EUROMECH

Newsletter 23

European Mechanics Society

April 2003

www.euromech.cz

President's Introduction

This is my first introductory message as incoming President of EUROMECH. It is an honour for me to succeed Hans Fernholz who has led with great vision our society during the last five years. Hans Fernholz has been a key figure in EUROMECH during the last thirty five years. He served first as Secretary for EUROMECH Colloquium N1 held in Berlin in 1965, then as Secretary of the EUROMECH Committee from 1972 to 1989, and a member of the EUROMECH Committee, followed by membership of the Council with five years as President. Let me take this opportunity to thank him on behalf of us all for his very effective, yet gentle, leadership which has firmly established EUROMECH as the scientific mechanics society of Europe. Hans Fernholz has kindly agreed to stay on as Vice-President so that we may continue to benefit from his experience and suggestions.

The goals of EUROMECH for the next few years are manifold. We should strengthen and expand participation in the large EUROMECH Conferences. They should be regarded by our community as the essential regular events which offer European mechanicians and sympathizers from other countries an opportunity to exchange and share new research ideas, to see old friends and meet junior colleagues, to recognize outstanding contributions through the award of scientific prizes, etc. These conferences have to be kept lively and made especially attractive to younger people. The meetings of the American Physical Society-Division of Fluid Dynamics come to mind as an example of very successful conferences. At the same time, members of our Society should be encouraged to suggest and organize smaller-scale EUROMECH Colloquia. Those being held in 2003 and 2004 will, for the most part, take place in Germany and France. This situation does not reflect the state of mechanics in Europe and we appeal to members from other countries to send us their proposals. We should also strengthen our relations with the national mechanics societies and engage in a lively partnership with them that preserves cultural and scientific diversity. Last but not least, we should strive to promote activities in newly emerging areas of mechanics which often lie at the interface with other disciplines such as biology, robotics, etc.

2003 will be an election year for the EUROMECH Council which is the governing body of our Society. Four new members will be elected. The Advisory Board (a list of members is available on the Internet at www.euromech.cz) will prepare a list of candidates on whom EUROMECH members will vote in September-October 2003. Suggestions for candidates can be made to any member of the Advisory Board. If you suggest a candidate, please make sure he/she is willing to serve on the Council for six years, and please supply a one page Curriculum Vitae and a complete address.

The final choice of candidates will reflect both the need for some continuity with the remaining Council members and for a suitable distribution over the different countries in Europe. A sufficient representation of the different disciplines within solid and fluid mechanics should also be ensured.

Candidates will prepare biographical notes which will be published in the Newsletter before the elections. The new members of the Council will take office on 1 January, 2004.

It is with deep sadness that I inform you of the death of Dr. John Finley earlier this year. John Finley was the founding editor of the EUROMECH Newsletter and all of us appreciated his commitment to the society. He was a wonderful person and we shall miss him greatly.

I would like to thank all members of EUROMECH bodies and all Chairpersons of EUROMECH Colloquia for their commitment to our Society and their support of EUROMECH.

Patrick Huerre

President, EUROMECH

Contents

Addresses for EUROMECH Officers

President: Professor Patrick Huerre
Laboratoire d'Hydrodynamique, École Polytechnique
F-91128 Palaiseau Cedex, France
E-mail: huerre@ladhyx.polytechnique.fr
Tel.: +33 1 6933 4990 Fax: +33 1 6933 3030

Secretary-General: Doc. Ing. Miloslav Okrouhlik, CSc.,
Mechanics & Solids Department, Institute of Thermomechanics
Academy of Sciences of the Czech Republic
Dolejskova, 5, 182 00 Prague 8, CZ
E-mail: ok@it.cas.cz
Tel.: +420 266 053 158 Fax: +420 286 584 695

Treasurer: Professor Emil. J. Hopfinger
LEGI/IMG, BP 53, F-38041 Grenoble Cedex 09, France
E-mail: emil.hopfinger@hmg.inpg.fr
Tel.: +33 4 7682 5043 Fax: +33 4 7682 5271

Vice President: Professor Dr.-Ing. Hans H. Fernholz
Hermann-Föttinger-Institut, Technische Universität Berlin
Strasse des 17. Juni 135, D-10623 Berlin, Germany
E-mail: fernholz@hobo.pi.tu-berlin.de
Tel.: +49 30 314 23359 Fax: +49 30 314 21101

Web page: http://www.euromech.cz

Objectives of the European Mechanics Society

The Society is an international, non-governmental, non-profit, scientific organization, founded in 1993. The objective of the Society is to engage in all activities intended to promote the development of mechanics in Europe as a branch of science and engineering. Mechanics deals with the motion, flow and deformation of matter, be it fluid or solid, under the action of applied forces, and with any associated phenomena. The Society is governed by a Council composed of elected and co-opted members.

Activities within the field of mechanics range from fundamental research on the behaviour of fluids and solids to applied research in engineering. The approaches used comprise theoretical, analytical, computational and experimental methods. The Society shall be guided by the tradition of free international scientific co-operation developed in EUROMECH Colloquia.

In particular, the Society will pursue this objective through

- The organization of European meetings on subjects within the entire field of mechanics;
- The establishment of links between persons and organizations including industry engaged in scientific work in mechanics and in related sciences;
- The gathering and dissemination of information on all matters related to mechanics;
- The development of standards for education in mechanics and in related sciences throughout Europe.

These activities, which transcend national boundaries, are to complement national activities.

The Society welcomes to membership in the Society all those who are interested in the advancement and diffusion of mechanics. It also bestows honorary membership, prizes and awards to recognize scientists who have made exceptionally important and distinguished contributions.

Members may take advantage of benefits such as reduced registration fees for our meetings, a reduced subscription to the European Journal of Mechanics, information on meetings, job offers and other matters in mechanics. Less tangibly but perhaps even more importantly, membership provides an opportunity for professional identification and for helping to shape the future of our science in Europe and make it attractive to young people.

ARE NEWTON'S LAWS THE FUNDAMENTALS OF SOLID MECHANICS?

Cyril Höschl, Jiří Plešek[1]

Summary: In mechanics of point mass systems, the principle of moment of momentum can be derived from the principle of linear momentum and impulse by purely mathematical manipulation. Both principles follow from Newton's second law. In solid mechanics, i.e., in the mechanics of deformable continuous bodies, these principles are independent. The authors explain this discrepancy. One consequence of the principle of moment of momentum for non-polar media in statics is the symmetry of Cauchy's stress tensor. Contradictory statements can be found in well-known textbooks about the validity of a similiar consequence in dynamics. In connection with this fact, the significance and the role of Boltzmann's axiom is clarified in this article.

Mechanics as a science is only about 350 years old. Despite this, many physicists take it for a closed, finished field; a part of history, which is perhaps decent to know about, but to which nothing can be added. A fleeting glance to many textbooks, however, shows several myths surviving up to today, that have become a firm part of the same history. Those that adhere to life most stubbornly are concerned with the brilliant success with which Newton's laws were applied to the mechanics of celestial bodies. If it is possible, with the Newtonian mechanics of mass particles, to describe and predict the motion of revolving planets and their moons in the Solar system, why not to describe and predict, to the same end, the motion of small bodies and their particles? After all, even a continuum is just an idealized model of a system of microscopic particles – molecules and atoms. Why could not, therefore, the Newtonean mechanics of mass particles serve as a description of continuum motion?

