EUROMECH
European Mechanics Society

Newsletter 10
January 1998

President's Introduction

I am very pleased to be in a position to inform EUROMECH *members that a successful outcome has been reached in the* EUROMECH *Council elections. Details of the votes cast are reported elsewhere in this Newsletter. Here I simply welcome to membership of the Council, for six years from 1 January 1998, Professor Franz Rammersdorfer of Vienna, Professor Paolo Blondeaux of Genoa and Professor Erik van der Giessen of Delft. All aspects of* EUROMECH *work will benefit greatly from their efforts, and from that of the other two newly-elected members of Council, Professor Hans Fernholz of Berlin (President) and Dr Miroslav Okrouhlik of Prague (Secretary General), who join Professor Emil Hopfinger of Grenoble (Treasurer) as the Euromech Officers.*

I want to thank the other candidates who stood for election and were not on this occasion elected. Readers will see that there was strong support for all of them, and I hope very much that they will continue to make valuable inputs to Euromech activities.

Although a satisfactory outcome of the elections was reached, it is clear that the election procedures could be improved in some ways. There are persistent difficulties still with the mail services in parts of Europe, which meant that voting papers did not reach members in adequate time. The request has also been made that with the voting papers there should be a fairly brief statement of the qualifications and interests of each of the candidates; and such a statement will certainly be provided for the next elections.

In handing over now to Hans Fernholz as incoming President, I would like to thank all those who have been involved with EUROMECH, *one way or another, for everything they have done to set up an organization which has done much for the science of mechanics right across Europe, even in the earlier times of substantial political division within Europe, and who have done so much to make* EUROMECH *meetings, whether of Council, colloquia or conferences, such scientifically and personally rewarding experiences. It has been a privilege for me to have had some part in the development of these activities.*

David G.Crighton
Retiring President, EUROMECH

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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 3142 3359. Fax: + 49 30 3142 1101.

Vice-President: Professor David.G.Crighton,
Department of Applied Mathematics and Theoretical Physics (DAMTP),
University of Cambridge, Silver Street, Cambridge CB3 9EW, England.
e-mail: dgc@damtp.cam.ac.uk
Tel: + 44 1223 337 860. Fax: + 44 1223 337 918.

Secretary-General: Doc. Ing. Mila Okrouhlik, CSc.,
Head of Mechanics & Solids Department, Institute of Thermomechanics,
Academy of Sciences of the Czech Republic, Dolejskova 5, 182 00 Prague 8.
e-mail: ok@bivoj.it.cas.cz
Tel.: + 42 2 688 5158. Fax: + 42 2 858 4695

Treasurer: Professor Emil.J. Hopfinger,
LEGI/IMG, B.P. 53, 38041 Grenoble Cedex 09, France.
e-mail: emil.hopfinger@hmg.inpg.fr
Tel.: + 33 476 82 50 43. Fax: +33 476 82 52 71.

Journal Editor: Dr. John Finley
Department of Aeronautics,
Imperial College of Science, Technology and Medicine,
Prince Consort Road, London SW7 2BY, UK.
e-mail: j.finle@ae.ic.ac.uk
Tel.: + 44 171 594 5063. Fax: + 44 171 584 8120

There is an internet web page being prepared at
http://www.euromech.maths.org.uk

Please copy this at A4 size and pass to any likely prospects

EUROMECH Membership Application Form

I would like to apply for membership of EUROMECH

Family name/surname:

First (given) name:

Title (Prof., Dr., etc.):

Position:

Work address:

Phone: Fax:

E-mail: Internet:

Research interests:

Names and addresses of two referees whom the Society may consult:

Signature

Please tick if you are a member of:

AIMETA _____ AUM _____ BYELOMECH _____

CCEMS _____ GAMM _____ USME _____

Please return this form to Prof. H.H.Fernholz

Hermann-Föttinger-Institut für Strömungsmechanik, Technische Universität Berlin,
Straße des 17 Juni 135, D-10623 BERLIN, Germany.

e-mail: fernholz@hobo.pi.tu-berlin.de

Miscellaneous Announcements

Upcoming EUROMECH Colloquia and Conferences are listed in Newsletter 9.

European Summer School on Modelling and Control of Mechanical Systems. Alghero, Sardegna, Italy. 2nd – 6th June, 1998.
e-mail: Bernard.Brogliato@lag.ensieg.inpg.fr

2nd. ERCOFTAC Summer School on Turbulence and Transition Modelling
Royal Institute of Technology, Stockholm, Sweden. 10th – 16th June 1998
e-mail: ercoftac@mech.kth.se (Catrin Engelstrand)
http://www.mech.kth.se/ercoftac/information.html

13th Australasian Fluid Mechanics Conference
Monash University, Melbourne, Australia. 13th – 18th December, 1998.
e-mail: afmc@eng.monash.adu.au (K.Hourigan)
http://www.monash.edu.au/mecheng/seminars/afmc

CISM Summer Programme 1998

Mechanics and Design of Tubular Structures	June 1 – 5
Computational Biology	June 10 – 19
Environmental Fluid Mechanics	June 22 – 26
Identification of Media and Structures by Inversion of Mechanical Wave Propogation	July 13 – 17
Kinetic and Continuum Thermodynamical Approaches to Granular and Porous Media	July 13 – 17
IUTAM Summer School: Advanced Turbulent Flow Computations	September 7 – 11
Modelling of Creep and Damage Processes in Materials and Structures	September 7 – 11
Fluid–Structure Interactions in Acoustics	September 14 – 18
Wind-Resistant Design of Structures: Codified and Advanced Methods	September 21 – 25
Multibody Dynamics with Unilateral Contacts	September 28 – October 2
Modern Optical Methods in Experimental Solid Mechanics	October 5 – 9
Neural Networks in Mechanics of Structures and Materials	October 19 – 23

Palazzo del Torso, Piazza Garibaldi 18, 33100 Udine, Italy.
e-mail: cism@cc.uniud.it – http://www.uniud.it/cism/homepage.htm

Results of the EUROMECH election, November 1997

Number of EUROMECH members at the time of election	1120
Number of votes	409
Invalid votes	2

The quorum (§10 of the statutes) was thus fulfilled.

