfully in Seoul, Korea during July 2016. It was attended by more than 2000 delegates from over 47 countries. There were more than 1300 participants from Asia Pacific Region representing 14 national associations.

The Australian Association for Computational Mechanics (AACM) played its part and contributed to the overall success in a small but significant way. Australia had over 30 delegates placing it 10th

Figure 1 (left & right):
Prof. Valliappan's welcome address

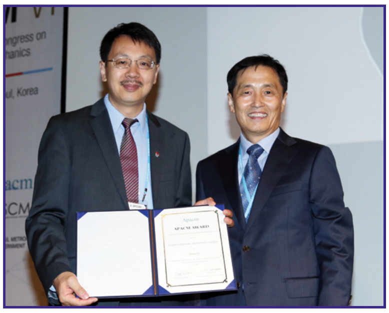

Figure 2:
Qing Li-- award from President Youn

ACCM2015: The 2nd Australasian Conference on Computational Mechanics

Brisbane, Australia 30 November – 1 December 2015

by:
Prof. Yuantong Gu
Chair of ACCM2015
Queensland Uni.of Technology
Australia

Prof. Hong Guan
Co-Chair of ACCM2015
Griffith University
Australia

The second Australasian Conference on Computational Mechanics (ACCM2015) was jointly organized by Queensland University of Technology (QUT) and Griffith University at QUT Gardens Point campus, under the auspices of the Australian Association for Computational Mechanics (AACM). It was a successful conference with over 200 participants including 2 plenary speakers, and 31 technical sessions to host more than 160 oral presentations by the experts in computational mechanics (CM) from Australia and 11 other countries around the world, including New Zealand, China, Japan, and USA. The objectives of the second conference were to promote computational mechanics (CM) in Oceanian region and bring together the CM researchers and users in the region to meet and present their work. Undergraduate and postgraduate students were particularly welcome in order to foster a new generation of CM researchers and users. There was an ample scope to network and exchange ideas. The cost was strategically kept lower to encourage wide participation. In total 107 high quality full-length papers from 160 presentations were selected and published in the special journal issue of Applied Mechanics and Materials.

Figure 5:
Inauguration of ACCM2015

The conference was inaugurated by Prof. John Bell, Head of School of Chemistry, Physics & Mechanical Engineering of QUT. He welcomed the conference delegates and emphasized the importance of conducting research in the fields relevant to computational mechanics. He outlined one of the major research strengths and priorities of QUT in "Data science, computational modelling and simulation science", a futuristic field of research in Australia.

Emeritus Prof. Valliappan also welcomed the participants as the Director of AACM and chaired the plenary lecture. He introduced the invited speaker Prof. Gui-Rong Liu, one of the most highly-cited researchers in computational mechanics and the past president of Asian-Pacific Association of Computational Mechanics (APACM), who highlighted the latest advances in Meshfree Methods: Strong, Weak and Weakened Weak (W2) formulations.

position in the world and 5th position in Asian Pacific region behind China, Korea, Japan and Taiwan. Emeritus Professor Valliappan, the former President of AACM and former Secretary General of APACM delivered the Welcome address on behalf of the Asia Pacific Association. Professor Nasser Khalili (University of New South Wales), President of AACM delivered one of the Plenary Lectures while Prof. Yuan Tong Gu (Queensland University of Technology), EC Member of AACM delivered one of the Semi-plenary Lectures. Among the awards, Professor Khalili received the 'Valliappan Medal' one of the two highest awards from APACM given to an individual for significant and sustained contributions in computational mechanics. Professor Qing Li (University of Sydney) received the Computational Mechanics award from APACM. ●

Figure 3:
Prof. Valliappan presenting medal to Prof.Nasser Khalili

Figure 4:
Bibimbop made by Yagawa,Valliappan,Youn,Oden, Hughes and others

His talk sparked strong interests in the audience and drawn considerable attention in the latest development and applications in the fields.

The second plenary session was chaired by Prof. Grant Steven, Director of AACM. He introduced the invited speaker Prof. Scott Sloan, a Laureate professor and Director of ARC Centre of Excellence for Geotechnical Science and Engineering and the Director of Priority Research Center for Geotechnical and Materials Modelling, at University of Newcastle, Australia. Prof. Sloan was the past president of AACM and one of the world's most highly-cited geotechnical researchers. His talk on "The Strength Reduction Method in Geotechnical Stability Analysis" interested many participants and attracted extensive discussions.

ACCM2015 set up the best paper awards for categories of postgraduate and early career researchers (within five years since PhD). Many presented papers were of very high quality and drawn considerable attention in the conference.

During ACCM2015, the AACM executive committee meeting was held, in which the AACM Constitution was reviewed and future development was discussed strategically.

ACCM2015 was purposefully served to raise/uphold the IACM/AACM memberships and timely promote WCCM/APCOM2016, to be held in Seoul in July 2016 in the Australasian region. ●

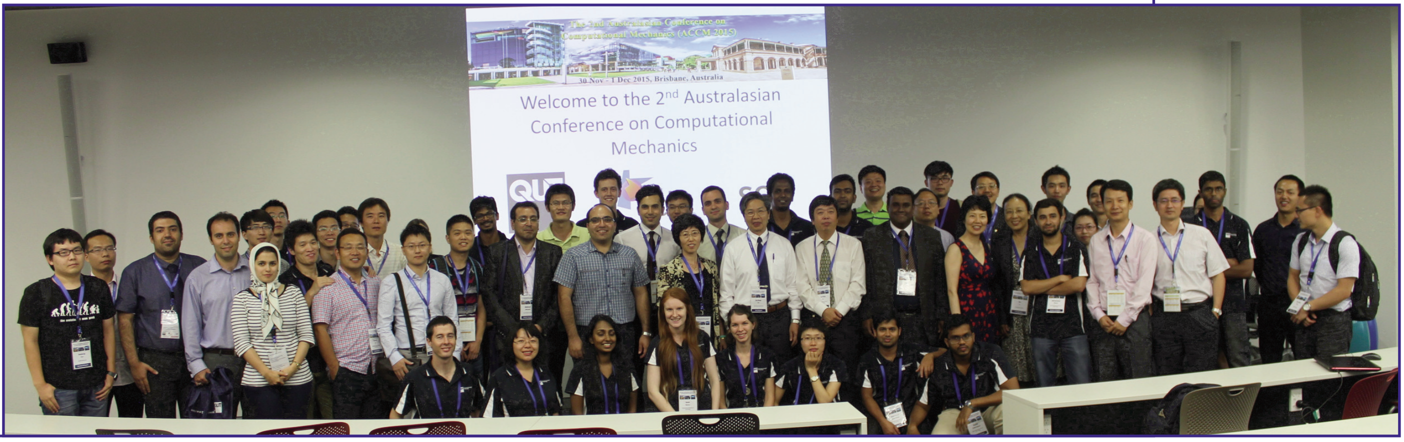

Figure 6:
Closing of ACCM2015

Argentine Association for Computational Mechanics

ENIEF 2016

XXII Congress on Numerical methods and their Applications

Córdoba, Argentina
08-11 November 2016

This new edition of the annual AMCA Congresses was organized by the Research and Development Group in Applied Mechanics of the National Technological University – Regional Faculty of Córdoba (GIDMA/UTN-FRC).

The organizing committee was chaired by Sebastián M. Giusti, and integrated by Javier E. Salomone, Patricia M. Dardati, Martin A. Pucheta, Adrian Boccardo, Francisco Rodriguez and Nestor D. Barulich. The Scientific Committee was chaired by Luis A. Godoy, and co-chaired by Sebastián M. Giusti.

The Congress counted with invited lecturers: Xavier Oliver (CIMNE-UPC, Spain); Josko Ozbolt (Stuttgart University, Germany); Ricardo Burdisso (Virginia Polytechnic Institute and State University, USA); Antonio André Novotny (National Laboratory for Scientific Computing, Brazil), Eduardo de Souza Neto (Swansea University, UK) and Rainald Löhner (George Mason University, USA).