It must suffice, for instance, to model a solid elastic body as a set of material points connected by massless springs. There are n such points; for the k-th point the equation of motion, Newton's second law, must hold

$$\frac{\mathrm{d}}{\mathrm{d}t}(m_k\dot{\mathbf{r}}_k) = \mathbf{F}_k + \sum_{i=1}^{n}\mathbf{F}_{ik} \quad \text{(no sum on } k\text{)} \tag{1}$$

According to Newton's third law, $\mathbf{F}_{ik} = -\mathbf{F}_{ki}$. Summing all the equations, we get the theorem of the balance of linear momentum for the whole body in the form

$$\frac{\mathrm{d}}{\mathrm{d}t}\sum_{k=1}^{n} m_k\dot{\mathbf{r}}_k = \sum_{k=1}^{n}\mathbf{F}_k \tag{2}$$

Multiplying Eq. (1) by the position vector $\mathbf{r}_k$ and then summing up the equa-

[1]Institute of Thermomechanics, Prague

tions again, we have

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathbf{L} = \mathbf{M} + \frac{1}{2}\sum_{j,k=1}^{n}(\mathbf{r}_k - \mathbf{r}_j) \times \mathbf{F}_{jk} \tag{3}$$

where

$$\mathbf{L} = \sum_{k=1}^{n} \mathbf{r}_k \times m_k \dot{\mathbf{r}}_k \tag{4}$$

denotes the moment of momentum and

$$\mathbf{M} = \sum_{k=1}^{n} \mathbf{r}_k \times \mathbf{F}_k \tag{5}$$

is the resultant moment of external forces. If the internal reactions $\mathbf{F}_{jk}$ are the central forces, that is if they act along the straight lines connecting the mass points j, k (no better direction is available), then the cross product in Eq. (3) equals zero. The result

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathbf{L} = \mathbf{M} \tag{6}$$

is known as the balance of moment of momentum. Thus, Eqs (2) and (6) can be derived from the Newton law (1). They are valid for the set of mass points m_k, $k = 1, 2, \ldots, n$. It is sufficient to pass to the limit $m_k \to \mathrm{d}m = \rho\,\mathrm{d}V$ and replace the sums with integrals to obtain theorems treating a solid body as a continuum

$$\frac{\mathrm{d}}{\mathrm{d}t}\int_V \rho\dot{\mathbf{r}}\,\mathrm{d}V = \int_V \rho\mathbf{b}\,\mathrm{d}V + \int_S \mathbf{t}\,\mathrm{d}S \qquad \text{and} \tag{7}$$

$$\frac{\mathrm{d}}{\mathrm{d}t}\int_V \rho\mathbf{r} \times \dot{\mathbf{r}}\,\mathrm{d}V = \int_V \rho\mathbf{r} \times \mathbf{b}\,\mathrm{d}V + \int_S \mathbf{r} \times \mathbf{t}\,\mathrm{d}S \tag{8}$$

in which $\rho\mathbf{b}$ is the body force, ρ density and $\mathbf{t}$ is the traction vector. The volume integral on the left-hand side of Eq. (8) is now called the *angular momentum* of a solid body.

At the moment, it is convenient to pause and point out that the derivation of Eqs (2)–(6) from Eq. (1) is only correct for the set of points, whose number is finite. Even then, the so called mechanics of mass points has an unsound foundation, which was criticized by Georg Hammel [1]. He regarded the point mass mechanics as intellectual impurity. The idea of assigning a finite mass to an infinitely small volume and, therefore, having infinite density is physically unacceptable. Moreover, the set of point masses cannot be a sound mathematical model of a continuum because it does not lead to the same number of elastic constants. Let us recall the historical dispute between the advocates of theories by S.D. Poisson (1781–1840) and A.L. Cauchy (1789–1857).

Clear criticism of the approaches outlined was given by C. Truesdell [2]. He noted that Leonard Euler (1707–1783) had already considered the balance theorems of linear and angular momenta as independent, except for the trivial case when the body was perfectly rigid (there were no elastic constants defined then). According to Truesdell, Euler often walked along the verge of an abyss but had never fallen in. He correctly recognized that Eq. (6) was derived from Eq. (2) but that was not true of Eqs. (8) and (7). These equations were independent.

Truesdell takes for the leading principle the master balance equation

$$\frac{\mathrm{d}}{\mathrm{d}t}\int_B \psi \,\mathrm{d}m = \oint_S \mathbf{i}(\psi)\cdot\mathbf{n}\,\mathrm{d}S + \int_B s(\psi)\,\mathrm{d}m \tag{9}$$

where ψ is a tensor density per unit mass, B is the body contained within its boundary S, $\mathbf{i}$ is the flux of quantity ψ across boundary S, and s is ψ's body source. Quantities $\mathbf{i}$ and s are independent. If all the fields entering (9) are sufficiently continuous, Eq. (9) is equivalent to

$$\rho\dot{\psi} = \mathrm{div}(\mathbf{i}) + \rho s \tag{10}$$

Subsequently, Truesdell substitutes for ψ energy as a scalar quantity, momentum as a vector and, finally, angular momentum represented by a skew-symmetric second order tensor. Three independent theorems governing energy, momentum and angular momentum are arrived at in this way. In particular, the classic theory of continuous media described by the Kirchhoff-Neumann equation is recovered for the specific internal energy $\rho\varepsilon$ as

$$\rho\dot{\varepsilon} = \boldsymbol{\sigma}\!:\!\mathbf{D} + \rho q - \mathrm{div}(\mathbf{h}) \tag{11}$$

with $\boldsymbol{\sigma}$ being the stress tensor, $\mathbf{D}$ the symmetric part of the velocity gradient, $\mathbf{h}$ the heat flux vector, and q is the heat source. Also, two Cauchy equations follow as

$$\rho\ddot{\mathbf{x}} = \mathrm{div}(\boldsymbol{\sigma}) + \rho\mathbf{b} \qquad \text{and} \tag{12}$$

$$\boldsymbol{\sigma} - \boldsymbol{\sigma}^T = \mathbf{0} \tag{13}$$

The latter equation implies the symmetry of the stress tensor – its skew-symmetric part is zero. In general, it may not necessarily vanish (in the Cosserat continuum) but it is always uniquely determined by the angular momentum theorem.

By contrast, I. Szabó proves in the textbook [3], which was published in several editions, that the symmetry of the stress tensor can be proved in statics only. In dynamics, symmetry may merely be assumed (the Boltzmann axiom). Eq. (8) expressed in Cartesian components takes the form

$$\frac{\mathrm{d}}{\mathrm{d}t}\int_V e_{ijk}\rho x_j\dot{x}_k \,\mathrm{d}V = \int_V e_{ijk}\rho x_j b_k \,\mathrm{d}V + \int_S e_{ijk}x_j\sigma_{kr}n_r \,\mathrm{d}S \tag{14}$$

Using the divergence theorem in the last integral, we get

$$\frac{\mathrm{d}}{\mathrm{d}t}\int_V e_{ijk}\rho x_j\dot{x}_k\,\mathrm{d}V = \int_V e_{ijk}x_j(\sigma_{kr,r}+\rho b_k)\,\mathrm{d}V + \int_V e_{ijk}\sigma_{kj}\,\mathrm{d}V \qquad (15)$$

In statics, all the quantities are independent of time. Hence, the left-hand side of the equality vanishes. In view of Eq. (12), the first term on the right-hand side also vanishes. The last term, therefore, must be zero in an arbitrary volume and Eq. (13) follows. In dynamics, the two integrals are, in general, non-zero and so is the last one. Thus, the symmetry of the Cauchy stress must be assumed as an additional requirement – the Boltzmann axiom. Szabó supports his claim by quoting Truesdell's treatise [2] where, however, such an assertion is never mentioned. Indeed, the introduction of Boltzmann's axiom might be replaced with the momentum theorem Eq. (7) that directly yields Eq. (12). With this result, recasting Eq. (14) to

$$\int_V e_{ijk}x_j(\rho\ddot{x}_k - \sigma_{kr,r} - \rho b_k)\,\mathrm{d}V = \int_V e_{ijk}\sigma_{kj}\,\mathrm{d}V \qquad (16)$$

and substituting from Eq. (12) for the term in parenthesis we get Eq. (13). In conclusion, for a non-polar continuum the symmetry property of the stress tensor follows from the combination of the momentum theorems both in statics and dynamics without the neccessity to employ the Boltzmann axiom.

Is this axiom really redundant? The answer is inconclusive. Only two of the three equations (7), (8) and (13) are independent; the third can be derived. If one of the Eqs. (7), (8) is considered to be fundamental and the other a consequence (as in the mass point mechanics) then the Boltzmann axiom is needed. If both equations are understood as independent and, thus, fundamental assumptions, there is no room for another axiom.