The candidates proposed by the Council for the positions of President and Secretary-General were unanimously confirmed.

The following candidates were elected as members of the Council:

P.Blondeaux.
Instituto di Idraulica, Facolta di Engegneria, Universita degli Studi de Genova, Via Montallegro 1, I – 16145 Genova, Italy.
e-mail: blx@idra.unige.it

F.G.Rammerstorfer.
Institut für Leicht-und Flugzeugbau, TU Wien, Gußhausstraße 25 - 29, A – 1040 WIEN, Austria.
e-mail: ra@ilfb03.tuwien.ac.at

E.Van der Giessen.
Laboratory for Mechanical Engineering, TU Delft, Mekelweg 2, P.O.Box 5033, NL – 2628 CD Delft, Netherlands.
e-mail: E.vanderGiessen@wbmt.tudelft.nl

The detail breakdown of the voting was:

H.Andersson, Trondheim/Norway: 134; *P.Blondeaux, Genoa/Italy: 135*
A.Kluwick, Vienna/Austria: 129.

I.Goracheva, Moscow/Russia: 134; M.Langseth, Trondheim/Norway: 102;
F.G.Rammerstorfer, Vienna/Austria: 145.

D.Bestle, Cottbus/Germany: 118; *E.van der Giessen, Delft/Netherlands: 137*
N.A.Fleck, Cambridge/UK: 133.

The following elected members will continue for three years:

J.Englebrecht, Tallin; E.Hopfinger, Grenoble (*Treasurer*); J.Lemaitre, Paris; P.A.Monkewitz, Lausanne; T.J.Pedley, Cambridge.

The following will also be members of the Council *ex officio*:

D.G.Crighton, *Vice-president;* F.R.Pfeiffer, Chairman, ENDCC; N.Jones, Chairman, ESMCC; F.T.M.Nieuwstadt, Chairman, ETCC; L.van Wijngaarden, Chairman, EFMCC.

Third EUROMECH Fluid Mechanics Conference, Göttingen

After Dinner Speech by Professor T.J.Pedley, September 17th. 1997.

(Half those attending were not able to hear as the public address system failed)

"I was rather non-plussed to be asked to give this speech at only two days notice. I find it difficult to speak spontaneously and fluently, on a mainly non-scientific topic, without long preparation – quite unlike politicians and religious leaders.

Which reminds me how sorry I am that our president, David Crighton, is not here tonight: for one thing, *he* could have given this speech. I expect it is because of his new job as Master of Jesus College, Cambridge. I understand that one of the first announcements that Professor Crighton was elected as Master of Jesus omitted the two words "Master of", and nobody realised there was an error.

Well, as I say, I cannot speak spontaneously on non-scientific topics, so I must turn to science. As you know, I am involved in biological fluid dynamics, so this evening provides a good example in which we are all performing interesting experiments. Our blood is circulating, fat cells are accumulating in our artery walls, our jugular veins are partially collapsed (except for those of us who are already horizontal), some of us are clearly having difficulty with our breathing (I do not know if anyone has actually studied the bio-fluid dynamics of laughter), peristaltic pumping is going on in our intestines and ureters, and further down that system many of us are conscious of an increasingly pressing problem in urostatics, to be followed in due course by a blissful episode of urodynamics. That is, uro–, not euro–, which are both pronounced the same in English, unlike other languages; I had a very confusing conversation about Euromech the other day with a colleague who is a kidney surgeon.

I want to share a bit more science with you. Last week at the British Association for the Advancement of Science, I went to a lecture by Richard Dawkins, the well known geneticist and evolutionary biologist, on interactions between selfish genes. That made me think it would be interesting to initiate a study of the genetics and evolution of subjects within the Euromech Fluid Mechanics Conference. I know we have only had three conferences, so there is not a lot of data, but gaps in the fossil record have never stopped evolutionary biologists – and anyway, many of my biological and medical colleagues reckon that three attempts at any experiment are enough: one to get the result, one to confirm it, and the third for statistics.

For example, let us consider the apparently healthy species of laminar boundary layers and their stability. A rough count through the programmes of the three EFMCs gives 20, 19, 31 papers in Cambridge, Warsaw, Göttingen respectively. So the subject is growing? But as a percentage of the papers presented, they were 10-11% in Cambridge, 7% in Warsaw and 8% in Göttingen (where the population as a whole has grown). But, within that, how about the sub-species of those using asymptotic, triple-deck methods? As far as I can tell, there were only

Membership Fee for 1998 – Deadline 1/6/98

The new treasurer of EUROMECH (EMS), starting January 1998, is
Emil J. Hopfinger, LEGI/IMG, B.P. 53, 38041 Grenoble Cedex 09.
Tel: 33 4768 25043, Fax: 33 4768 35271, email: emil.hopfinger@hmg.inpg.fr.