More than 275 persons attended the Congress. Full length papers were submitted to a review process prior to publication. From them, 200 papers were accepted and published in the proceedings which are publicly available at the website: **http://www.amcaonline.org.ar/mcamca**

AMCA Awards 2016

The ceremony of the AMCA Awards 2016 took place during the Congress Banquet of ENIEF 2016

Figure 1:
The AMCA Secretary General, Victor Fachinotti (left) delivers the AMCA Young Researcher Award to Pablo Kler (right)

The award for Young Researchers was granted to Pablo Kler, from CIMEC, CONICET-UNL, Argentina. The award for Scientific, Professional and Teaching Career was for Norberto Nigro, from CIMEC, CONICET-UNL, Argentina. ●

Figure 2:
Norberto Nigro (left) receives the AMCA Award 2016 for Scientific, Professional and Teaching Career from Victor Fachinotti, AMCA Secretary General (right)

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http://www.amcaonline.org.ar

Figure 1:
ENIEF 2016 opening ceremony. From left to right: S. Giusti, chairman of the organizing committee, H. Aiassa, Dean of Regional Faculty of UTN, and V. Fachinotti, AMCA Secretary General

A special session in honor of Dr. Luis Augusto Godoy took place. Dr. L. A. Godoy is one of the pioneers of computational mechanics in Argentina and one of the founders of AMCA. This special session was organized and chaired by Dr. Patricia M. Dardati and co-organized by Dr. Sergio Elaskar.

ENIEF 2016 gave frame also to other activities: a pre-congress course on OpenFOAM; a meeting of OpenFOAM users; a meeting of EDF CODES users and the ceremony of AMCA Awards 2016 during the ENIEF2016 banquet. ●

Figure 2:
Special Session devoted to Luis Godoy. From left to right: C. Prato, L. Suárez, J. Salmone, S. Giusti, P. Dardati, V. Fachinotti, E. Zapico, L. Godoy, M. Ameijeiras, C. Guzmán and R. R. Lopéz. Front: P. Arduino and G. Maldonado

Figure 3:
Participants ENIEF 2016

Call for Papers

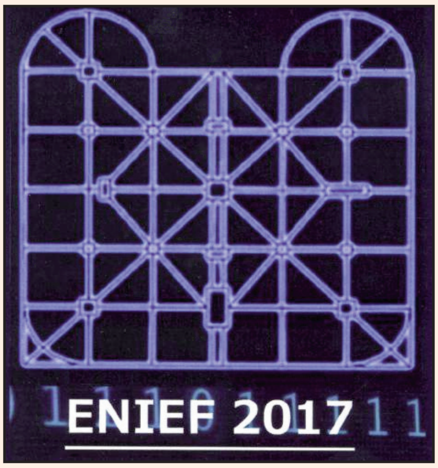
ENIEF 2017

XXIII CONGRESS ON NUMERICAL METHODS AND THEIR APPLICATIONS

La Plata, Buenos Aires, Argentina
7 - 10 November 2017

The Argentine Association for Computational Mechanics (AMCA) announces the XXIII Congress on Numerical Methods and their Applications, which will be held in La Plata, Buenos Aires, Argentina, organized by the Faculty of Engineering of the National University of La Plata.

Email: enief@ing.unlp.edu.ar ●



The 7th International Conference on Discrete Element Methods

The 7th International Conference on Discrete Element Methods successfully held at Dalian University of Technology, China

Figure1: *Prof. Xikui Li, the chairman of the conference presided the opening ceremony*

The 7th International Conference on Discrete Element Methods was successfully held at Dalian University of Technology (DLUT), China on August 1-4, 2016. The conference is hosted by State Key Laboratory of Structural Analysis for Industrial Equipment at DLUT. Prof. Xikui Li from DLUT, Prof. Yuntian Feng from Swansea University, UK and Prof. Mustoe from USA are co-chairs of the conference and Prof. Shunying Ji from DLUT is a chairman of local organization committee.

The opening ceremony of the conference was presided by Prof. Xikui Li. Prof. Dongming Guo, the president of DLUT and the academician of Chinese Academy of Engineering delivered the welcome speech. Prof. Gang Li, the director of the State Key Laboratory of Structural Analysis for Industrial Equipment and Prof. Yuntian Feng from Swansea University, UK attended the opening ceremony.

The conference is mainly aimed to promote the comprehensive and deep academic exchanges and discussions on the physical and mechanical properties of granular materials, the contact models in the Discrete Element Methods, the high performance computing, etc., as well as the critical scientific issues arising in the natural disasters and a variety of engineering fields, which are closely related to granular materials. The delegates attending the conference are from 19 countries and regions including China, UK, US, Australia, Netherlands, Germany, Korea, France, Iran, Canada, Japan, Austria, South Africa, India, Czech Republic, Switzerland, Argentina and so on. The total number of delegates is 263 including 96 graduate students. There were 166 Chinese scholars attended the conference. They showed the recent development on Discrete Element Methods and the computational mechanics for granular materials.

Prof. Felix Darve from University Grenoble Alpes (France), Prof. Stefan Luding from University of Twente (Netherlands), and Prof. Xiaojing Zheng from Xidian University (China) were invited to deliver the plenary lectures of the conference. Prof. Aibing Yu from Monash University (Australia), Prof. Shunying Ji from Dalian University of Technology (China), Dr. Kloss Christoph from DCS Computing GmbH & CFDEM (Austria), Prof. Yuntian Feng from Swansea University (UK) and Prof. Mikio Sakai from University of Tokyo (Japan) were invited to deliver keynote lectures. Besides, 23 domestic and foreign well-known scholars delivered the invited session lectures.

This conference received 158 full papers and 161 abstracts, and set 207 oral reports including 9 plenary lectures. The conference set up 32 parallel sessions covering 21 topics which includes the basic theories and numerical methods of DEM, the high performance computing and the platform of software for granular materials, Granular Flow dynamics, rock mechanics and DEM in multiphase flow, DEM-FEM Models, the numerical analysis for failure of granular materials, powder technology, the contact and constitutive models of granular materials, the packing of irregular particles, the effects of geometry of particles, cohesive models of particles, coarse

Figure 2: *Prof. Felix Darve delivered the plenary lecture*

Figure 3: *Prof.Stefan Luding delivered the plenary lecture*

Figure 4: *Prof. Xiaojing Zheng delivered the plenary lecture*

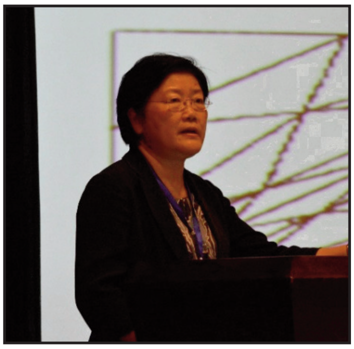


Figure 5:
Group photo of the winners of best student papers

graining of particles and size effects, the applications of DEM in agriculture / rock / ocean / chemical engineering / transportation / mechanical engineering, the computational methods on particles, the experimental validation of computational mechanics for granular materials and so on. In the conference, through the academic exchange and discussions on the current status and development trends of computational mechanics for granular materials, new research directions and the related key mechanical issues in granular materials were concluded, that will promote the developments of DEM in basic theories, numerical methods, engineering applications, and so on, and also facilitate the interaction and integration between DEM and other methods.

During the conference, the academic committee voted 7 best student papers. They are A Farsi (Imperial College London, UK), Budi Zhao(City University of Hong Kong), Clément Joulin (Imperial College London, UK), Hongyang Cheng (Hiroshima University, Japan), Lu Liu (Dalian University of Technology, China), Qi Luo(Monash University, Australia), Tingting Zhao (Swansea University, UK).

In the closing ceremony, Prof. Yuntian Feng, the co-chair of the DEM7, from Swansea University, UK summarized the conference. This conference showed the DEM's applications in different fields and the significant progress in DEM in the past 3 years. The 8th International Conference of DEM8 will be hosted by University of Twente, Netherlands in 2019.

The first conference on DEM was held in 1989. At present, it is held every three years and it is one of the important series of international conferences in the field of DEM and its engineering applications. The success of the DEM7 Conference benefits from the research and wide application of DEM in China and the active participation in international conferences and cooperation of Chinese domestic scholars. The conference provides a platform for domestic scholars to carry out international cooperation on the basic theory, numerical methods and engineering applications of DEM, and greatly promotes the development of DEM in China.