This article was written to remind us that each science is subject to perpetual critical querying, even when the field is apparently closed as, for instance, is seemingly the case of mechanics. According to Karl Popper (1902–1994) no science is ever complete since *the science* is an unending quest [4].

References:

[1] Hammel G., 1949. Über die Grundlagen der Mechanik. Mathematische Annalen, LXVI (1908). See also Theoretische Mechanik, Springer Verlag, Berlin.
[2] Truesdell C., 1964. Die Entwicklung des Drallsatzes. Zeitschrift für Angewandte Mathematik und Mechanik, 44, 4/5, pp. 149–158.
[3] Szabó I., 1963. Einführung in die Technische Mechanik. 6th ed., Springer Verlag, Berlin.
[4] Popper K., 1992. Unended Quest: An Intellectual Autobiography. Rev. ed., Routledge, London.

EUROMECH - MECAMAT

7th European Mechanics of Materials Conference (**EMMC7**)

Adaptive Systems And Materials:
Constitutive Materials And Hybrid Structures, 18–23 May 2003

LOCATION: Conference site and participant accommodation will be in Frejus, France, in the Villa Clythia which belongs to the CAES of the CNRS.

Dates:	Abstract due:	15 December 2002
	Notification of acceptance:	31 January 2003
	Paper due:	18 May 2003

SCOPE OF EMMC7

Since the 1990s shape memory alloys and other active materials have been used to design active structures in many industrial fields (biotechnology, aerospace, microsystems, automotive application, civil engineering, ..). This industrial need implies the development of numerical tools for computer aided design processes. Complexity of the material behaviour involved requires a deep understanding of strain mechanisms, the use of accurate experimental techniques and advanced modelling approaches at various scales (micro, meso, macroscopic). This also allows the tailoring of new materials with exciting properties and the improvement of the existing ones.

The EMMC7 conference will address Smart Materials and Systems from the view point of solids mechanics. Four classes of Active Materials will be considered:
- Shape Memory Alloys
- Piezoelectric Materials
- Magnetostrictive Materials
- TRIP Steels

Examples of applications are welcome. Abstracts of papers related to the following topics are encouraged:
- Strain mechanisms in smart materials
- Behaviour modelling
- Experimental characterisation
- Active composite
- Smart structure analysis
- Command and control of hybrid structure
- Microsystems
- Applications of smart materials and systems

EMMC7 CALL FOR PAPERS

The conference will include presentations in oral and poster form. Abstracts of about 500 words are invited before December 15, 2002. They should contain the title of the communication, full names and addresses of the authors, objectives of the study, methods employed and the most significant results. Submission of the abstract by e-mail is recommended. Notification of acceptance and instructions concerning the format of the papers will be sent to authors by January 31, 2003.
For accepted (oral or poster) communications, an eight-page paper will be due before the conference.
Fully refereed papers will be published a few months after the conference as an issue of the *Journal of Physique IV*.

CONFERENCE OFFICE

EMMC7
Prof. E. Patoor
LPMM
Ile du Saulcy
57045 Metz Cedex 1, France
Tel.: +33 3 87 31 54 08; Fax: +33 3 87 31 53 66
E-mail: emmc7@lpmm.univ-metz.fr

EUROMECH Conferences in 2003

5th Euromech Fluid Mechanics Conference
DATE: 24–28 August 2003
LOCATION: Toulouse, France
DEADLINE FOR ABSTRACTS SUBMISSION: 10 December 2002
CONTACT: Dr J. Magnaudet, Institut de Mécanique des Fluides de Toulouse, 2 allée C. Soula, 31400 Toulouse, France
E-MAIL: efmc2003@imft.fr
WEB: http://www.imft.fr/efmc2003

5th Euromech Solid Mechanics Conference
DATE: 17–22 August 2003
LOCATION: Thessaloniky, Greece
DEADLINE FOR ABSTRACTS SUBMISSION: 30 November 2002
CONTACT: Prof. E.C. Aifantis, Lab. of Mechanics of Materials, Polytechnic School Box 468, 54124, Thessaloniki, Greece
E-MAIL: esmc2003@mom.gen.auth.gr
WEB: http://mech3.gen.auth.gr

7th European Mechanics of Materials Conference (EMMC7)
DATE: 18–23 May 2003
LOCATION: Frejus, France in villa Clythia belonging to CAES of the CNRS
CONTACT: Prof. E. Patoor, LPMM, Ile de Saulcy 57045 METZ Cedex, France
E-MAIL: emmc7@lpmm.univ-metz.fr

EUROMECH Conference in 2005

ENOC-2005: 5th EUROMECH Nonlinear Oscillations (Nonlinear Dynamics) Conference
DATES: 7–12 August 2005
LOCATION: Auditorium Building, Eindhoven University of Technology, The Netherlands
CONTACT: Prof. Dick H. van Campen, Dept. Mechanical Engineering, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands
E-MAIL: D.H.v.Campen@tue.nl , Fax: +31 40 243 7175
REMARKS: *Although the brand name ENOC is still used as the historical abbreviation, the ENOC conferences aim at covering the complete field of nonlinear dynamics. The previous ENOC conferences were organized in Hamburg (1993), Prague (1996), Lyngby (1999) and Moscow (2002).*

EUROMECH Colloquia in 2003

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Computer-Aided Optimization of Mechanical System
CHAIRMAN: Professor. Dr.-Ing. Peter Eberhard
Institute of Applied Mechanics, University of Erlangen-Nuremberg, Egerlandstr. 5, 91058 Erlangen, Germany
E-MAIL: eberhard@ltm.uni-erlangen.de
WEB: www.ltm.uni-erlangen.de/euromech442
CO-CHAIRMAN: Prof. Dr.-Ing. habil. Dieter Bestle, BTU Cottbus, Germany
EUROMECH CONTACT PERSON: Prof. Dr.-Ing. Dr. h.c. Werner Schiehlen, University of Stuttgart, Germany
DATE AND LOCATION: 23–27 February 2003, Erlangen - Germany

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High Rayleigh Number Thermal Convection
CHAIRMAN: Professor. Dr. D. Lohse
P.O.Box 217, 7500 AE, ENSCHEDE, The Netherlands
E-MAIL: lohse@tn.utwente.nl
CO-CHAIRMAN: Prof. Dr. F. Busse, Univ. of Bayreuth, Germany
EUROMECH CONTACT PERSON: Prof. H.H. Fernholz, Prof. L. van Wijngaarden

DATE AND LOCATION: 10–18 June 2003, The Lorentz-Center, Leiden, The Netherlands

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Mechanics of Material Forces

CHAIRMAN: Professor P. Steinmann
Chair of Applied Mechanics, University of Kaiserslautern, P.O. Box 3049, D-67653 Kaiserslautern, Germany
E-MAIL: ps@rhrk.uni-kl.de
WEB: mechanik.mv.uni-kl.de/euromech/
CO-CHAIRMAN: Prof. G.A. Maugin, Université Pierre et Marie Curie, Laboratoire de Modélisation en Mécanique 4 place Jussieu, Case 162, 75252 Paris, France
EUROMECH CONTACT PERSON: Prof. A. Benallal
DATE AND LOCATION: 21–24 March 2003, Kaiserslautern, Germany

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High-order methods for the numerical simulation of vortical and turbulent flows

CHAIRMAN: Professor Dr. rer.nat. Michael Schäfer
Fachgebiet Numerische Berechnungsverfahren im Maschinenbau, Technische Universität Darmstadt, Petersenstr. 30, D-64287 Darmstadt, Germany
E-MAIL: schaefer@fnb.tu-darmstadt.de
WEB: www.fnb.maschinenbau.tu-darmstadt.de/euromech446/
CO-CHAIRMAN: Dr. Patrick Bontoux, Laboratoire de Modélisation et Simulation Numérique,CNRS/MSNM unité 2405, IMT Château-Gombert, La Jetéee, 38 Rue Frédéric Joliot-Curie, 13451 Marseille Cedex 20, France
EUROMECH CONTACT PERSON: Prof. Patrick Huerre
DATE AND LOCATION: March 2003, Seeheim, Germany