The EUROMECH account is EUROMECH - HOPFINGER and is at:

Banque Populaire DA, Grenoble University Campus Agency

Bank code	Agency	Account number	Key
12807	00015	01519068782	20

Any payment by bank transfer should be made to this account clearly specifying the sender. It will also be possible to pay membership dues by Visa, Euro and Master cards as well as cheques drawn in French Francs to EUROMECH - Hopfinger. Payment of membership dues for 1998 needs to be made before **June 1, 1998.** A payment form will be sent to members in due course.

The account in Göttingen, EUROMECH - Prof.Müller, Sparkasse Göttingen, Bank code 260 500 01, Account number 213 022 734, will remain open and those who find it more convenient can pay their 1998 dues to Göttingen.

The unit of subscription will remain 15 DM = 50 FF with 3 units for individual members, 2 units for Joint members and 6 units for Institutional members.

We have established a Data Base and each member will have an EM number which should be used as an identification for payment of reduced registration fees at Euromech Colloquia and Conferences. Membership cards can be issued if requested.

Editor's Piece

In common with all editors throughout time, I plead for suitable material for what must, I suppose, be called the "feature article". What about a contribution from the Solids fraternity?

In the meantime, I wonder if a Learned Member can tell me the source of the following – I have had it on the wall of my office for some time:

AETAS DE VIA MORES DEFLECTIT,
ARTIS INGENII QUA MONUMENTA SAEPE DELET.

QUAE AUTUM SECUNDUM GEOMETRIAM ET VERUM SCIENTIAM
CONSTRUCTA IMMUTABILITER PERMANEBUNT.

"Time turns custom from its course, and indeed often destroys the memorials of our intelligence. But all that is built up in accordance with geometry and true science will abide without change." – A suitable motto for the mechanician?

EUROMECH Colloquium 356

Transform Methods in Solid Mechanics

Chairman: H.Grundmann, Munich, Germany

The colloquium took place on October 3rd.–5th., 1996, in the historic monastic setting of Kloster Seeon, Munich. There were thirty participants from fifteen countries.

Integral transform methods can be applied in various fields of solid mechanics, while recent developments in scientific research have had a strong influence on their field of application. On one hand advanced computerisation has made possible numerical solutions (Finite or Boundary Elements) of complex problems, some of which call for particular treatment or special solutions within the framework of transform methods. On the other hand progress in analysis, especially the functional analysis initiated by the mathematicians in the 1950s and 1960s, has significantly enlarged the realm of transform methods.

On the numerical side the discussion ranged from the generalisation of variational principles for viscoelastic media to the question of applying Boundary Elements to transient problems. Newly designed transforms for special identification problems as well as several applications of wavelets (such as identification, mixed boundary value problems) were presented. These are capable of achieving improved convergence or greater compactness in presenting data. A principal result of the discussions was an assessment of the possibility of combining these methods , e.g. to apply the data concentration ability of wavelets to numerical procedures demanding high computational effort such as the Boundary Element method.

The material in these papers was complemented by papers treating the analytic applications of integral transforms, such as the extension of the transformability due to functional analysis, particular fundamental solutions, and the exact solution of certain mechanical problems. The heterogeneity of physical nature, for instance with porous, magnetic and viscoelastic media, and in modelling with stochastic as well as analytical and numerical approaches, was balanced by the homogeneity of the mathematical methods applied. This analytical work is necessary for the numerical work described above.

The colloquium demonstrated that new or modified procedures can be developed.

6, 4 and 3 papers respectively! Of course, these are difficult to diagnose, because I have only recognised them by the title and the name of the authors, not by examining the length or sharpness of their teeth, or anything else. But there are certainly a lot fewer than in British conferences. Maybe this is the well-known property of island communities to evolve differently from the mainland, like the giant and cumbersome Galapagos tortoises; or possibly large Reynolds number asymptotics is only a sort of virus or prion disease – which we have in the UK but to which most Europeans are immune, or, at least, they don't admit they have imported it. (There was some really good beef for dinner this evening.)

Let me now give you a few words about Euromech itself. It was begun at the International Congress of Theoretical and Applied Mechanics in München in 1964 with a group consisting, I believe, of Küchemann, Wille, Landhal, Legendre, Fiszdon and chaired – for about 20 years – by George Batchelor. They initiated the very successful series of Euromech colloquia (the first one on the Coanda effect was in Berlin and its secretary was Hans Fernholz, who has been involved ever since and will be the President of Euromech from January 1st. 1998), and more or less in parallel, Professor Fiszdon initiated the series of fluid mechanics meetings in Poland which were to continue every two years with the main and successful aim of bringing together fluid dynamicists from the East and West of Europe, including Russia, because of the difficulty Easterners had in travelling to the West (the meetings included several Americans as well). When Professor Fiszdon retired, these conferences had to be replaced by something else, and that has become the EFMC. At about the same time, Euromech became a society and the organisation became a bit more formal. But the idea of having regular EFMC (and the other Euromech conferences) has met a genuine need. The Americans have the APS Division of Fluid Mechanics annual meeting, with well over 1000 participants and 15 parallel sessions. They welcome us as attendees, as we do them, but they do not go out of their way to be other than an American meeting. Europe has nearly as much fluid dynamical activity as the United states – and we should have our meeting too. Some feel there is a distinctive European style of fluid mechanics, originating more in Physics departments than in Engineering, and more concerned with fundamental questions than applied ones; but I am not too sure about that. In the UK most of us are in Applied Mathematics or Engineering departments. As far as I am concerned, fluid mechanics will continue to be an exciting subject indefinitely, because not only are the fundamental problems non-linear and intrinsically hard, but also every new application, in technology or natural science, leads to new fluid mechanics requiring inventiveness, breadth, and, most of all, a child-like imaginative curiosity.