The conference was successfully held with the strong supports from State Key Laboratory of Structural Analysis for Industrial Equipment, Dalian University of Technology, EDEM company (UK) and Beijing Hi-Key technology. The active participation of domestic and foreign scholars to the DEM7 is also important to its success. ●

by
Xikui Li & Zhuo Zhuang

Figure 6:
Group photo of the delegates of DEM7

Since our last report (IACM Expressions No. 38) the Israel Association for Computational Methods in Mechanics (IACMM) updated its logo, and elected Prof. Slava Krylov *(Figure 1)* as Secretary/Treasurer of IACMM. He is the head of the School of Mechanical Engineering at Tel Aviv university and his main research topics are related to MEMS.

Two symposia were held last year. The 39th Israel Symposium on Computational Mechanics (ISCM-39) was held in November 2015 at the Dept. of Civil Engineering at the Technion, organized by Profs. Mahmood Jabareen and Yiska Goldfeld. Prof. Pierre Ladeveze, from LMT/ENS Cachan, CNRS, Paris-Saclay University, France, was IACMM's international invited speaker, delivering an interesting opening lecture on "Reduced Models in Nonlinear Solid Mechanics: State of the Art and Challenges". *Figure 2* shows Prof. Ladeveze lecturing and *Figure 3* is taken at dinner with IACMM members of the executive committee. The symposium included 11 other lectures, presented by practitioners and researchers from industry and academia. These included talks by Dr. Yuri Feldman (Stability Analysis of Natural Convection Flows in the Presence of Immersed Bodies), and Dr. Pavel Trapper (Space-Time Discontinuous Galerkin Methods for Hyperbolic Systems), both young faculty member at the Ben Gurion University. Prof. Shmuel Ryvkin presented a talk on multiscale fracture analysis of periodic materials and there were many other talks by students and industry participants on computational biomechanics, composite materials, CFD and optimization.

Figure 1:
Prof. Slava Krylov – secretary/treasurer of IACMM

Figure 2:
Prof. Pierre Ladeveze at the opening lecture of the ISCM-39, Nov 2015, Technion

Figure 3:
Dinner following ISCM-39. Right to Left: Mrs. Ladeveze, Dr. Harszage, Prof. Harari, Prof. Ladeveze, Prof. Givoli, Prof. Jabareen, Dr. Trapper, Prof. Bar-Yosef & Prof. Yosibash

Figure 4:
Prof. Djordje Peric at the opening lecture of the ISCM-40, April 2016, Tel-Aviv University

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The 40th IACMM Symposium was held in April 2016 at Tel-Aviv University, organized by Profs. Isaac Harari and Slava Krylov form the School of Mechanical Engineering. The delightful opening lecture was given by the international invited speaker Prof. Djordje Peric from Swansea University, Swansea, UK, titled "On Computational Strategies for Fluid-Structure Interaction: Algorithms and Applications". This inspiring and well explained talk presented clearly the strategies used for the numerical analysis of fluid-structure interaction problems. *Figure 4* shows Prof. Peric lecturing. *Figure 5* is a group photo of the Invited speaker with the IACMM executive council. Twelve additional presentations were given at ISCM-40, including a talk by Prof. Timo Saksala from the Tempre University of Technology, Finland, on "Combined Continuum Viscodamage-Embedded Discontinuity Model for Numerical Modelling of rate Sensitive Brittle Materials" –*Figure 6*. The IACMM held a competition on the best presentation at ISCM-40. The winner of this competition was Mr. Lior Medina, a PhD student of Profs. Krylov and Gilat, who presented his work in a very enthusiastic and unique way "Snap-Through Behavior of Electrostatically Actuated Initially Curved Shallow Micro Plates". *Figure 7* shows Lior while answering questions from the audience during his talk.

The IACMM elected the PhD thesis of Dr. Igor Sokolov, prepared under the supervision of Profs. Isaac Harari and Slava Krylov, titled "Non-linear Beam Models for Problems of Interaction" as the best PhD thesis in computational mechanics in Israel in 2015. *Figure 8* shows Prof. Yosibash (president of IACMM) while presenting the IACMM certificate to Dr. Sokolov during the General Assembly of the IACMM at ISCM-40. ●

Figure 5:
Group photo of IACMM council and invited speaker at ISCM-40, at Tel Aviv University. Left to Right: Dr. Szanto, Prof. Jabareen, Dr. Ben-Zvi, Mr. Tal, Prof. Krylov, Prof. Harari, Prof. Peric & Prof. Yosibash

Figure 6:
Prof. Timo Saksala lecturing at the ISCM-40

Figure 7:
Mr. Lior Medina (PhD student supervised by Profs. Slava Krylov & Rivka Gilat), the winner of the ISCM-40 best presentation, during an answer to a question from the audience

Figure 8:
Dr. Igor Sokolov (left) receives the certificate on the best PhD thesis in computational mechanics in Israel in 2015 from Prof. Yosibash (president of IACMM) during the General Assembly of the IACMM at ISCM-40

JACM 日本計算力学連合

Japan Association for Computational Mechanics

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The JACM is a union of researchers and engineers working in the field of computational mechanics mainly in Japan. JACM is a loosely coupled umbrella organization covering 29 computational mechanics related societies in Japan through communication with e-mail and web page (http://www.sim.gsic.titech.ac.jp/jacm/index-e.html). The number of individual members is about 310. JACM members actively participate the IACM activities. For example, the members organized 23 minisymposia at WCCM XII & APCOM VI, Seoul, Korea, 24-29 July, 2016 and 26 minisymposia at USNCCM13 in San Diego, USA in July 2015.

On July 27th, 2016, the 2016 JACM annual meeting and award ceremony were held on the occasion of the WCCM XII & APCOM VI, Seoul, Korea (*Figures 1 and 2*). In the award ceremony, the award winners received their certificates from Professor T. Aoki (Vice President of JACM). At the annual meeting, the JACM members discussed the current state of the JACM and future plans and events such as COMPSAFE (International Conference on Computational Engineering and Science for Safety and Environmental Problems, an APACM Thematic Conference & IACM Special Interest Conference) in Chengdu, China, held in October 2017.

The JACM also supports a variety of international and domestic activities related to computational mechanics. As reported in IACM expression No.38, 2015, Japan initiated a new national supercomputer development project named the FLAGSHIP 2020 project. The RIKEN AICS (Advanced Institute for Computational Science) is developing the new exascale supercomputer to be launched in FY2020, that is tentatively called "Post K Computer". In parallel to this, a total of nine projects for developing software applications to solve important scientific and social issues have been conducting. On 12th October, 2016, the first symposium on Issue 6 : Accelerated Development of

Figure 1:
Attendee of JACM annual meeting waiting for the discussions to start

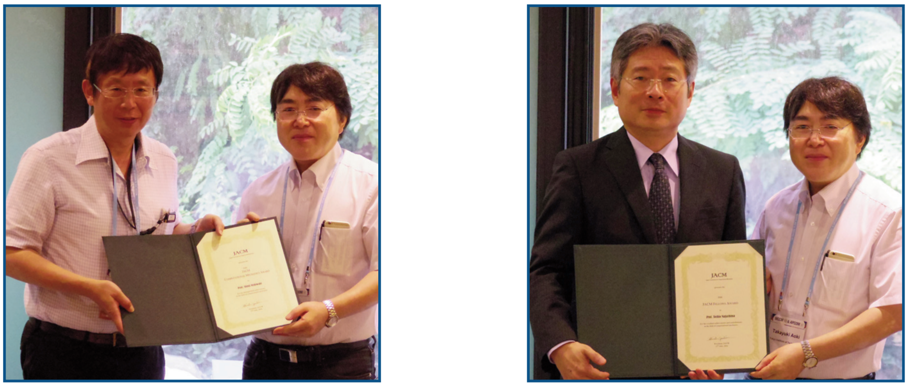


Figure 2:
JACM award winners Professor. S. Nishiwaki (left) and Professor T. Nagashima (right) with Professor T. Aoki in the award ceremony

Innovative Clean Energy Systems, which is leaded by Professor S. Yoshimura (UTokyo) was held. Here the research plans and goals of the following four subtasks were presented, i.e. Subtask A: Energy Conversion Accompanied by High-pressure Combustion and Gasification, B: Advancement of Fuel Cell Design Process by High-performance Computing of Gas-liquid Two-phase Flow and Electrodes, C: Large-scale Numerical Simulations for Constructing High-efficiency Wind Power Generation Systems, and D: Core Design for Fusion Reactor. In a panel session shown in *Figure 3*, we discussed several common issues towards exascale computational mechanics, i.e. code tuning and co-design, multi-steps Verification and Validation, and others.