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Interaction phenomena in turbulent gas-particle flows

CHAIRMAN: Professor Martin Sommerfeld
Fachbereich Ingenieurwissenschaften, Martin-Luther-Universität Halle-Wittenberg D-06099 Halle (Saale), Germany
E-MAIL: martin.sommerfeld@iw.uni-halle.de
CO-CHAIRMEN: Dr. Ph. Ülo Rudi, Director of Estonian Energy Research Institute of the Tallinn Technical University, Paldiski Rd. 1, 10137 Tallinn, Estonia
Prof. Leonid Zaichik,Head of Laboratory of Mathematical Modelling, Russian Academy of Sciences Institute for High Temperatures, Kasnokazaarmennaya 17a, 111250 Moscow, Russia
EUROMECH CONTACT PERSON: Prof. J. Engelbrecht
DATE AND LOCATION: 18–20 June 2003, Tallinn, Estonia

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Vortices and field interactions

CHAIRMAN: Dr. Maurice Rossi
Laboratoire de Modélisation en Mécanique, Université Pierre et Marie Curie (Paris 6),CNRS (UMR n07607) 8 rue du Capitaine Scott, 75015 Paris, France
E-MAIL: maur@ccr.jussieu.fr
CO-CHAIRPERSONS: Dr. Andrew Gilbert, Lecturer in Applied Mathematics, School of Mathematical Sciences, University of Exeter, Exeter, EX4 4QE, UK
E-MAIL: a.d.gilbert@ex.ac.uk
Dr. A. Maurel, CNRS, Lab. Ondes et Acoustique, ESPCI - 10 rue Vauquelin, 75005, Paris, France
E-MAIL: anges.maurel@espci.fr
EUROMECH CONTACT PERSON: Prof. Patrick Huerre
DATE AND LOCATION: **Postponed to 6–10 September 2004, ESPCI, 10 rue Vauquelin, Paris, 75005, France**

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Computational Aeroacoustics: from acoustic sources modeling to far-field radiated noise prediction

CHAIRMAN: Professor Pierre Sagaut
LMM - UPMC/CNRS, Boîte 162, 4 place Jussieu, 75252 Paris Cedex 05, France
E-MAIL: sagaut@lmm.jussieu.fr
CO-CHAIRMAN: Prof. Eric Manoha, ONERA, DSNA/BREC
E-MAIL: eric.manoha@onera.fr
WEB: http://www.onera.fr/congres/euromech-449/
EUROMECH CONTACT PERSON: Prof. Patrick Huerre
DATE AND LOCATION: 9–12 December 2003, Chamonix, France

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Studies on Splashes, a Century after A.M. Worthington

CHAIRMAN: Professor Clanet Christophe
IRPHE, Technopole de Chteau Gombert, 49 rue Frédéric Joliot-Curie, 13384 Marseille, France
E-MAIL: clanet@irphe.univ-mrs.fr
CO-CHAIRMEN: Prof. David Quéré, Physique de la Matiere Condensée, Collège de France, 11 place Marcelin Berthelot, 75231 Paris, France
Prof. Jean-Marc Chomaz, LADHYX, École Polytechnique, Laboratoire d'hydrodynamique, 91128 Palaiseau, France
EUROMECH CONTACT PERSON: Prof. Patrick Huerre
DATE AND LOCATION: **Postponed to September 2004, Carry le Rouet, France**

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Sea Wave Bottom Boundary Layer
CHAIRMAN: Associate Professor Enrico Foti
Department of Civil and Environmental Engineering, University of Catania,V. le A. Doria 6, 95125 Catania, Italy
E-MAIL: efoti@dica.unict.it
WEB: www.dica.unict.it/users/efoti/euromech451
CO-CHAIRMAN: Prof. Jorgen Fredsoe, Department of Hydrodynamics and Water Resourses, Technical University of Denmark, Building 115, DK-2800 Lyngby, Denmark
E-MAIL: fredsoe@isva.dtu.dk
EUROMECH CONTACT PERSON: Prof. Paolo Blondeaux
DATE AND LOCATION: 26–29 October 2003, Taormina, Sicily, Italy

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Advances in Simulation Techniques for Applied Dynamics
CHAIRMAN: Professor M. Arnold
Martin-Luther-University Halle-Wittenberg, Department of Mathematics and Computer Science Institute of Numerical Mathematics, Theodor-Lieser-Str. 5, 06120 Halle (Saale), Germany
E-MAIL: arnold@mathematik.uni-halle.de
CO-CHAIRMAN: Prof. Dr.-Ing. Dr. h.c. W. Schiehlen, Institute B of Mechanics, University of Stuttgart, Germany
EUROMECH CONTACT PERSON: Prof. W. Schiehlen
DATE AND LOCATION: **Postponed to 1–4 March 2004, Halle, Germany**

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Internal Stresses in Polymer Composite Processing and Service Life
CHAIRMAN: Professor Alain Vautrin
Mécanique et Matériaux, École Nationale Supérieure des Mines de Saint-Étienne, 158, cours Fauriel 42023 Saint-Étienne Cedex 2, France
E-MAIL: vautrin@emse.fr
WEB: http://www.emse.fr/euromech453
CO-CHAIRMAN: Prof. Luigi Nicolais, Materials and Production Engineering, University of Naples Federico II, Naples, Italy
EUROMECH CONTACT PERSON: Prof. Ahmed Benallal
DATE AND LOCATION: 1–3 December 2003, École des Mines de Saint-Étienne, France

EUROMECH Colloquia in 2004

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Large Eddy Simulation (LES), Coherent Vortex Simulation (CVS) and Vortex methods for incompressible turbulent flows

CHAIRMAN: Professor Kai Schneider
L3M & CMI, Université de Provence (Aix-Marseille I), 39 rue Joliot-Curie, 13453 Marseille Cedex 13, France
FAX: +33 4 91 11 35 02 PHONE: +33 4 91 11 85 29
E-MAIL: kschneid@cmi.univ-mrs.fr
CO-CHAIRPERSONS: Prof. Marie Farge, LMD-CNRS, École Normale Supérieure 75231 Paris Cedex 5, France
E-MAIL: farge@lmd.ens.fr
Prof. Joel Ferziger, Department of Mechanical Engineering, Stanford University, Stanford, U.S.A
E-MAIL: ferziger@ecoule.stanford.edu
EUROMECH CONTACT PERSON: Prof. Patrick Huerre
DATE AND LOCATION: 12–16 April 2004 at CIRM, Marseille, France.

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Semi-active Vibration Suppression

CHAIRMAN: Professor Michael Valášek Department of Mechanics, Faculty of Mechanical Engineering, Czech Technical University Karlovo nám. 13, 12135 Prague 2, the Czech Republic
E-MAIL: valasek@fsik.cvut.cz
CO-CHAIRMAN: Prof. Andre Preumont, Active Structures Laboratory Department of Mechanical Engineering and Robotics, Faculty of Applied Sciences, Université Libre de Bruxelles, Bruxelles, Belgium
EUROMECH CONTACT PERSON: Asoc. Prof. Miloslav Okrouhlík
DATE AND LOCATION: 2–4 July 2004, Prague, the Czech Republic

First Announcement and Call for Papers

21st INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED MECHANICS

INTERNATIONAL UNION OF THEORETICAL AND APPLIED MECHANICS

15–21 August, 2004 Warsaw, Poland
http://ictam04.ippt.gov.pl

President of ICTAM 2004 and Chairman of the Local Organizing Committee is *Prof. Witold Gutkowski*
Co-Chairmen of ICTAM 2004 are: *Prof. Michal Kleiber and Prof. Wlodzimierz Kurnik*
Secretary-General of ICTAM 2004 is: *Prof. Tomasz Kowalewski*

Correspondence related to the Congress should be sent to:
ICTAM04 Secretary-General, Prof. Tomasz Kowalewski
Institute of Fundamental Technological Research
Swietokrzyska 21, 00-049 Warszawa, Poland
Tel.: +48 22 826 9803 Fax: +48 22 826 9815
E-Mail: ictam04@ippt.gov.pl

All information on ICTAM 04, including forms to submit papers and to register, is available on the Congress World Wide Web site at:
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ICCS'03

The International Conference on Computational Science ICCS'03
St Petersburg and Melbourne

After many requests and discussions with the program committee and the publisher, we are happy to announce that we shall extend the deadline for paper submission by 3 weeks. The new dates are:

- 07 January 2003	Deadline Paper Submission Conference
- 30 January 2003	Programme Committee meets and decides on acceptance
- 01 February 2003	Notification to Authors
- 15 February 2003	Revised versions of accepted papers
- 15 February 2003	Final versions of Workshop papers
- 01 March 2003	Camera ready papers (conference and workshops)
- 02–04 June 2003	Conference at bi-location Melbourne and St Petersburg

Please check the conference site for all details:
http://www.science.uva.nl/events/ICCS2003/

16th AIMETA National Congress of Theoretical and Applied Mechanics
Ferrara (Italy) 9–12 September 2003

Special offer for this meeting: EUROMECH members pay only the same reduced fee as AIMETA members.