Let me conclude by thanking our hosts for this remarkably well organised conference. The Chairman of the local organising committee, to whom our thanks are addressed and who I know will pass them on to all his assistants, is Professor Gert Meier, so let us thank him and them warmly.

I look forward to seeing you all in Eindhoven in 2000. All that remains to offer a joint toast to EUROMECH and Fluid Mechanics."

EUROMECH Colloquium 342

Aerothermodynamics

Chairman G. Eitelberg, Göttingen, Germany

The topic "Aerothermodynamics" has its applications mostly in spacecraft flow, especially in re-entry flow. The colloquium, held on September 26th.-29th. 1995 at Göttingen, therefore mixed researchers from the rarefied flow community with the continuum high enthalpy flow community. To study these flows, where the state or composition of the gas changes in the course of the flow, including reactions and relaxation phenomena of internal and external degrees of freedom, several highly sophisticated facilities have been built up during the last five to ten years in Europe. These facilities and the experience gained with each of them were represented at the colloquium. Most of the 60 participants came from France (15) and Germany (15), where the new testing facilities are located, and from Eastern European countries. For the greater part the latter contributed theoretical work.

The principal facilities are:

The hypersonic free piston driven shock tunnels TCM2 of the University of Marseille and the HEG of the DLR in Göttingen; the hot-shot high enthalpy wind tunnel F4 of ONERA at La Fauga-Mauzac; the renewed Plasma Wind Tunnel facilities at the Institut für Raumfahrtsysteme" (IRS) of the University of Stuttgart; a Laser-sustained Plasma Free Jet at the Laboratoire des Jets Moléculaires, CEA, DRECAM-SCM at the "Centre d'Etudes de Saclay"; and the high vacuum plume test facility (STG) of the DLR in Göttingen.

A main concern in high enthalpy facilities remains flow quality, including the effects of contamination, e.g. gas surface interaction and relaxation phenomena. The gas surface interaction was treated theoretically and experimentally from the translational degrees of freedom through the internal degrees of freedom to the chemical catalysis, but the uncertainties in the experimental and theoretical results are still very large. Concerning plume flow and impingement (especially from small satellite control thrusters) several models were presented but there is still a lack of experimental data concerning the nozzle boundary layer expansion, which the plume testing facility (STG) should deliver. To study the flow, optical methods, especially laser techniques (e.g. LIF or LIPF) are often used. These methods are still partly under development. The electron beam fluorescence method has now been extended to several gases.

Theoretical work was partly directly connected with the high enthalpy facilities, e.g. with nozzle flow behaviour, but was also connected with bodies in tests and in flight (blunted and sharp cones, sharp flat plates, a hyperboloid flare) tested in these facilities. In the rarefied flow regime, the Direct Simulation Monte Carlo Technique is now a standard tool, where especially at smaller Knudsen numbers

EUROMECH Colloquium 355

Interfacial Instability

Chairmen: J-M.Chomaz, Palaiseau and E.J.Hopfinger, Grenoble, France

The colloquium took place on September 10th.–13th., 1996, at the École Polytechnique, Palaiseau. There were eighty participants from twelve countries. There were 46 oral presentations and 11 posters. The main topics were introduced by six general lectures:

T.A.Kowaleski	Liquid jets and drops
G.Tryggvason	Drops and bubbles in shear flows
S.H.Davies	Singular behaviour in viscous films
C.Dopazo	Liquid jet break-up and atomisation by co-flowing gas
S.Zalski	Numerical methods for interfaces
A.Cartellier	Experimental methods for interfaces

The interest in interfacial instabilities is motivated by a wide range of applications and papers at the meeting addressed problems such as film coating, wetting, ink-jet printing, pipeline lubrication, printing instabilities and spray formation in combustion chambers. These applications raise a number of interesting and fundamental questions which were identified at the meeting.

Numerical simulations are now capable of tracking the interface displacement up to the point of pinching. Substantial advances were also demonstrated on liquid bridges, moving contact lines, thin film destabilisation by high velocity gas streams, conditions for absolute instability of liquid jets and liquid jet atomisation.

The proceedings of the meeting have been placed on a word wide web node which will not only provide abstracts of the papers, but will continue to maintain links to home pages of the participants.

The address is: http://www.ladhyx.polytechnique.fr/euromech/welcome.html

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Experimentally it has been shown that the orientation and phase of an initial pulse disturbance plays an important role in the development of the disturbance in the non-linear regime.

Contributions from the sub-field of absolute/convective and global instability yielded a number of results: the extension of the concept of absolute stability to global stability makes possible actual design for flow control at low Reynolds numbers; the dynamics of wave packets can be correctly simulated with vortex blob methods, making it possible toinvestigate non-linearity, particularly with large initial disturbances; global instabilities do not always lead to better mixing in jet flows; controlled (one-sided) initiation of global instabilities may beexploited to redirect jets without moving mechanical parts in the presence of significant surface tension the breakup of liquid jets into drops can be described (and possibly controlled – e.g. the inkjet printer) by means of absolute instability theory.

EUROMECH Colloquium 354

Stress Waves in Solids for Materials Classification

Chairmen: D.A.Sotiropoulos, Chania, Greece and R.W.Ogden, Glasgow, UK

The colloquium took place on September 17th.–20th. at the Technical University of Crete, Chania. There were fifty participants from ten plus countries, with a good mix of senior scientists, young researchers and doctoral students.