The 2016 JACM award winners are listed with their photos:

Computational Mechanics Award:
(a) H. Okada (Tokyo Univ. of Science),
(b) T. Kajishima (Osaka Univ.),
(c) S. Nishiwaki (Kyoto Univ.)


(a)


(b)


(c)

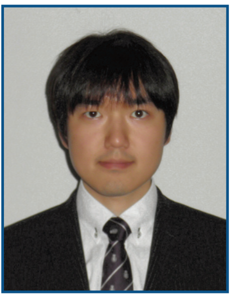
Fellows Award:
(a) M. Sakai (UTokyo),
(b) T. Nagashima (Sophia Univ.),
(c) M. Tanahashi (Tokyo Inst. Tech.)


(a)


(b)


(c)

Young Investigator Award:
(a) Y. Onishi (Tokyo Inst. Tech.),
(b) D. Tawara (Ryukoku Univ.),
(c) M. Uchida (Osaka City Univ.)


(a)


(b)

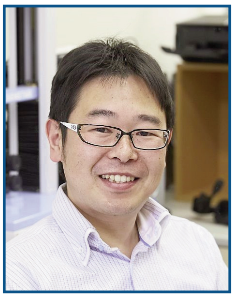

(c)

Figure 3: Panel Discussion during the Symposium of Issue 6 of Post K Computer Project
From Left to Right:
Prof. S. Yoshimura (UTokyo),
R. Kurose (Kyoto Univ.),
N. Shikazono (UTokyo),
M. Yoneda (MIZUHO Co.),
C. Kato (UTokyo))

Towards an Attractive Academic Society

- with higher social presence and for lively young scholars -

Message from the new President of JSCES
Kenjiro Terada

The Japan Society for Computational Engineering and Science (JSCES) was established in 1995 after the third World Congress on Computational Mechanics (WCCM III) in Chiba, Japan in 1994, and honored to celebrate its 20th anniversary in 2015. It has been acknowledged at home and abroad as an exclusive academic society in Japan to pursue further development/progress of computational engineering and science.

Figure 1: *Kenjiro Terada*

This society was officially registered as a general incorporated association of Japan in 2010. Under the articles of incorporations, various regulations were established and the code of ethics has recently constituted, implying that it technically and nominally arrived at manhood. In this situation, it is my pleasure to have an opportunity to serve as its 11th president. I was a Ph.D. student in the U.S. when this society was founded, so I am the first president who did not experience the difficult moments to make it happen. Instead, I helped to run JSCES annual conferences from the 1st time for more than 10 years and enjoyed organizing the body for 10 years as a board member to make it more mature, sometimes with pain. At the same time, such an experience gave me an excellent opportunity to mature myself. I would like to return this favor and make every effort for further development of this society. It is my great honor to take this heavy responsibility as the first navigator for the next twenty years.

Needless to say, “Academic Society” is a place to pursue the benefits, which must be common to researchers belonging to it, for further development of its relevant academic fields. Sharing the same understanding, our goals include deepening the academic system of computational engineering and science based on our past activities, continuing to deliver the research results that could contribute to safer and secure environments with wider range of production activities, and incorporating computational engineering and science into industrial use at higher level and being more implemented into societies by navigating industries to work together with public research organizations more closely.

Under the above-mentioned goals, our work program incorporates the milestones of “deepening computational engineering and science academically, and utilizing it for industries at higher level”, “promoting more energetic research activities”, “preparing frameworks to produce more synergetic effects”, “enriching human resource developments”, “improving international exchange programs”, and “healthy fiscal managements”. Considering again what “the benefits common to members” are, and setting our goals more explicitly, we will organize respective plans more specifically and effectively.
We will then be able to suggest how computational engineering and science is useful for our nation and raise our social reputation.

One of our most important activities is to organize Annual Conferences on Computational Engineering and Sciences, and to publish magazines and journals. In addition to these fundamental activities, we have started a variety of activities to encourage young scholars for next generation and to shape our future. For example, the Doctor Theses Award is now included in the society awards. The JSCES Scholarship Award was established at the 20th anniversary to assist young scholars to attend IACM-supported international conferences. Summer camps and various seminars are held routinely for encouraging potential doctoral students. Study group systems have recently renewed as places for new computational theories and technologies to share, and regularly hold seminars and lectures. Industries, public research organizations and the JSCES exchange active discussions together. Furthermore, international exchange programs such as a series of binational workshops are livelier at higher quality, which have raised our presence.
I will work wholeheartedly on continuing and developing them and appreciate all of your understanding and assistance. ●

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Summer Camp for Students

“The summer camp for students 2016”, which is a successful series hosted by JSCES from 2013, was held during September 18-19, 2016. The seminar facility was located at the lakeside of Lake Kawaguchi near Mt. Fuji, which is one of the famous summer resorts in Japan. This year, 28 students attended to build a relationship among the graduate students from different universities *(Fig. 2).* During this camp, five keynote speakers gave talks on their research background and experiences, followed by 16 students presenting their ongoing researches. The best presentation awards were given to two students (Mr. Yusuke Koakutsu and Mr. Kensuke Harasaki) from Prof. Kenjiro Terada, the President of JSCES *(Fig. 3)*. All attendees enjoyed talking to each other in a relaxed atmosphere of barbeque dinner after lecture meeting *(Fig. 4)*. ●

by:
Seizo Tanaka

Figure 2:
Participants of the JSCES student summer camp 2016

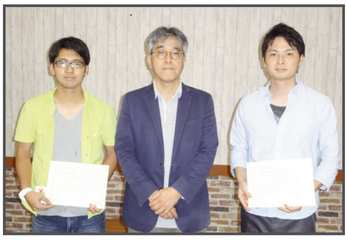


Figure 3:
Winners of the best presentation awards (left to right): Mr. Koakutsu, Prof. Terada, Mr. Harasaki

Figure 4:
Barbeque dinner after lecture meeting

Study Group on Advanced Computational Simulation for Manufacturing (ACSM) in JSCES

As one of the special activities among the 20th Anniversary events in 2015, a study group on Advanced Computational Simulation for Manufacturing (ACSM) was established to discuss the collaboration in the near future, among industry-academia-government in the field of the computer aided engineering and manufacturing. The first committee chairman was Mr. Kazuto Yamamura from NIPPON Steel & SUMITOMO Metals, and the current chairman is Dr. Akira Tezuka, the principal researcher at National Institute of Advanced Industrial Science and Technology (AIST). The current steering committee members of ACSM consist of five industrial researchers, four academic researchers and one governmental officer.

The main event at the meeting held on January 19, 2016, was a panel discussion of issues raised from the needs of the industrial side and issues raised from the seeds of each side. At the end of the meeting, we decided to start drawing a roadmap for both industrial and academic sides. At the last meeting held on March 31, 2016, the industrial and academic roadmap issue was discussed again with a help of graphic recording, a particular scheme carried out by Mr. Toshiaki Kume, a design specialist at Seiko Instruments Inc. It made the key points of the discussion clearer by creating a graphical image of the discussion. ●

by:
Mitsuteru Asai

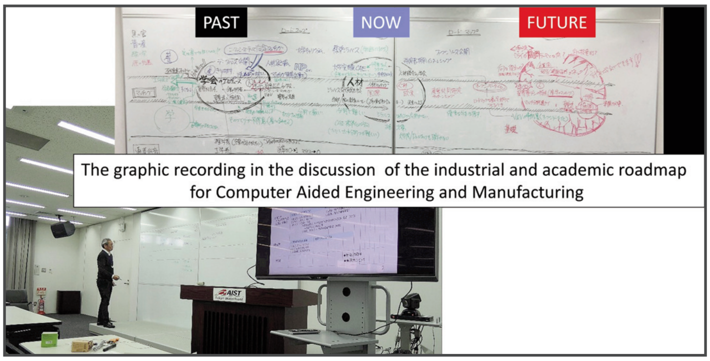


Figure 5:
A scene of graphic recording carried out by Mr. Kume

Other Upcoming Events

The JSCES will hold the 4th Germany-Japan (GJ) Joint Workshop on Computational Engineering under the joint sponsorship with the GACM (German Association for Computational Mechanics) in Sendai and Matsushima, Japan, during March 27-28, 2017. This event is a bilateral workshop to share new ideas, methods and trends for all aspects of computational methods and their applications in mechanics, engineering and applied sciences. The beautiful bay area, Matsushima, is known for its 260 small pine-covered islands arising from the pale blue sea. We believe that this event provides a fruitful time in the scientific discussion, and also a long lasting friendship between the German and Japanese associations under beautiful circumstances. ●

by:
Junji Kato

gacm German Association for Computational Mechanics

In Memoriam
Christian Miehe
(1956 – 2016)

Figure 1:
Christian Miehe
(1956-2016)

The too early and unexpected passing of Christian Miehe on August 14, 2016 at the age of 60 after a serious illness was a shock for all of us. The computational mechanics community lost a worldwide highly respected scientist.