This fee is 300 Euros instead of 370 Euros.

CONFERENCE VENUE
University of Ferrara, Faculty of Architecture 'Biagio Rossetti'
Via Quartieri, 8, 44100 Ferrara, Italy

FURTHER INFORMATION
http://www.lineacongressi.it/main.asp?corpo=evento&idcong=24

AIMETA Secretary: Angelo Morro (morro@dibe.unige.it)

Fast-track papers in Journal of Fluid Mechanics

There is a fast-track procedure for papers that will occupy 10 or fewer printed pages. These short papers are neither Letters, nor Rapid Communications, but normal JFM papers that must not appear in expanded form in JFM or elsewhere.

There will be no compromise on the required standards of scientific quality and clarity of writing. Papers especially dealing with the impact of fluid mechanics on neighbouring areas of science will be welcome.

The reviewing procedure will be expedited and the aim is to publish these papers in about 5 months from their initial submission. Communications between authors, editor and referees will usually be electronic. Fast-track papers should be submitted by email to
Professor P. Manneville (manneville.jfm@ladhyx.polytechnique.fr) or to
Professor K.R. Sreenivasan (krs_jfm@ictp.trieste.it),
who are the associate editor designated to deal with them. The papers must be prepared using the JFM latex style file, with the figures incorporated in the text. Authors are advised to contact the editor regarding the form of the files before submission; usually a single PDF or .ps file is needed until the refereeing process is completed. If the papers are likely to require extensive revision or grow as a result of the review process, then they will revert to the regular track. JFM is printed in a typeface that is not in the public domain; this and possible rearrangement of figures may take up slightly more space than the format prepared by the authors. It is therefore helpful to keep the length to about 9.5 pages. Once accepted the papers will be required as LaTex and .eps files. The Papers will appear unsegregated from regular-track papers.

EUROMECH Conference Report

4th EUROMECH Nonlinear Oscillations Conference

Chairperson: Prof. D.M. Klimov

The 4th EUROMECH Nonlinear Oscillations Conference was hosted by the Institute for Problems in Mechanics of the Russian Academy of Sciences, in Moscow (Russia) from 19–23 August 2002. The conference brought together 101 scientists from 21 countries. The program of the conference comprised 9 invited lectures that were presented in Plenary sessions and 133 contributed papers presented in 5 sections.

The scope of the conference covered a wide range of topical issues of the modern theory of nonlinear oscillations and its applications, including those of mathematical modeling of oscillatory processes in nonlinear systems; analytical, geometrical, and computational techniques for the study of nonlinear oscillations; control of vibration; stochastic and chaotic processes in oscillatory systems.

The titles of the invited lectures are now listed:

- H.W. Broer, University of Groningen, The Netherlands: *Geometry of KAM tori for nearly integrable Hamiltonian systems*;
- D.S. Broomhead, University of Manchester, UK: *Oscillations and Eye Movement Control*;
- R.L. Nigmatulin, I.S. Akhatov, Russia: *Nonlinear Dynamics of Bubbles*: Sonoluminiscence and More;
- G. Karolyi, Budapest University of Technology and Economics, Budapest, Hungary: *Fractality, Chaos, and Reactions in Open Flows*;
- D.M. Klimov, The Institute for Problems in Mechanics, Russian Academy of Sciences, Moscow, Russia: *Asymptotic Methods in Nonlinear Mechanics*;
- V.V. Kozlov, Moscow State Univeristy, Moscow, Russia: *Statistical Theory of Oscillations*;
- A. Luongo, University of L'Aquila, Italy: *Multiple Scale Bifurcation Analysis for Finite-Dimensional Autonomous Systems*;
- R. Seydel, University of Cologne, Germany: *Bifurcation - a Mechanism of Risk Analysis*;
- H. Troger, Vienna University of Technology, Austria: *Application of Dimension Reduction Methods to the Oscillations of Continuous Systems.*

The invited lectures provided the participants with awareness of the state of the art and most significant recent achievements in nonlinear oscillations science, major trends in the development of this science, as well as new areas of applications.

Presentations in the section '*General Theory of Oscillations*' were mostly devoted to mathematical methods (both analytical and numerical) of analysis of oscillatory processes in deterministic nonlinear systems of various physical nature.

Numerous problems of control of oscillatory systems were reported and discussed in the section '*Control of Complex Systems*'. Both theoretical and applied aspects were considered.

New results on the investigations of nonlinear wave phenomena and vibration-induced failure processes were reported in the section '*Nonlinear Oscillations in Continuous Media*'.

The section 'Applied Problems of Nonlinear Oscillations' dealt with the study of nonlinear vibratory phenomena in engineering, physical, and biology sciences.

A special section '*Stochastic and Chaotic Oscillations*' was organized for the exchange of results on stochastic vibrations and chaotic phenomena in systems of various physical natures.

The conference has shown the great interest of scientists and engineers from different countries in studying nonlinear oscillatory phenomena and an increasing tendency to international cooperation in this field. A noticeable part of the presentations were made by research teams involving scientists from different countries. The conference confirmed the interdisciplinary character of problems related to nonlinear oscillations. It brought together applied mathematicians, specialists in theoretical mechanics, physicists, mechanical, electrical and chemical engineers, and biologists. Many presentations called for lively discussions. The overall scientific level of the conference was high. At the same time it should be mentioned that the overwhelming majority of presentations were devoted to the theoretical investigation of computer simulation of oscillatory phenomena in nonlinear systems. Experimental studies were insufficiently represented.

A book of abstracts has been published and distributed to the participants.

EUROMECH Colloquia Reports

EUROMECH Colloquium 433
Dynamics of Trailing Vortices

Chairpersons: Prof. W. Schröder (Aachen), Prof. D. Jacob (Aachen)

EUROMECH 433 took place at Aachen University of Technology on 20–22 March, 2002. 63 scientists from 9 countries and 2 continents participated in the colloquium.

The main focus of the contributions was on vortex dynamics in the filed of aerodynamics of aircraft wings. Based on free flight measurements, numerous wind and water tunnel and towing tank experiments, and numerical and theoretical studies for the near and far field of highlift and cruise-flight configurations, the essential phenomena to describe wake vortices were discussed at length. Additionally, some presentations dealt with the behaviour of vortices in internal flows and in aeroacoustics.

The program comprised 3 invited lectures and 47 twenty-five minute oral presentations, were given in the following 8 technical sessions:

- Vortex Breakdown;
- Vortex Merging;
- Vortex Instabilities;
- Aeroacoustics;
- Experimental Studies of Wake Vortices;
- Alternative Numerical Methods for Vortical Flows;
- LES/DNS of Wake Vortices;
- Airport Capacity and Wake Hazards.