The topics covered were:

Finite amplitude waves in finitely deformed metals; propagation of elastic guided waves in anisotropic layered plates; transient Rayleigh and Stoneley waves in thermoelastic solids; measurement of stresses in solids during shock loading, non-linear wave propagation in cracked media; shock properties of high-strength ceramics; waves in non-linear elastic membranes; scattering considerations in elasticity; directivity control of a probe; stabilised finite elements for exterior wave problems, active composite materials characterisation; solitary elastic surface waves due to cascaded quadrant non-linearity; elastic interfacial waves in anisotropic interlayers; numerical simulation of ultrasonic non-destructive testing of two-dimensional multi-layered structures; acoustic imaging of inhomgeneity; ultrasonic waves in Biot solids; transient coupled thermo-elastodynamic reponse of a crack under concentrated thermal loading; modifications of the Moens-Kortweg model for arterial pulse waves; energy and dissipation of inhomogeneous plane waves in thermoelasticity; stop bands for elastic waves in periodic composite materials; the influence of pre-stress on the eflection ofelastic waves in incompressible solids; laser probing of ultrasonic waves inside materials; etc.

chemical reactions and gas surface interaction are of major concern.

The combination of rarefied flow with high enthalpy flow seemed fruitful for both sides. The physical models for relaxation phenomena, chemical reactions, gas surface interaction etc. are usually similar or the same in both research fields. The combination of numerical codes for continuum flow in technical applications employing Navier Stokes equations or boundary layer theory and codes for rarefied flow employing mostly the DSMC technique is still a pending task, though the gap in Reynolds number is closed, at least for two-dimensional flows.

In spite of the considerable reduction in funding of aerospace activities, the colloquium was a success and very well attended, with about 60 participants and over 50 contributions .

EUROMECH Colloquium 343

Computerised Symbolic Manipulation in Mechanics

Chairmen: E. Kreuzer, Hamburg-Harburg, Germany, and M.B. Lesser, Stockholm, Sweden

The colloquium took place from October 9th. – 13th. 1995 at TU Hamburg-Harburg. Eleven sessions and one discussion session were held from the Monday to mid-day Friday. The scientific programme comprised 30 lectures of 30 minutes each, and one discussion session. The session topics were the following:

Multibody Systems,
Semi-analytical Computation,
Application in Modelling and Solution,
Algorithms,
Bifurcation Analysis and Approximate Symbolic Computing,
Programs,
Boundary Value Problems,
Solutions of Differential Equations,
Structural Mechanics and Materials,
and Tools

The colloquium brought together 47 scientists from 13 countries, from Mechanics, Physics, and Mathematics, and promoted a vigorous exchange of ideas. The topics mentioned above show the wide variety of the scientific use of symbol manipulation but also show that the power of computer-aided analytical computing has not yet been fully exploited. Mathematicians as well as users of symbol manipulation are requested to develop efficient methods of analytical computing to solve the great challenges which appear partly in practical problems. As a further result of the panel discussion session, we see an

increasing significance for the establishment of programs for symbol manipulation in the education of students. Because no deep programming knowledge is necessary, students could be confronted at an early stage with investigations of realistic complex systems.

A panel discussion co-ordinated by Professor Lesser was held on the Thursday. Panellists were Dr Kecskeméthy, Professor Kreuzer, Professor Valásek, and Professor Winkler. The position and the possibilities of computer algebra in Mechanics were discussed in the plenum session. All participants considered the discussion session particularly fruitful. They agreed to establish a platform for the exchange of the different research activities. It was therefore agreed that a so-called home page in the World Wide Web should be installed for the area of computer algebra.

It is planned to organise a further colloquium on the same topic in two or three years' time in another European country.

EUROMECH Colloquium 344

Fluid-Structure Interactions in Biomechanics

Chairmen: T.J.Pedley, Leeds University, UK and C.Caro, Imperial College, London, UK

The colloquium was held at Imperial College, London, on April 10th.– 13th., 1996. There were 107 registered participants from 19 countries; 62 were members of Euromech. There were three invited lectures, 31 oral presentations and 45 posters.

The colloquium formed part of a series of 10 starting with no. 12 (Poland) in 1969. The emphasis was on dynamic interactions between fluid loading and wall geometry in which neither could be prescribed in advance. It was hoped that papers would be offered not only on passive interactions (elastic boundaries), but also on active ones, both short term, when muscle contractions determine the boundary deformation but are themselves determined by the hydrodynamic load (e.g. peristaltic pumping), and long term, involving biological remoulding in response to mechanical stresses. Submissions on pure fluid mechanics – blood flow in arteries of fixed or prescribed geometry – were not encouraged. In the event very little was offered concerning flow-muscle interaction, but there was a lot of very interesting material on the passive interactions and on remodelling.

The three invited lectures (P.F.Davies, U. of Chicago; T.L.Daniel, U. of Washington, P.G.de Groot, U. of Utrecht) laid great emphasis on the important message that in this field, the mechanics must be subservient to the biology.

EUROMECH Colloquium 353

Dynamics of Localised Disturbances in Engineering Flows

Chairmen: H.Oertel and J.Delfs, Karlsruhe, Germany

The colloquium took place on April 1st.–3rd., 1996 on the campus of the University of Karlsruhe. In a very full programme twenty-seven papers were presented to the fifty-six participants, from nine or more countries. There was a strong Russo-Ukraine presence.

A realistic disturbance in a flow field is of limited extent. The last 10-15 years have seen considerable progress in the understanding of locally excited disturbances in unstable flow fields gained from theoretical and experimental studies, and also direct numerical simulation. The meeting was intended to summarise the state of knowledge in the field of wave packet mechanics, including three-dimensional, compressible and non-parallel linear theory with extensions to non-linearity, experiments and numerical simulation. The aim was to show how the theory of localised disturbances can be applied to engineering problems in the field of transition to turbulence and active flow control etc.

Promising new analytical and numerical approaches in describing the crucial disturbance initiation caused by local roughness were described.