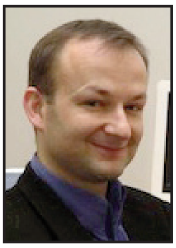
Christian graduated from civil engineering at the University of Hannover and started his academic career in the well-known group of Professor Erwin Stein. A grant of the German Research Foundation (DFG) allowed him to spend two years as post-doc at the University of Stanford; this was a particularly important time for him in the group of Juan Simo. Returning to Hannover he finished his habilitation and became a lecturer and then associate professor for continuum mechanics. Shortly thereafter in 1995 he was called to the Chair for Applied Mechanics and Material Theory at the Department of Civil and Environmental Engineering of the University of Stuttgart. In the over 20 years as head of the institute his research group became one of the most successful and internationally leading institutions in applied and computational mechanics with a special emphasis in material modeling. He was also the chairman of the well-known master program “Computational Mechanics of Materials and Structures (COMMAS)” and substantially contributed to its great success.

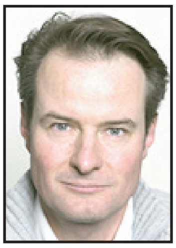
Christian Miehe’s exceptional scientific achievements in solid and structural mechanics and in particular in modeling of heterogeneous materials were characterized by an amazing breadth and impressive depth. His research in structural modeling, shell theories, finite elements for solids, optimization methods including parameter identification characterized by a lot innovations. He established general concepts for the analysis of material behavior representing the complex microstructure and its evolution on several scales, also in multi-physics environments. They include advanced homogenization and multiscale techniques with many novel features, for example using mathematically rigorous minimization principles. Variational consistency has been a key note of his scientific reasoning. His recent works on phase field models were milestones opening a new door for modeling solids at fracture. He appreciated the important role of mathematics and took advantage of the cooperation with scientists from this area. The many excellent, frequently cited archival papers in high rank journals are an evidence for the exceptional quality of his research, also leading to frequent invited lectures on international conferences.

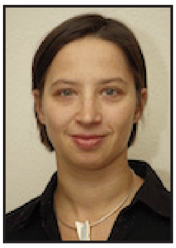
New GACM Executive Council Elected

At ECCOMAS Congress on Crete Island, Greece, in June 2016, the general assembly of GACM took place. The members of the scientific society elected the new executive board for a four years term, which will start January 2017. Main focus points of the next term will be to involve stronger junior scientists into the society and to strengthen the link to industry.

Michael Kaliske from TU Dresden, Vice-President of GACM in the past four years, has been elected as new President and **Marek Behr** has been elected as new Vice-President. Further members of the EC are:
Sven Klinkel, RWTH Aachen (Treasurer)
Andreas Menzel, TU Dortmund (representing solid mechanics)
Sigrid Leyendecker, FAU Erlangen-Nürnberg (representing mathematics and dynamics)
Thomas Münz, Dynamore (representing industry)
Wolfgang Wall, TU München (representing CFD and solid mechanics)
Ines Wollny, TU Dresden, will act as new Secretary General







Christian Miehe was equipped with a remarkable scientific talent and the necessary ambition for high quality work in teaching and research. He was a dedicated educator and a guiding scientific role model for his students. His courses and supervision were definitely a serious challenge and his students' own accomplishments are an evidence for his excellence as teacher and mentor. We sometimes experienced that Christian could be very emotional and impatient when we did not meet his requirements; but we also recognized it was the driving force to reach a better solution, not to forget the high expectations he himself put upon his own performance. His ability to concentrate on the essential was impressive; when he took over a responsibility, we could rely on his commitment to execute the task to a complete satisfaction. A typical example was his term as dean of the Department of Civil and Environmental Engineering in Stuttgart where his input and performance were exemplary.

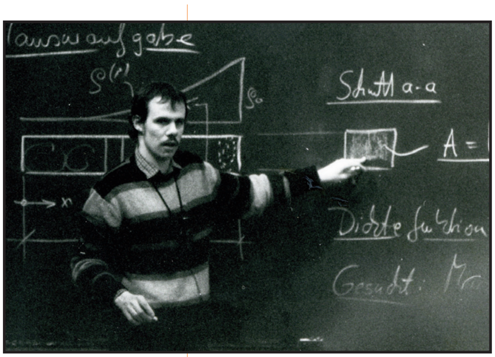


Figure 2:
Christian as research assistant in the group of Erwin Stein, University of Hannover, around 1987 (courtesy of Elke Miehe)

Christian maintained a large international scientific network. He organized workshops and conferences and hosted quite a few scholars in his group, a personal and scientific enrichment to his university. Often this was a starting point of new friendships for all of us.

Most of all, Christian was a great personality and for many of us a wonderful friend. Besides science, the second essential focal point was his family: his wife Elke, who was his true companion since both were thirteen years old, and their sons Robert and Paul. In both scientific and personal matters, one could always count on his straightforwardness, integrity and sincerity beyond paralyzing political correctness and diplomatic chains. His passing is truly a great loss to the world of computational mechanics and leaves a vacuum in our community.

Manfred Bischoff *and* ***Ekkehard Ramm****, Universität Stuttgart, Germany*
Jörg Schröder*, Universität Duisburg-Essen, Germany*

Figure 3:
Christian and Elke Miehe together with Juan Simó in Cologne, Germany, 1994 (courtesy of Elke Miehe)

The 7th GACM Colloquium on Computational Mechanics (GACM 2017) will be organized in Stuttgart, Germany from October 11-13, 2017. The colloquium is hosted by the Institute of Structural Mechanics and the Institute of Applied Mechanics of the University of Stuttgart in cooperation with DYNAmore GmbH. The previous 6 conferences of this series were held in Bochum (2005), Munich (2007), Hannover (2009), Dresden (2011), Hamburg (2013) and Aachen (2015).

The GACM Colloquium on Computational Mechanics (www.gacm2017.uni-stuttgart.de) intends to bring together young scientists who are engaged in academic and industrial research on Computational Mechanics and Computer Methods in Applied Sciences. It provides a platform to present and discuss recent results from research efforts and industrial applications.

Thematically arranged sessions and organized mini-symposia as well as social events will provide an environment for lively discussions in an informal atmosphere. The contributions from young researchers will be supplemented by plenary lectures from three senior scientist from academia and industry as well as from the GACM Best PhD Award winners 2015 and 2016. In addition, there will be a poster session including a plenary poster-flash. All submitted posters are eligible for the GACM Best Poster Award. ***We are looking forward to welcome you in Stuttgart!***

Malte von Scheven,
Marc-André Keip
and **Nils Karajan**
(Conference Chairmen)

Important Dates:

28.04.2017
Submission of Micro-Abstracts

30.06.2017
Notification of Acceptance

31.07.2017
Early Registration

31.08.2017
Submission of extended Abstracts and Posters

Workshop on Advances in Computational Methods for Nanoscale Phenomena

The TTA on Nanotechnology and Lower Scale Phenomena hosted a Workshop on Recent Advances in Computational Methods for Nanoscale Phenomena at the **University of Michigan** at Ann Arbor from **August 29-31, 2016**. Organized by Vikram Gavini (Michigan), Dennis Kochmann (Caltech), Greg Wagner (Northwestern) and Jonathan Zimmerman (Sandia) and support by the National Science Foundation through grant CMMI-1622585, the three-day meeting brought together a diverse group of scientists and engineers (primarily from the US but also from Europe) with a common interest in investigating nanoscale physical phenomena through theoretical, computational and experimental methods. A total of 29 presentations covered topics of material modeling across several length and time scales, starting with electronic-structure and first-principles calculations at the lowest scales, continuing with atomistic techniques, and ascending in scale to continuum methods including phase-field and crystal-plasticity modeling as well as discrete dislocation dynamics and more.