In the first invited lecture, P. Huerre and J.M. Chomaz (École Polytechnique) presented an illustrative analysis of '*Instabilities and Control of Vortex Breakdown in Swirling Jets*'. The subsequent discussion determined the outspoken scientific framework of the colloquium. A pioneer in the trailing in the field of trailing vortices, V. Rossow (NASA Ames) gave a comprehensive '*Historical Overview of Research on Lift-Generated Vortex Wakes*' that stimulated an intensive exchange of views on the use of active devices to control wake vortices. In his talk on '*Trailing Wake Vortices in the Atmosphere*' Th. Gerz (DLR, Oberpfaffenhofen) presented a concept to predict the attenuation of vortex wakes by using large-eddy simulations and local meteorological data.

The contributions and the constructive discussion showed future theoretical and applied research in the field of aircraft wakes to focus on four-vortex wake

systems. In the near field, convincing agreement between theoretical, numerical, and experimental finding was achieved. As to the numerical analysis of the far field, it became apparent that new alternative methods should be sought to develop efficient analysis and prediction tools.

To document the current state of the art, a CD-ROM is available containing all lectures of the colloquium.

EUROMECH Colloquium 434
Contact Mechanics of Coated Bodies

Chairpersons: J.J. Klaker (TU Delft, Delft, The Netherlands), V.M. Alexandrov (IPM RAS, Moscow, Russia)

EUROMECH Colloquium 434 took place between 21–23 May 2002 at the Institute for Problems in Mechanics of the Russian Academy of Sciences, Moscow, Russia. The colloquium was also sponsored by the Russian Foundation for Basic Research. At first 73 communications from all over the world submitted to the Organizing Committee were chosen to be presented at the colloquium. Finally 35 participants from the European Union, Russia, the United States, Australia and countries of the Former Soviet Union came to Moscow. The meeting had an informal character, with open discussions and exchange of ideas between researchers.

The scope of the colloquium was to review current advances in the study of contact interaction, friction and fracture of bodies with coatings. The coated bodies are widely used in tribosystems to decrease the energy losses and to increase the wear resistance. The different technologies used for coating implantation produce the coatings with various mechanical and geometrical characteristics and different conditions at the interface. Stress field, temperature distribution and fracture of coated bodies depend essentially on coating properties.

The topics of the colloquium lectures were:-2mm

- rolling/sliding contact of bodies coated by elastic, viscoelastic or plastic layers;
- lubricant contact of coated bodies;
- effect of roughness in contact of coated bodies;
- contact interaction of bodies covered by inhomogeneous coatings and multilayers;
- wear contact problems for coated bodies;
- fracture of coated bodies;
- experimental study of contact, friction and fracture of coated bodies.

Both aspects, theoretical and experimental, were presented.

In addition to recent achievements in the field and current research activities discussed at the colloquium, a memorial lecture was given by Professor Irina Goryacheva at the colloquium opening. The lecture was devoted to the life and scientific contribution of Lev Alexandrovich Galin - one of the pioneers in Contact Mechanics, who worked at the Institute for Problems in Mechanics in 1939–1981 and whose 90^{th} anniversary is celebrated this year.

EUROMECH Colloquium 435
Friction and Wear in Metal Forming (FWMF 2002)

Chairpersons: Prof J. Oudin, Prof. S. Cescotto

EUROMECH Colloquium 435 took place between 18–20 June 2002 at LAMIH, University of Valenciennes, France. It brought together 42 scientists from Western Europe, Poland and Russia.

Metal forming processes represent an efficient way to manufacture reliable products with complex shapes and good properties. Nevertheless, in this wide field, friction at the tool-workpiece interface, wear phenomena, lubrication regimes and surface properties of the final part remain crucial questions for scientists and for industry to save production costs. Moreover, European laboratories are very active in the next PCRD 6th to build up a network of excellence project. Friction and wear constitute one of the main topics of the Virtual Intelligent Foraging European Network proposal.

For all these reasons, besides the three recent very attractive conferences Esaform, Numiform and Numisheet, the FWMF colloquium focused on friction and wear in metal forming has been agreed to by the EUROMECH Council.

The success of forging processes can be enhanced by the use of reliable finite element simulations. On the one hand, the mastering of contact algorithms is required to improve the finite element code accuracy. On the other hand, bulk behaviour laws of coatings and lubricants have to be identified in order to refine computations in the near contact zones. Therefore, specific methodologies – using experimental and numerical approaches – were developed to quantify the friction and wear, and to optimise the forging process.

The scope of the colloquium concerns specific simulations of forming processes with friction and contact conditions related to new experiments and testing apparatus. This includes:

- the improvement of contact algorithms;
- the numerical identification of bulk behaviour of lubricants and coatings;
- the numerical and experimental characterisation of friction and wear;
- influences of coating and lubrication on the success of the forming process.

EUROMECH Colloquium 436
Nonlinear Waves in Microstructured Solids

Chairpersons: Prof. J. Engelbrecht; Prof G.A. Maugin

EUROMECH Colloquium 436 was organised by the Institute of Cybernetics at Tallinn Technical University in Tallinn, from 29 May to 1 June 2002. It brought together 22 scientists (including 3 students) from 8 countries (European Union plus Russia, Estonia and Ukraine). The colloquium was the second in the series, the previous (EUROMECH Colloquium 348 'Nonlinear Dynamics of Heterogenous and Microstructured Solides') was also held in Tallinn in 1996.

This colloquium had a somewhat smaller audience than the 1996 colloquium. Altogether the talks reflected many of the studies made within several co-operative programmes such as the NATO programme '*Thermomechanics of progress and stability of phase interphases (crystals, alloys)*', and two INTAS programmes on '*The synergetic approach to the analysis of advanced materials - nonlinear wave dynamics of structurally sensitive media*' and '*The multi-level-physics approach to nonlinear localized strain waves in solids*'. In addition, close to these studies is the ongoing ESF Programme NATEMIS on 'Nonlinear acoustic techniques for microscale damage diagnostics'.

As stated in calls for participation, the colloquium was planned to cover the physically motivated modelling of wave propagation in structured solid materials with a special attention to nonlinear effects related to or interacting with the microstructure. Both theoretical and experimental studies were planned to be discussed including also numerical techniques.

Altogether 6 scientific sessions were held along with 2 discussions, one on experimental techniques (related to NATEMIS) and the other on the general outcome of the colloquium. The sessions started with an Introductory lecture (J. Engelbrecht) explaining the aims of getting a better understanding of physical phenomena which affect the wave propagation in microstructured solids and of finding out effective methods for analysing these phenomena. The general ideas of nonlinear wave mechanics in complex materials were presented (G.A. Maugin), focusing on the relationships between dynamical localized concentrations of continuous fields and the notion of quasi-particles. The complexity of

rough surfaces was explained by using scalar exponents describing the geometrical properties (J. Kalda). The importance of heat and moisture transfer in solids was stressed (A. Szekeres) where coupling leads to nonlinear effects.

The surface waves in coated structures have been analysed. The shear solitons were described (A. Kovalev et al.), and observed also in experiments (A. Mayer et al.). The corresponding evolution equations may involve nonlocal nonlinearity (terms containing a Hilbert transform). Such solitons become more and more important due to wide applications. A possibility to describe bi-layered materials by a lattice model leads to coupled equations of the Klein-Gordon type (K. Khusnudtinova). The lattice model was also used in order to explain discrete multi-breather dynamics (M. Bogdan) and the slowness diagram of 2D lattices (M. Braun).

The multisoliton complex dynamics requires the solution of a nonlinear eigenvalue problem (M. Bogdan). On the other hand, in most practical cases exact solutions can be found only if certain differential constraints are valid (D. Fusco). If modelling is based on stepwise construction of balance laws then several mathematical models can be constructed. Waves in granular media with particle rotation were described (A. Potapov et al.), in solids with vectorial microstructure (F. Pastrone) and in solids with dissipative microstructure (T. Sillat et al.). Motivated by experimentally observed strong nonlinearities in a microstructure, a corresponding mathematical model was presented (J. Engelbrecht et al.), which could also explain the basic structure of the Mindlin model. The various numerical results have been described using a general evolution equation (A. Porubov et al.), an evolution equation with quartic nonlinearity and higher order dispersion (O. Ilison et al.), a hierachical KdV-equation (L. Ilison et al.). Periodically forced solitonic structures were found (A. Salupere et al.). The pseudospectral method has been used in most of these calculations.