Particular interest was expressed in flows susceptible to the cross-flow instability (CFI). Experimentally it has been found that the unsteady modes of the CFI are sensitive to free stream turbulence, the steady modes respond to roughness, in combination the steady modes are attenuated by the unsteady modes, the occurrence of local high frequency disturbances following the CFI play a crucial part in the breakdown process and that the roughness effect dominates for elements within 2–5% of the attachment line.

An absolute instability was found both experimentally and theoretically in the rotating disc flow which appears to be similar to the 3D swept-wing boundary layer flow. The change from convective to absolute instability is Reynolds number dependent. There remains the question of whether the rotating disc flow provides a suitable model for the swept wing flow.

The significance of longitudinal or "streaky" structures in conjunction with localised disturbances was underlined in a number of papers. Longitudinal, long living, flow structures can be created by 3D disturbances, leading to considerable increase in heat transfer. Streaky structures apparently play a crucial role in the generation of turbulent spots by interaction with Tollmien-Schlichting instabilities (TSI). This may provide a model for the mechanism by which free stream turbulence influences TSI. *Longitudinal structures occur as a result of algebraic growth from localised small, finite amplitude, initial disturbances.* Pronounced longitudinal disturbances are found within turbulent spots in Couette flow.

EUROMECH Colloquium 352

Mean Flow Effects in Acoustics

Chairman: C.J.Chapman, Keele, UK

The colloquium took place on July 9th.–12th. at Keele. There were fifty participants, representing eleven plus nationalities, of whom thirty made presentations. A noteworthy feature of the meeting was the wide age range of those taking part, from fifteen to 80 years old, and a strong presence of scientists from the Soviet Union. In preparing for the meeting it became apparent that there was much interest world-wide in the topic. The Chairman considered that this community might well gain a great deal by taking up ideas at present underused – based on group velocity and wave interactions, as expounded in many papers in the *Journal of Fluid Mechanics.*

The material fell naturally into eight groups:

Aerofoils, blade rows, cascades and fans. The effects of camber, thickness and angle of attack on the noise produced by convected disturbances striking a blade row, of unsteady distortion on fan noise from aero-engines and of Tollmien-Schlichting waves on tone noise from aerofoils.

Acoustic analogies. Total enthalpy, turbulent jets and variational principles.

Ducts, silencers and turbines. The effects of absorbent linings, splitter plates, changes in duct diameter, resonators, thermoacoustic oscillations, hyperbolic umbilic catastrophes and shear layers in ducts and turbines; the design of ultrasonic flowmeters in ducts.

Elastic membranes and plates. The noise produced by finite flexible plates in a mean flow, and by a pair of elastic membranes.

Energy and reciprocity. Flow reversal theorems, reciprocity principles for fluids and elastic solids and exact energy balance relations.

Jets, mixing layers and streaming. The different types of jet produced by streaming (including jets with a potential core), direct numerical simulation of Mach wave radiation and jet shock-cell acoustic radiation.

Moving sources. The resonance produced in a dispersive system when the initial source velocity equals the group velocity and the sound field produced by a sphere moving underneath a water surface.

Wave interactions. Interactions between acoustic and internal waves, between inertial and Rossby waves, and between fast and slow magnetosonic waves in a mean flow; the effect of turbulence in limiting the resolution of sonar transducers and interaction between water waves and currents.

Oral presentations were grouped into six sessions:

Mechanical effects of blood flow on vessel walls
Biological responses of vascular walls to applied stresses
Microvascular networks
Respiratory flow-structure interactions
Cardiac mechanics
and Unsteady flows and compliant structures.

The colloquium closed with a general discussion on the role of biomechanics within Euromech. Despite the relatively large number of participants attending colloquia on this topic, it was felt desirable to continue with the existing format rather than, say, transforming into a Euromech Conference. A particular virtue was the absence of parallel sessions, resulting in a mixture of scientists with different backgrounds.

A further colloquium in this series was proposed, possibly in Austria, while there might be a distinct meeting on Cell Mechanics in France, both in about 1998/99.

The organisers were very grateful to receive financial support from the British Heart Foundation, the Welcome Trust and the Physiological Society, most of which was used to provide bursaries for young or East European participants.

EUROMECH Colloquium 345

The Future of Structural Optimisation

Chairmen: A.B.Templeman, J.Blachut. Liverpool, UK

The colloquium was held on April 1st.–3rd., 1996 at Derby and Rathbone Halls, University of Liverpool. In total 51 people attended from 14 countries. Proposals were received for 50 papers, of which 47 materialised so that the original intention of having themed panel discussions was abandoned to allow each speaker 20 minutes. No complaints resulted, and all sessions were very well attended.

Structural optimisation has been the subject of research, development and application since the early 1960s. It has benefited from a steady flow of new concepts and ideas over the past 30 years. In the past five years particularly there have emerged several very different new approaches to structural optimisation problems, such as genetic algorithms, global optimisation, homotopy, topological and discrete optimisation which have each developed into separate strands of research. The purpose of the colloquium was to bring together experts in each of these strands and attempt to see the direction in which each of them is going. It was hoped that some general directions for research would emerge which would be stimulated by interactions and collaborations among the present separate research themes.

A main strand of research in recent years has been the use of sensitivity analysis and approximate optimisation methods to improve structural design based upon implicit analysis (i.e. finite element based optimisation). Capabilities in this area have grown considerably to include simple topology optimisation. One interesting possibility which was discussed was the replacement of the sensitivity analysis and approximate optimisation elements of such packages by zeroeth-order optimisation methods. Genetic algorithms appear to be a good candidate for such replacement although other methods have potential. The view which emerged from the colloquium was that this is not an immediate possibility. The number of trial evaluations (FE analyses) needed by generic algorithms and other methods based on probability is still far too large to compete with conventional sensitivity-based methods.