An overarching scheme of many contributions was the development and application of scale-bridging methodologies such as coarse-grained atomistics and density functional theory as well as hierarchical and concurrent multiscale techniques all the way up to computational homogenization. The material systems of interest were as diverse as the computational methods presented. While microstructural evolution in metals was most prominently discussed, presentations also covered geological materials, composites, silicon-based batteries, to name but a few. Especially fruitful was the decision to leave plenty of room for discussions among the more than 50 workshop participants, not only between presentations and in coffee and lunch breaks but also over breakfast and dinner, including the conference banquet on Monday night in Ann Arbor's Gandy Dancer (the beautifully restored 1886 Michigan Central Depot). Tuesday evening's poster session featured 22 posters from students and postdocs and enabled extended collaborative discussions.

The workshop demonstrated how lively, active and diverse USACM's nanoscale community is. Following various USNCCM and related minisymposia on topics of nanoscale computational techniques, this was the first thematic conference of the TTA on Nanotechnology and Lower Scale Phenomena.

Figure 1:
Attendees at recent workshop on nanoscale phenomena in Ann Arbor, Michigan

The organizers would like to thank all participants for making this workshop a success, the NSF for the generous support of travel grants for junior participants (a total of 21 graduate students, postdocs, and junior faculty were supported), and USACM for their support.

Thematic Conference on Isogeometric Analysis and Meshfree Methods

Yuri Bazilevs
JS Chen
Co-Chairs of
IGA-Meshfree 2016

The 2016 USACM Thematic Conference on Isogeometric Analysis and Meshfree Methods took place at **Estancia La Jolla Hotel and Spa in La Jolla, CA** on **October 10-12, 2016**. Professors Yuri Bazilevs and JS Chen from the Department of Structural Engineering at UC, San Diego were the conference Co-Chairs, and the conference was supported by three of the USACM's Technical Thrust Area (TTA) Committees on Isogeometric Analysis, Novel Methods in Computational Engineering and Sciences, and Computational Fluid Dynamics and Fluid-Structure Interaction.

Figure 4:
Tom Hughes delivering a Plenary Lecture titled "Isogeometric Analysis: Present, Past and Future"

The development of Isogeometric Analysis (IGA) and Meshfree Methods, both very important and highly visible areas of Computational Mechanics, was motivated by somewhat different needs in engineering analysis. While IGA development was primarily driven by the need for tighter integration between Computer-Aided Design (CAD) and FEM, Meshfree methods were developed for applications that involve phenomena such as fracture and material fragmentation. Nevertheless, both techniques have many common challenges, among which are analysis-suitable model generation, speed and efficiency of the

USACM Upcoming Events

- **Advances in Computational Sciences and Engineering,** *Austin, TX, March 20-21, 2017,* **http://acse2017.usacm.org/**
- **Quantification and Data-Driven Modeling,** *Austin, TX, March 23-24, 2017,* **http://uqpm2017.usacm.org/**
- **U.S. National Congress on Computational Mechanics,** *Montreal, Canada, July 17-20, 2017,* **http://14.usnccm.org/**
- **Advances in Integrated Computational and Experimental Methods for Additive Manufacturing,** *Golden, CO, September 6-8, 2017,* **http://aicem-am2017.usacm.org/** ●

IUTAM Symposium

Baltimore, June 20-22, 2016

An international group of distinguished experts in the complementary fields of Computational and Experimental Mechanics, and Materials Science from academia, industry and government met at the IUTAM Symposium on Integrated Computational Structure-Material Modeling of Deformation and Failure under Extreme Conditions, held in downtown **Baltimore, Maryland**, on **June 20-22, 2016**. This event was hosted by Johns Hopkins University-Whiting School of Engineering (JHU-WSE) and co-sponsored by USACM. Prof. Somnath Ghosh, the chair of the organizing committee, welcomed the congregation on the first day of the meeting and this was followed by opening remarks by the dean of the Whiting School of Engineering, T.E. “Ed” Schlesinger. The Whiting School’s associate dean of research, Dr. Larry Nagahara, also made an appearance.

A total of thirty-four eminent invited speakers and eight panelists from academia, governmental agencies, and industry presented and discussed their work over the three full days of meeting. In addition to talks, a poster session was included to display the latest research performed by invited junior faculty members and researchers. An important feature of the symposium was panel discussions by leading industry and government visionaries. There were 3 panel discussion sessions focused on (i) fatigue problems, (ii) dynamical problems, e.g. impact and blast, and (iii) radiation and high temperature environments, led by key people from various industries and government agencies.

This symposium provided a platform for experts to discuss multidisciplinary approaches for integrating modeling and simulation, characterization and experiments to predict non-homogeneous deformation and failure in heterogeneous materials including metals, ceramics and composites. It focused on different material classes and covered a range of spatial and temporal scales needed for physics-based modeling of deformation and failure.

Additional funding for this symposium has come from National Science Foundation (NSF), Army Research Organization (ARO) and Los Alamos National Laboratories (LANL).

Figure 2:
Somnath Ghosh opens the workshop

Figure 3:
Presentations made throughout the workshop at the Royal Sonesta Hotel

computational procedures, and numerical quadrature. This USACM Thematic Conference brought together experts in both areas to discuss recent progress in each field, and transfer knowledge and experience between the two communities.

With nearly 200 attendees, the Thematic Conference featured four Plenary Lectures (delivered by Tom Hughes, Dave Benson, C.-T. Wu, and Wing-Kam Liu) and 19 Thematic Sessions. The conference social program included a welcome reception, coffee breaks, lunches, and banquet. The latter was held on the terrace of the new Structures and Materials Engineering building, which is the home of UC San Diego’s Structural Engineering Department.

The Co-Chairs would like to thank all the Thematic Session organizers and the conference participants for their efforts in delivering a high-quality technical program. The Co-Chairs would also like to thank Mrs. Susan Guthrie for her help with the venue selection and social program. A very special “Thank You!” goes to Mrs. Ruth Hengst & Mrs. Jane Hallquist for their great efforts on the administrative front. ●

Figure 5:
Welcome Reception at Estancia La Jolla Hotel & Spa

Figure 6:
Conference Banquet on the Terrace of the Structures and Materials Engineering building

CHILEAN SOCIETY FOR COMPUTATIONAL MECHANICS

for all inclusions under
CSCM
please contact:
Marcela Cruchaga
marcela.cruchaga@usach.cl

The last two years (2014-2015), the Chilean Society for Computational Mechanics (CSCM) in association with the Universidad de Talca and the Universidad de Concepción have organized two Workshops on Computational Mechanics (JMC, acronym in Spanish).

The Universidad de Talca hosted the **JMC 2014** in the city of Curicó on **2-3 October 2014**. This event was co-chaired by Profs. Jorge Hinojosa, Karin Saavedra and Edgardo Padilla from the Industrial Technologies Department and was officially opened by Prof. Claudio Tenreiro, Dean of the Faculty of Engineering, and Prof. Franco Perazzo, President of the CSCM.

The **JMC 2015** was held at the Universidad de Concepción on **8-9 October 2015** to commemorate the 20th anniversary of the first JMC that took place at the same University in 1995. Profs Luis Quiroz, Emilio Dufeu, Pablo Cornejo, Paulo Flores and Cristian Cuevas have locally organized this meeting. Prof. Joel Zambrano, Dean of the Faculty of Engineering; Luis Quiroz, on behalf of the organizers and as co-founder of the CSCM in 1995; and Prof. Carlos Rosales, President of the CSCM, have warmly welcomed the participants in the opening ceremony.

In these workshops, academics, researchers, students and engineers from Chile and others countries met around different topics related to computational mechanics involving theory and applications. The program included Plenary Lectures, Technical Parallel Sessions, the annual CSCM Members Meeting and a banquet.