Last, but not least, attention was turned to experimental results and their interpretation. A review of nonlinear spectroscopy techniques for microdamaged material was presented (K. Van Den Abeele). These studies are a part of the NATEMIS programme. Another part was described on the basis of a simplified cell approach (M. Scaleranti). It was accompanied by numerical studies of waves and fronts in structured materials (a thermodynamic approach) compared with experiments (A. Berezovski et al.). It was shown how nonlinear acoustic waves interact with material inhomogeneities (A. Braunbrück et al.). Finally, it was demonstrated experimentally and theoretically that bulk solitary waves exist in plexiglas (A Samsonov et al.).

The discussion showed the goal for the studies in the near future. There exists an excellent theoretical basis of continuum mechanics and there exist excellent experimental facilities. In addition, the analysis of model equations has been developing fast. The future aim is to bring all this knowledge together in order to create a synergetic effect explaining the physical phenomena such as

dispersion, dissipation, existence of solitary waves, etc. based on experimentally measured material characteristics. Only such a combination of knowledge gives rise to applications of complex materials under dynamical influences.

The articles from the colloquium will be published in the Proc. Estonian Acad. Sci, Phys-Maths series in 2003.

The organizers acknowledge the display of journals 'Proc. Estonian Acad. Sci, Phys-Maths', and 'Comptes Rendus Acad. Sci, Mecanique', generously donated by the publishers.

EUROMECH Colloquium 437
Identification and Updating Methods of Mechanical Structures

Chairpersons: Ing. Jan Kozánek, PhD. (Czech Republic), Prof. Gérard Lallement (France)

EUROMECH Colloquium 437 was held from 19–21 June 2002 in Prague, Czech Republic, in the Institute of Thermomechanics, Academy of Sciences of the Czech Republic. There were 48 participants from 18 countries and 45 presentations which are published in a Book of Abstracts of 62 pages.

The colloquium brought together scientists and researchers interested in the generation of linear and nonlinear mathematical models of dynamical systems. The main areas of interest were the parametric identification (in the frequency and time domains) and vibrodiagnostics of experimental data, followed by the updating of existing models.

The Organizing Committee acknowledged the contribution of Assoc. Prof. O. Danek from Institute of Thermomechanics AS CR, Prague, in the field of Dynamics of Machines, particularly in the Identification and Tuning of Mechanical Systems and Structures. We wish him good health and further success in his scientific work.

The scientific program focussed on the following scientific topics:

- Parametric identification of dynamical systems in the frequency and time domains;
- Curve fitting of Transfer functions;
- Identification of vibrating systems with small non-linearities;
- Spectral and modal sensitivity;
- Updating methods of Finite Element models;
- Tuning and vibrodiagnostics of Mechanical Structures;
- Robustness of model-based decisions with respect to uncertainties.

The colloquium was opened by the director of the Institute of Thermomechanics AS CR Assoc. Prof. Jaromír Příhoda. An excellent opening lecture '*Experimental modal analysis: realities, applications and perspectives*' of the colloquium was given by Prof. Gérard Lallement from the Applied Mechanics Laboratory RC, University of Besançon, France. The other papers covered the following scientific topics:

- Time Domain and Frequency Domain Methods (J. Antoni)
- Wavelet Analysis (P. Argoul)
- Identification of critical speeds of rotors (M. Balda)
- Identification of Turbine Blades with Friction Damping (J.-U. Bruns)
- Structural Damage Detection by Eigensolutions Measurements (A. Bouazzouni)
- Theory of Modelling of Vibrating Mechanical Systems and Processes (A. Buchacz)
- Modal Identification Possessing Cubic Stiffness (R. Camillacci)
- Model Updating with Supermodels (G. Chen)
- Material Damping for Composite Laminate Structures (M. Dalenbring)
- The modelling of electromagnetic exciters (T. Gáspár)
- Identification of Statically Indeterminate Rotor Bearing Systems (E.J. Hahn)
- Identification and Compensation of Friction (B. Heimann)
- Adaptive Stabilisation of the Jet-Edge-Flow (A. Ickler)
- Identification of Nonlinear system's parameters (D.V. Iourtchenko)
- Identification and Updating of Mistuned Bladed Disk Assemblies (B. Irwanto)
- Application of FEM - Temperature and Displacement for Metal-ceramic Joints (J. Juraszek)
- The Vibration of the Paper Machine Roll Presses (J. Karhunen)
- Identification of Rheological Parameters (N.N. Kizilova)
- The Mathematical Model of a Mobile Crane (J. Klosinski)
- Permanent Magnetic and Aerodynamic Contactless Bearings (J. Kozánek)
- Modal Identification in Resonant Ultrasound Spectroscopy (M. Landa)
- The Use of Pade Approximants in Identification (J. Lardies)

- FEM Updating of Flexible Rotors (S. Lindemann)
- Modal Analysis of the Crane Telescoping Jib (A. Maczynski)
- Modelling and Dynamic Behaviour of a Pump (E. Malenovský)
- Model Response Expansion (S. Michot)
- Detecting Cracks in Vibrating Beams (A. Morassi)
- Model Reduction Methods in Nonlinear Dynamical Problems (L.I. Myklebust)
- Freedom Reduction and Stiffness bounding in Structural Mechanics (B. Nayroles)
- Time-Domain Identification (L. Pešek)
- Active Damping of Laminated Plates (M. Pietrzakowski)
- Appropriation and Condensed FRF Curve-Fitting (J. Piranda)
- Bayesian identification of non-linear systems (S. Pisapia)
- Fatigue Crack Identification in Rotor Systems (R. Platz)
- Homology Structure of Ergodic Measures (A.K. Prykarpatsky)
- Identification of Constitutive Viscoplastic Law (M. Pyrz)
- Identification of the Shaft-Bearing Assembly (A.V. Radulescu)
- Friction Identification Using Local Linear Models (H. Schulte)
- Distributed Stiffness Identification Using Mode Shape Information (H. Sol)
- Nonlinear Identification - Time Response Prediction (M. Stefan)
- FEM Updating Method by Damage Functions (A. Teughels)
- Wave Phenomena in Thin-Wall Structures (J. Trnka)
- Diagnostic Magneto-Kinetic Equipment (F. Vaněk)
- Substraction Technique for Modal Parameter Estimation (H.P. Yin)

EUROMECH Colloquium 439
Mathematical modelling of the dynamic behaviour of thin elastic structures

Chairpersons: Prof. Leonid Yu. Kossovich (Saratov State University), Prof. Julius D. Kaplunov (Manchester), Prof. Graham A. Rogerson (Salford)

EUROMECH Colloquium 439, hosted by the Saratov State University, Russia, took place on 24–27 July 2002. Most of the participants came from the United Kingdom and Russia, but there were also visitors from Denmark and Ireland, as well as from the United States, China and Armenia. The interest of the Colloquium demonstrated the importance of the chosen topic for both modern applied mathematics and engineering.

The papers presented at the Colloquium covered many aspects of various techniques associated with modelling of the dynamics of thin-walled structures, such as rods, plates and shells, within different constitutive frameworks. Various aspects of stationary and non-stationary wave motion in thin isotropic and anisotropic / pre-stressed / layered structures were illustrated in many talks, including those by Professor Fu and Professor Ustinov. Doctor Scott demonstrated the propagation of generalised thermoelastic waves in an isotropic rod. Aspects of visco-elasticity, piezo-elasticity, non-linearity and microstructure were covered in talks given by Professor Sargsyan, Professor Zemlyanukhin and others. Within this context of mathematics applied to serve the needs of natural sciences, probably the presentation given by Professor Lavrentyev was a scientific highlight of the conference. A leading Russian cardio-vascular surgeon working at the famous Bakulev's Centre, he presented a series of challenging mathematical problems based on his own medically motivated hypotheses.