The colloquium demonstrated that structural optimisation is still a vigorous and flourishing area of research and development after more than 30 years' work. There are now probably more different lines of research than ever in the past. Two or three main lines can be extrapolated into the future, but many of the interesting unconventional approaches currently under study could blossom and disrupt predictions of the future.

It is hoped that there might be a successor colloquium in about 1998/99.

EUROMECH Colloquium 346

Fretting Fatigue

Chairmen: D.A.Hill, D.Nowell, Oxford, UK

The colloquium took place on March 20th.–22nd., 1996, at Mansfield College, Oxford. Twenty-eight participants attended, none of them members of Euromech. The subject matter was restricted to fretting fatigue as no papers on the allied and proposed topics of corrosion and wear were received.

It was very noticeable that several groups had independently arrived at the same conclusion about the most fruitful areas for future work. It was quite widely accepted that problems of modelling crack growth had now been solved, and there was little left to do in determining stress intensity factors for cracks propelled by contact loading. There was, instead, very considerable interest in trying to quantify the conditions under which fretting fatigue cracks initiate. It was recognised that there are both similarities and differences from plain fatigue, and various models at the sub-grain level were put forward. These were based either on microplasticity or the motion of dislocations on persistent slip bands, which may be simply an alternative view of plasticity at the very earliest stages of crack initiation. A lively debate on these theories ensued, with an agreement that we should exchange views, and preferably also post-doctoral visitors, regularly.

The scheme above is too simple to embody all the work presented during the week. Two particular strands were the definition of precise and rapid methods of classification and the use of image acquisition in the process of measuring physical properties (dispersion in 2D artificial media). This is a demonstration of the wealth of the topic rather than a sign of any imprecision in its formulation. It was felt that a further colloquium would be valuable as early as 1998.

EUROMECH Colloquium 351

Systems with Coulomb Friction

Chairmen: A.Klarbring and L-E.Andersson, Linköping, Sweden

The colloquium took place on August 5th.–7th. 1996, at Vadstena, Sweden. There were 50 participants from 16 countries. The 37 technical presentations were given over the three days, each speaker being allotted a total of 35 minutes.

Coulomb or "dry" friction is one of the most basic mechanical phenomena, discussed in virtually every textbook on mechanics. However, the problem of the evolution of deformable or rigid bodies subject to friction and unilateral contact remains rich with unsettled questions.

The purpose of the meeting was to bring together mechanicians, mathematicians and engineers to discuss questions related to the qualitative theoretical understanding of systems with Coulomb friction. Related questions concerning solution algorithms and experiments were also included.

Notable was the large number of application areas treated: finite elements, multibody dynamics, masonry material, wheel-rail contact, squealing brakes, .geological faults, automatic control, fretting fatigue and seismic interaction. These applications provided the backbone to the more theoretical questions concerning existence, uniqueness, instability and regularity which were central to the meeting. Concrete new results were presented which have promoted a more complete theory for the mechanics of deformable and rigid bodies affected by Coulomb friction or its generalisations. As a specific example we would mention how the existence question in linear elasticity was taken a step further by a paper by Eck and Jarusek.

EUROMECH Colloquium 350

Image Analysis, Porous Materials and Physical Properties

Chairmen: D.Bernard, Talence, Bordeaux, France; R.Ehrlich

The colloquium took place on June 3rd.–7th. at Carcans (Bordeaux), France. The 35 participants from 9+ countries gave 22 oral presentations and put up 5 posters.

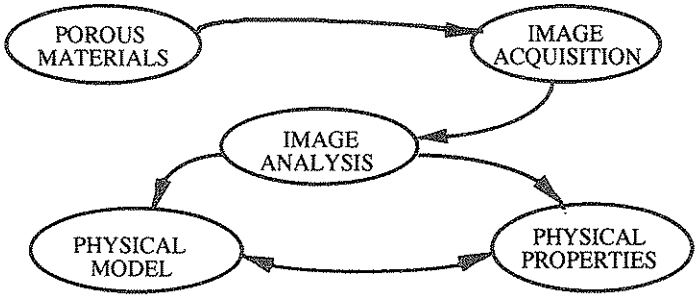
The focus was on the use of image analysis as a preferential tool assisting the understanding, modelling and prediction of the physical properties of *real* porous media. All physical properties were considered (mechanical, electrical, acoustical, hydraulical, chemical – –) for all types of real porous media, whether natural (rock, snow, wood – –) or artificial (concrete, ceramics, composite materials –).

Physical properties treated were: porosity, permeability, capillary pressure, diffusion coefficient, thermal conductivity, mechanical, electrical and magnetic properties and electro-osmotic proerties.

Porous materials studied were: cementing materials, composite materials, artificial 2D materials, porous titanium, vycor glass ceramics, sedimentary rocks, snow, wood and bones.

The fields of application were: hydrogeology, oil exploration and production, medecine, global change (snow compaction), forestry, aeronautics (composite materials) building, environment, mathematical and physical theories.

It is difficult, if not impossible, to define and classify all the interactions between the varied topics discussed during the week, but a possible general scheme is:



The aims of the meeting were stated precisely in the original announcement so that all presentations can be fitted to this scheme, though perhaps too many were devoted to physical mdels *potentially* using image analysis as a source of information for calculating physical properties. All participants agreed on the importance of such models (volume averaging, homogenisation, – –) but also on *the necessity to have good images* (image acquisition as such was the subject of only one presentation and one poster) and *the problem of characterising 3D media using 2D data.*

The first few examples of the latter were already being arranged.