The Plenary Lectures in JMC 2014 were given by Prof. Olivier Allix (Laboratoire de Mécanique et Technologies in Cachan, France), Prof. Raj Das (University of Auckland, New Zeland), Noemi Zaritzky (Centro de Investigación y Desarrollo en Criotecnología de Alimentos, Argentina) and Gabriel Gatica (Universidad de Concepción, Chile). Prof. Emer. Pierre Beckers (Université de Liège, Belgium), Prof. Marcela Cruchaga (Universidad de Santiago, Chile) and Prof. Héctor Sepúlveda (Universdidad de Concepción, Chile) were the Plenary Speakers in JMC 2015.

Over 200 participants attend each workshop, including 62 speakers in Curicó and 77 in Concepción. In addition, a collection of full papers was collected in the Journal of the CSCM "Cuadernos de Mecánica Computacional", Vols. 12 (2014) and 13 (2015).

The CSCM wants to thank all the participants, in particular the under and post-graduate students, for their contribution to the success of these meetings and invites you to take part of the next JMC 2016 being held on 7-8 October at the Universidad de Tarapacá in Arica. For further information about this event, please contact Prof. Cristobal Castro (ccastro@uta.cl) or visit the website **http://jmc2016.uta.cl**

A video about JMC 2014 is available on the website **https://vimeo.com/142506849** ●

by
Karin Saavedra &
Marcela Cruchaga

Figure 1:
XIII Workshop on Computational Mechanics JMC 2014 at Universidad de Talca

Figure 2:
XIV Workshop on Computational Mechanics JMC 2015 at Universidad de Concepción

for all inclusions under
PACM
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put.poznan.pl

Short Course on Nanomechanics of Materials and Material Structures

Polish Association for Computational Mechanics organized recently two editions of a two-day course titled Nanomechanics of Materials and Material Structures (in Polish: Nanomechanika materiałów i struktur materialnych). The course was held in Poznań at the Poznan University of Technology (PUT) on 1st and 2nd July 2016, and in Kraków at the Cracow University of Technology (CUT) on 6th and 7th October 2016. The course was addressed to young researchers and PhD students who are interested in the nanomechanics approach to modelling of modern materials.
The lecturer, Prof. Gwidon Szefer (CUT), delivered excellent lectures on the wide spectrum of issues including the following topics: sources of nanomechanics, new generation materials, nanotechnology, modelling at different length scales, molecular dynamics and statics, potentials and intermolecular interactions, viral theorems (stress tensors, measures of deformation), molecular-continuum models (Cauchy-Born hypothesis and its extension), models of structural mechanics (numerical analysis of CNT, graphene), elements of quantum mechanics (Schrödinger equation, Born-Oppenheimer approximation), Hellmann-Feynman theorem (atomistic definition of the stress tensor), quantum dots, numerical examples from computational quantum mechanics.

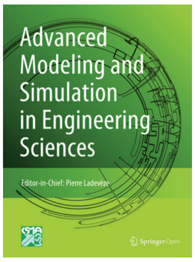
The course in Poznań was supported by the PUT and the Committee on Mechanics of the Polish Academy of Sciences. The course in Kraków was supported by the CUT and the Polish Association of Theoretical and Applied Mechanics, Kraków Branch. A number of PACM members (Mieczysław Kuczma, Jerzy Pamin, Magdalena Łasecka-Plura, Katarzyna Rzeszut, Monika Chuda-Kowalska, Bożena Kuczma, Marzena Mucha) were involved in the organization of the course. Altogether some 70 young researchers and PhD students from Polish universities and research institutes participated in the course. ●

Figure 1:
Prof. Gwidon Szefer lecturing at the Course on Nanomechanics

Figure 2:
Participants of the Course on Nanomechanics in Poznań

Figure 3:
Participants of the Course on Nanomechanics in Kraków

Advanced Modeling and Simulation in Engineering Sciences (AMSES)



Editor In Chief
Prof. Pierre Ladevèze

The Journal

Advanced Modeling and Simulation in Engineering Sciences (AMSES) is a journal affiliated with the Computation Structural Mechanics Association (CSMA). AMSES is a fully open access title and is published by Springer Nature.

Aims and Scope

The research topics addressed by AMSES cover the vast domain of the advanced modeling and simulation of materials, processes and structures governed by the laws of mechanics. The emphasis is on advanced and innovative modeling approaches and numerical strategies. The main objective is to describe the actual physics of large mechanical systems with complicated geometries as accurately as possible using complex, highly nonlinear and coupled multiphysics and multiscale models, and then to carry out simulations with these complex models as rapidly as possible. In other words, this research revolves around efficient numerical modeling along with model verification and validation. Therefore, the corresponding papers deal with advanced modeling and simulation, efficient optimization, inverse analysis and simulation-based control. These challenging issues require multidisciplinary efforts – particularly in modeling, numerical analysis and computer science – which are showcased in this journal.

Topics of Interest

AMSES welcomes submissions on topics that fall into the following major research areas:

- Computational Science and Engineering
- Theoretic and Applied Mechanics
- Classical Continuum Physics

Thematic Series

Topical collections on a wide range of subjects have already been published in the journal:

- **Model order reduction: POD, PGD and reduced bases**
  Editors: Prof. Francisco Chinesta, Prof. Pierre Ladevèze, Prof. Yvon Maday
- **Computational mechanics and medicine**
  Editors: Prof. Bernhard Schrefler, Prof. Elias Cueto
- **Computational Rheology**
  Editors: Dr. Roland Keunings, Prof. Francisco Chinesta
- **Verification and validation for and with reduced order modeling**
  Editors: Prof. Pedro Diez, Dr. Ludovic Chamoin

AMSES by the Numbers

- 77 published articles since the launch in 2014
- 28 articles published per year
- Current rejection rate: 58%
- Submissions and readership from all over the world, spanning from Europe, to Asia and the Americas

Top Cited Articles

- **Membrane wrinkling revisited from a multi-scale point of view**
  N. Damil, M. Potier-Ferry and H. Hu
- **A frontal approach to hex-dominant mesh generation**
  T. C. Baudouin, J.-F. Remacle, E. Marchandise, F. Henrotte and C. Geuzaine
- **Separated representations of 3D elastic solutions in shell geometries**
  B. Bognet, A. Leygue and F. Chinesta
- **Weakly periodic boundary conditions for the homogenization of flow in porous media**
  C. Sandstöm, F. Larsson and K. Runesson

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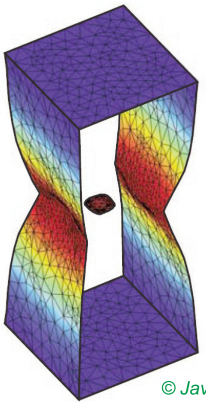

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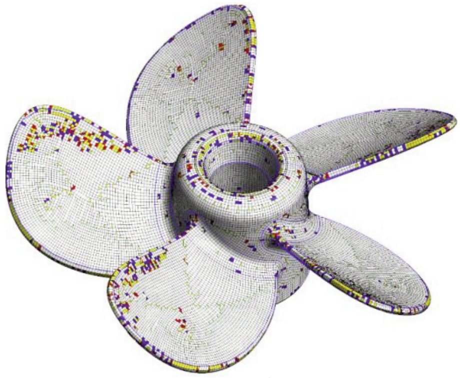

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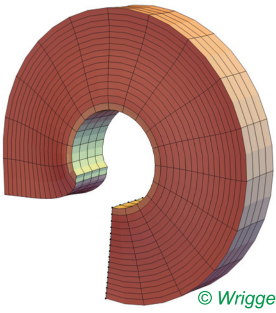
The CSMA partially sponsors the AMSES authors by covering the article-processing charge (APC) of 20 articles per year. The journal and the CSMA welcome proposals concerning the free publication, and will distribute these APC waivers depending on the demand and quality of the submissions.