Particularly pleasing aspects of the meeting were the number of senior Russian scientists, including those from former Russian States, elaborating techniques and methodologies still not too well known outside Russia and a significant number of post-graduate students from outside Russia. Many modern trends were reflected, among them: the analysis of high-frequency and short wavelength phenomena, generalisations to coatings and interface layers, i.e. applicable for not only traction free faces. A common theme was the almost total dominance of a rigorous asymptotic approach with most state of the art theories involving no ad hoc hypotheses. A close link with other areas of continuum mechanics was shown. In particular, several papers dealing with edge vibration were presented at the Colloquium, including an outstanding talk by Professor Tovstik on localised vibration modes in thin shells.

During the colloquium numerous fruitful discussions were conducted, new friendships and collaborative links were born, and the participants had a fair chance to sample Russian hospitality and culture.

EUROMECH Colloquium 440
Aerodynamics and Thermochemistry of High Speed Flow

Chairpersons: J.-P. Dussauge, A. Chikaoui (IRPHE, France)

EUROMECH Colloquium 440, was held in IUSTI, Marseille, France, from 16–19 September 2002. It brought together 50 scientists, from 6 European Union countries and Russia.

The objective of this colloquium was to cover the main scientific problems occurring in supersonic and hypersonic flights, in relation with situations found in aeronautics or during the reentry into an atmosphere. The selected papers dealt with the physics of phenomena or with the development of appropriate methods. Theoretical, numerical and experimental contributions have been considered.

For questions related to aerodynamics of high speed flows, presentations about the following topics have been made: compressible turbulence in shear flows, separated or not, including interactions with shock waves; stability and unsteadiness of shock waves, control of jets and of shock systems, stability of compressible flows; the progress of appropriate experimental and numerical methods has also been discussed. Hypersonic flow problems were mainly focused on the thermochemistry of reactive flows, including catalycity effects, radiative transfers and characterisation of radiation downstream of shocks of strong intensity. Diagnostic methods in hypersonic/hyperenthalpic facilities were also examined. Particular attention was paid to questions related to the reentry into Mars atmosphere, in connection with the question of thermal protection of space vehicles.

Some conclusions can be drawn from the papers presented during the sessions.

It was confirmed that significant progress has been made by (and can still be expected from) diagnostic methods applied to high speed flows. Results of flow visualizations obtained by filtered Rayleigh scattering enhanced by CO_2 injection used with laser pulsed at a high rate (of the order of 1 MHz) and with an ultra fast camera (also up to 1 MHz) have given remarkable results on the structure of hypersonic boundary layers. Recent progress confirms also that PIV, in spite of the difficulties inherent to the seeding of supersonic flows by particles, can give reliable quantitative results. Finally, experiments in transitional hypersonic boundary layers have shown that, when properly used, traditional hot wire measurements can provide measurements at frequencies up to 500 kHz!

Numerical investigations on compressible turbulence mainly explored the possibility to compute supersonic flows in different situations with turbulence closures (1 or 2 closures) essentially designed for solenoidal turbulence. They are essentially related to attempts to solve the difficulties inherent to supersonic

flows, due partly to the presence of shock waves, before moving to more physical closures.

Some presentations were dedicated to flow control. The case of supersonic jets and of shock wave intersections was explored. The control of jets was made by small transverse jets; it appears that the effect of the transverse jets is to increase the surface of the main jet and therefore to increase mixing. The control of shock wave intersection (Edney IV) was made by hot spots or by cold plasma; the main effect seems to be in the increase of temperature and the correlative decrease of Mach number, rather than in the change in molecular mass or electrostatic forces.

Stability studies were well represented, in particular by many contributions from numerical simulations. However, analytical and experimental work was still important and well represented for 3-d boundary layer, jets, and shock waves. The field is still in development.

Studies on shock/turbulence and shock/boundary layer interactions have shown improvement in the definition of experimental conditions, coming essentially from a better definition of the boundary conditions imposed to the shock.

For reactive flows, a model describing the vibrational and electronic kinetics has been proposed to evaluate the infrared and ultra-violet radiation, in the case of CO. Moreover, a rebuilding method for hyperenthalpic nozzle flows has been presented for CO_2. This method gives a characterisation of such flows, together with indications about the relevant models.

Finally, the subsequent result is a gain in accuracy for the prediction of thermal fluxes over the probe during the Mars Sample Return mission.

Contributions to the experimental simulation of hyperenthalpic flows was also given. Among them, an arc plasma facility was presented, with which it is possible to match reentry conditions in the Martian atmosphere. Moreover, results were obtained about diagnostics methods applied to the mixture CO_2-N_2, in hyperenthalpic conditions.

This conference has been successful in getting together European experts working on high-speed flow physics. Discussions were numerous and of good quality, so that the conference was a rather animated one. In particular, the danger of a dispersed interest between purely aerodynamic topics and real gas effects purely connected to chemistry has been mostly avoided. Some prospects can be drawn from the presentations. Progress in particular in experimental methods and in compressible modelling can be expected, and should lead to a better understanding of the effect of compressibility on large scale eddies. Similarly for reactive flows, some promising prospects can be defined. At this stage, it seems likely that the experts are ready to propose schemes and models to describe the reactive processes and the kinetics in cases of interest for the space missions under examination and definition. Such models should be designed

to be incorporated into CFD codes. Another axis to be developed is the study of radiative fluxes, which are of primary importance for reentry phases. They depend critically on kinetics (for Mars atmosphere, of CO_2-N_2 with radical CN, CO, and C_2). The expected results should lead to a better optimisation of the heat shields, but for more fundamental issues, this could lead to a control of the rate of ionisation during phases of reentry.

Finally, the meeting has shown that at a European scale, there are a sufficient number of experts for the animation of the scientific life in the field. The skills of this European group has shown that, with the work which has started in different places, other meetings on similar topics help in a few years will be useful, and will contribute to encourage research on high speed flows.

EUROMECH Colloquium 444
Critical Review of the Theories of Plates and Shells and New Applications

Chairpersons: R. Kienzler (Bremen), H. Altenbach (Halle)

EUROMECH 444 was held at the 'Atlantic Hotel Universum' in Bremen on 22–25 September 2002. There were 50 participants from 15 countries. The presentations were divided into two groups: 26 oral presentations and 16 posters. It was considered that this was the optimum for such a EUROMECH colloquium with a limited number of participants.

The main items and subjects of the presentation and discussion were:

- formulation approaches and principles of general theories;
- formulation of applied theories;
- numerical approaches;
- asymptotic analyses; and
- applications.

The conference brought together engineers with civil and mechanical engineering backgrounds, mathematicians and others. The participants conclude that there is not "a best theory or formulation approach", but with respect to applications you can find better and partly new approximations of the three-dimensional field equations.

All suggested theories are approximate, and the accuracy depends on many factors. In addition, the full reconstruction of the three-dimensional solutions

is impossible since any two-dimensional theory is connected with some loss of information.

Applied contributions were related to light-weight structures (sandwiches, composites) and to coupled field problems (thermo-mechanical-electrical-magnetic-...). Due to the fact that there exists a practical need such applications will also be discussed in the future.

Finally, the asymptotic approach was discussed. It was shown that we have to build more and more bridges to engineering problems.

Information for prospective chairpersons of EUROMECH Colloquia

a) EUROMECH will give three grants of 200 Euro each (total 600 Euro), for the support of young participants. The recipients should not be from the chairperson's institute. The chairperson can either request the amount, in a letter addressed to the Treasurer, or deduce it at the end of the Colloquium from the amount of additional registration fees collected from non-members, then due to be sent to the Treasurer. The names and addresses of the grant recipients should appear in the final report.

b) EUROMECH members will be allowed a 32 Euro reduction in the registration fee. Their identification is their membership number, which may be requested by the chairperson. Non-member participants who have paid the full registration fee can become members by sending a completed membership application form to the President, (available from the chairperson or on www.euromech.cz). The 32 Euro will in this case be credited as membership dues for the year of the Colloquium.

c) After the Colloquium or Conference the chairperson should transfer to the Treasurer (within a month after the meeting) an amount corresponding to the 32 Euro collected from the non-member participants, together with a list of participants, indicating members and non-members.

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