There was also some debate about another feature which separates fretting fatigue from plain fatigue; that is, the presence of self-arrested cracks which arise as a result of contact loading, but are never propelled to failure by bulk loading. It was agreed this was a feature meriting further analysis.

There was a general feeling that there was little need for a further colloquium on fretting in the near future, but there was considerable interest in a possible meeting to discuss the numerical modelling of cracks, with particular emphasis on strain nuclei and eigenstrain type procedures.

EUROMECH Colloquium 347

Stability and Bifurcation in Solid Mechanics

Chairmen: Q.S.Nguyen, Paris and M.Poitier-Ferry, Metz, France

The colloquium took place on May 13th.–15th. 1996 at the Ministry of Education and Research, Paris. Seventy participants attended, of which half were from France.

The colloquium provided an opportunity for research workers in Engineering and Applied Mathematics to review the state of the art in stability and bifurcation of solid systems as it has developed since the Glasgow meeting of 1989. The stability of materials and structures was discussed under five headings:

Hopf bifurcation, dynamic aspects
Computational and theoretical aspects of multiple mode elastic buckling
Plastic and visco-plastic effects on buckling analysis
Localisation and micro-buckling in composites
and Stability under contact with friction.

Particular interest was lent to the discussions and presentations by the attendance of most well known specialists in the subject.

The organisers were grateful to receive support from Electricité de France, Commissariat à Energie Atomique, Delégation Générale à l'Armament, Association Universitaire de Mecanique and the Structural Mechanics association.

EUROMECH Colloquium 348

Nonlinear Dynamics of Heterogeneous and Microstructured Solids

Chairmen: J.Engelbrecht, Tallinn, Estonia
and G.A.Maugin, Paris, France

The colloquium took place on May 22nd.–26th. 1996 at the Hotel Pirita, Tallinn, Estonia. There were about 40 participants from eleven countries. The 28 contributors represented a blend of mechanicians *per se*, applied mathematicians and condensed matter physicists, with a natural emphasis on the first group.

The contributions were essentially concerned with the mechanics and physics of media carrying a microstructure of various origins, and nonlinear effects related to, or interacting with, this aspect. Particular attention was paid to non-linear waves of various types developing in composite structures with an emphasis on pathological or exotic solutions (e.g. edge waves, "compactons", "peakons" - -) or engineering applications (devices, smart materials). Topics included chaotic behaviour, simulation (cellular automata), configurational forces as applied to the progress of fronts, numerical simulation of solitonic structures and the accuracy of finite element schemes in solid mechanics. Further papers concerned the interesting case of shock waves in porous media or gas-saturated solids while others highlighted the essential role of a sound thermochemical approach. Materials dealt with included solid deformable crystals with coupled mechanical, magnetic, electrical and thermal properties, composites of various types and liquid crystals.

It was felt that the aims of the colloquium had been very successfully accomplished. The relatively small numbers, efficient organisation and the pleasant environment had contributed notably to this success.

The organisers are very much aware that the many aspects of the rich and varied field of non-linear science and structured materials could only be sampled in such a short time, and hope that a further colloquium can be arranged in 1988/89.

It is hoped that a INTAS (EU) grant can be used to assist the publication of a large selection of the papers in a double issue of the *Proceedings of the Estonian Academy of Sciences* in 1997.

EUROMECH Colloquium 349

Simulation of structure-fluid interaction in Aeronautics

Chairmen: H.Hönlinger, Göttingen, Germany
and J.P.Grisval, ONERA Chatillon, France

The colloquium took place on September 10th.–12th. at the DLR, Göttingen, Germany. There were 51 participants from 11 countries.

The meeting started with an overview presentation entitled "The Expanding Domain of Computational Aeroelastic Simulation". The paper addressed, in particular, aeroelastic phenomena which occur at high transonic speeds during flight. The principal themes were shock-boundary-layer and elastic structure interactions as well as the structural response to flow separation effects. These problems have to be countered with modern CFD codes, fluid-structure coupling methods and high performance computers. This was followed by five working sessions:

In the first session the problem of the acceptance of current CFD methods for routine aeroelastic analyses was discussed. In view of the availability of the CFD codes or the lack of them, it was concluded that further development of FEM-compatible unsteady aerodynamic methods for non-linear flight regimes is most desirable. The MDO (Multidisciplinary Design Optimisation) environment will require both modern CFD codes and panel methods.

In the second, flutter prediction for the transonic speed range was the main topic. The comparison of standard flutter prediction methods employing subsonic and supersonic panel methods with either CFD methods or semi-empirical flutter methods with the ability to predict lowly-damped modes at subcritical LCO (Limited Cycle Oscillations) conditions covered the greater part of the session.

The third and fourth were dedicated to the aircraft application of fluid-structure coupling methods. Various methods, directed towards the computation of unsteady separating and reattaching transonic flows and typified by shock-induced oscillations were described. Key elements of the methods such as time-accurate Euler and Navier Stokes solvers and time-efficient implementation were also addressed

The fifth dealt with turbomachinery and related problems. As far as turbo-machinery is concerned, the presentations concentrated not only on the study of the flutter behaviour of plane cascades in subsonic flow, but also on the fluid structure buffeting phenomenon. There was also an important overview paper on the simulation of fluid-structure interaction for bridges. the engineering of bridges supported by long span cables requires in-depth knowledge of aeroelastic stability, vortex shedding excitation and buffeting due to turbulence. Computer simulations of the flow-structure interaction can reduce the turnover time greatly.