More funding opportunities and further information on the APC can be found at **http://bit.ly/2er15xJ**

Interview with the Editor In Chief

Get to know more about the man and the ideas behind the creation of AMSES in a recent interview with the Professor Ladevèze to the Springer Open blog at **http://bit.ly/2e4nTaK**



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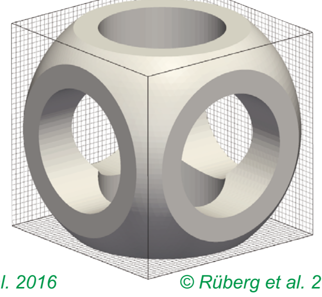

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Special Workshop

Multiscale Modeling of Heterogeneous Structures

MUMO 2016

by:
Jurica Sorić
Member of the
CEACM Board
jurica.soric@fsb.hr

The Workshop "Multiscale Modeling of Heterogeneous Structures" was held September 21-26, 2016 in the city of Dubrovnik, a town-monument and UNESCO world heritage site on the Croatian coast. The workshop was organized by Olivier Allix (ENS Cachan), Jurica Sorić (University of Zagreb) and Peter Wriggers (Leibniz University Hannover).

The objective was to bring together researchers with common interest in numerical modeling of heterogeneous materials. Special attention was focused on multiscale approaches and homogenization procedures as well as damage evaluation and crack initiation. Recent advances in the analysis and discretization of heterogeneous materials were addressed. The state-of-the-art was highlighted with respect different computational methods, software development and applications to engineering structures. Furthermore, the workshop provided an excellent environment to discuss open questions regarding accuracy and efficiency of computational methods. It was a good opportunity for interactions between junior and senior scientists that resulted in a valuable exchange of new ideas.

More than 77 participants from 10 countries took part in this scientific event. Six keynote and 45 regular lectures were presented. Keynote lecturers were Joerg Schroeder (University Duisburg-Essen), Marko Čanađija (University of Rijeka), Francois Hild (ENS Cachan), Werner Wagner (Karlsruhe Institute of Technology), Olivier Allix (ENS Cachan) and Peter Wriggers (Leibniz University Hannover).

The Workshop was held under the auspices of the German Association for Computational Mechanics (GACM), the Central European Association for Computational Mechanics (CEACM), the ENS Cachan, the Leibniz University Hannover, and the Faculty of Mechanical Engineering and Naval Architecture of the University of Zagreb. It was sponsored by the Alexander von Humboldt Foundation, the Deutsch-Franzoesische Hochschule and the Deutsche Forschungsgemeinschaft. The organizers express their deep gratitude to all sponsoring institutions.

The extended abstracts of all contributions were distributed to all workshop participants. Selected peer reviewed papers will be published by Springer in Lecture Notes in Applied and Computational Mechanics.

After a dense day of fruitful scientific gathering, workshop participants enjoyed local hospitality, food, culture, and sight-seeing in the beautiful city of Dubrovnik. ●

Figure 1:
City of Dubrovnik

Figure 2:
Participants at the Workshop venue

conference diary planner

5 - 7 April 2017 **FEF2017 - 19th International Conference on Finite Elements in Flow Problems**
Venue: Rome, Italy Contact: http://congress.cimne.com/FEF2017/

6 - 7 April 2017 **SYMCOMP 2017 - Int. Conf. Numerical & Symbolic Computation: Developments & Applications**
Venue: Minho, Portugal *Contact:* http://www.eccomas.org/vpage/1/14/2017

10 - 12 April 2017 **CMBE17 - 5th Int. Conf. on Computational & Mathematical Biomedical Engineering**
Venue: Pittsburgh, USA *Contact:* http://www.compbiomed.net/2017/

11 - 13 April 2017 **25th UKACM Conference on Computational Mechanics**
Venue: Birmingham, UK *Contact:* http://ukacm2017.ukacm.org/

15 - 17 May 2017 **VII International Conference on Computational Methods in Marine Engineering**
Venue: Nantes, France *Contact:* http://www.eccomas.org/vpage/1/14/2017

15 - 17 May 2017 **MultiBioMe 2017 - Multiscale Problems in Biomechanics and Mechanobiology**
Venue: Corsica, France *Contact:* http://www.eccomas.org/vpage/1/14/2017

30 - 31 May 2017 **PARENG 2017 - V Int. Conf. Parallel, Distributed, Grid and Cloud Computing for Engineering**
Venue: Pecs, Hungary *Contact:* https://pareng2017.mik.pte.hu/

6 - 9 June 2017 **SMART 2017 - 8th Conference on Smart Structures and Materials**
Venue: Madrid, Spain *Contact:* http://www.eccomas.org/vpage/1/14/2017/

12 - 14 June 2017 **COUPLED PROBLEMS 2017 - VII Int. Conf. on Coupled Problems in Science & Engineering**
Venue: Rhodes Island, Greece *Contact:* http://www.eccomas.org/vpage/1/14/2017

14 - 16 June 2017 **CFRAC 2017 -V Int. Conf. Computational Modeling of Fracture & Failure of Materials & Structures**
Venue: Nantes, France *Contact:* http://www.eccomas.org/vpage/1/14/2017

15 - 17 June 2017 **COMPDYN 2017 - 6th Int. Conf. on Comp. Methods in Structural Dynamics & Earthquake Engineering**
Venue: Rhodes Island, Greece *Contact:* https://2017.compdyn.org/

19 - 21 June 2017 **X-DMS 2017 - eXtended Discretization Methods**
Venue: Umeå University, Sweden *Contact:* http://www.eccomas.org/vpage/1/14/2017

26 - 28 June 2017 **ADMOS 2017 - VIII International Conference on Adaptive Modeling and Simulation**
Venue: Lombardy, Italy *Contact:* http://www.eccomas.org/vpage/1/14/2017

30 June - 1 July 2017 **MDA 2016 - 1st International Conference on Materials Design and Applications 2016**
Venue: Porto, Portugal *Contact:* www.fe.up.pt/mda2016

3 - 5 July 2017 **CMN 2017 - Congreso de Métodos Numéricos en Ingeniería**
Venue: Valencia, España *Contact:* http://congress.cimne.com/CMN2017/

11 - 14 July 2017 **2nd Int. Conference Mechanics of Composites**
Venue: Bologna, Italy *Contact:* https://sites.google.com/a/gcloud.fe.up.pt/mechcomp2016/

17 - 21 July 2017 **USNCCM14 - 14th U.S. National Congress on Computational Mechanics**
Venue: Montreal, Canada *Contact:* http://14.usnccm.org/

21 - 23 Aug. 2017 **Modern Finite Element Technologies - Mathematical and Mechanical Aspects**
Venue: Bad Honnef, Germany *Contact:* http://www.eccomas.org/vpage/1/14/2017

5 - 7 Sept. 2017 **COMPLAS 2017 - XIV International Conference on Computational Plasticity**
Venue: Barcelona, Spain *Contact:* http://www.eccomas.org/vpage/1/14/2017

11 - 13 Sept. 2017 **IGA 2017 - International Conference on Isogeometric Analysis**
Venue: Pavia, Italy *Contact:* http://congress.cimne.com/iga2017/

13 - 16 Sept 2017 **CMM-2017 - 22nd International Conference on Computer Methods in Mechanics**
Venue: Lublin, Poland *Contact:* http://cmm2017.pollub.pl/

26- 28 Sept. 2017 **PARTICLES 2017 - V International Conference on Particle-based Methods**
Venue: Hannover, Germany *Contact:* http://www.eccomas.org/vpage/1/14/2017

9 - 11 Oct 2017 **8th International Conference on Textile Composites and Inflatable Structures**
Venue: Munich, Germany *Contact:* http://congress.cimne.com/membranes2017

11 - 13 Oct 2017 **11th SSTA - 11th International Conference "Shell Structures: Theory and Applications"**
Venue: Gdańsk, Poland *Contact:* http://www.ssta.pg.gda.pl

15 - 18 Oct. 2017 **COMPSAFE 2017 - 2nd Int. Conf. on Comp. Eng. & Science for Safety & Environmental Problems**
Venue: Chengdu, China *Contact:* http://http://www.iacm.info/vpage/1/0/Events/

11 - 15 June 2018 **ECCM - ECFD Conference 2018**
Venue: Glasgow, UK *Contact:* http://www.eccomas.org/vpage/1/14/2017

22 - 29 July 2018 **WCCM XIII & PANACM II - 13th World Congress in Computational Mechanics**
& 2nd Pan American Congress on Applied Mechanics
Venue: New York, USA *Contact:* http://www.wccm2018.org/