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President's Address

One of the main objectives of EUROMECH is to promote scientific interactions on a European scale in the field of Mechanics. Significant changes have been introduced in this respect during the past few months.

First, the schedule and frequency of EUROMECH Fluid Mechanics (EFMC) and European Turbulence Conferences (ETC) have been revised. Following a transition period, these two series of conferences will be held every two years on alternate years: EFMCs on even years and ETCs on odd years. Beyond the transitory phase, they will take place at the same time of the year, within a two-week window in late August-early September. The new schedule was set up after extensive consultations with the standing committees in charge of these conferences. We very much hope that in this way an even larger number of European fluid dynamicists will be enticed to participate regularly in these events. For the time being, the EUROMECH Solid Mechanics Conference will continue to be held every three years.

The Council has also introduced the new category of EUROMECH Fellow, in order to recognize members who have contributed significantly to the advancement of mechanics (p. 19). Together with the EUROMECH Fluid Mechanics and Solid Mechanics Prizes (p. 22), the Fellow status provides an effective way of distinguishing particularly meritorious colleagues. We strongly encourage members to nominate outstanding candidates for these awards. The procedure is straightforward and we refer you to pp. 19–23 of this newsletter for specific guidelines. These initiatives will only be successful if EUROMECH members become actively involved in the process. Please nominate candidates for the awards!

This is also the right time to make a call for EUROMECH Colloquium proposals in 2006 and 2007, to be evaluated by the council at its yearly meeting next April. These small-scale gatherings, without formal proceedings, continue to be popular, as seen from the list of planned colloquia in this newsletter.

As always, let us share your ideas regarding our program of activities!

Patrick Huerre

President, EUROMECH

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HOW ULTRASOUND DRIVEN BUBBLES ACT ON LIPID MEMBRANES

Philippe Marmottant[1], Michel Versluis, Nico de Jong[2], Sascha Hilgenfeldt and Detlef Lohse

Philippe Marmottant won the EUROMECH Young Scientist Prize, awarded at the fifth EUROMECH Fluid Mechanics Conference Toulouse, August 2003

When micrometer-sized bubbles are exposed to ultrasonic waves, they respond with vigorous radial oscillations and strong backscattering of the ultrasound. Suspensions of microbubbles have therefore proved to be excellent contrast enhancers in ultrasound echography. A few years ago, a new application of the bubbles has emerged, in therapy rather than diagnostics: the oscillating bubbles exert forces on nearby tissue, so that the combination of ultrasound and microbubbles can open pores in cell walls to admit the passage of drugs and DNA molecules. One explanation for the process lies in the intense flow generated by the bubble oscillations.

A growing challenge for medical therapy today is to administer drugs in controlled quantities at controlled locations in the human body. Only as much drug as necessary (but as little as possible) is to be applied to exactly the right tissue cells. This is all the more difficult as the first step to drug delivery (and to its close analog, gene transfection, in gene therapy) is to porate or rupture the wall of these cells, an inherently violent and potentially damaging process. An external force is needed to make large molecules like drugs or genes penetrate the cell membrane. Such forces include electrical fields, shear on substrates, or the impact force of nanospheres.

Recently, ultrasonic forcing has been proposed as an alternative. Ultrasound by itself is poorly suited to permeate cell walls. However, its action can be amplified and focused down to micrometer length scales by using bubbles as actuators. The backscattered ultrasound from the bubbles has been used to enhance contrast in echography images. However, in recent studies, the mechanical actuation itself has come into focus: researchers brought the living cells in close contact with ultrasound-driven microbubbles, which underwent large oscillations of radius and even violent collapses. The bubble motion then exerts forces onto nearby cells. In the past few years, the feasibility of drug delivery and gene transfection with this method has been demonstrated. The efficiency and side-effects have been assessed through in vitro experiments with cell cultures: the stronger the ultrasonic forcing, the larger the amount of drug incorporated in the cells [1]. While the delivery rate increases with sound

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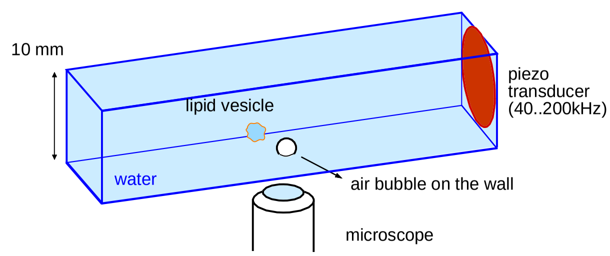

Figure 1: Layout of the experiment. The piezoelectric transducer generates a standing ultrasound field.

amplitude, secondary effects appear when the sound amplitude is too high, resulting in the death of a fraction of cells. Very large molecules, such as DNA, could be transferred into cells, which would allow gene therapy without the known side-effects of viral vectors. However, the precise mechanism behind the bubble–cell interaction was not understood, nor was it simple to control the amount of transfection (and minimize the amount of cell damage).

At University of Twente, in the context of the FOM project "*Ultrasound contrast agents: a new tool for diagnostics and therapy*", we address these questions from a physicist's point of view. For the first time, we isolate the simplest elementary process of interaction between single bubbles and single cells and observe it directly with high-speed photography [2]. Because of the mechanical complexity of cells, we replace them by vesicles, 'artificial cells' consisting only of a lipid membrane surrounding water. The vesicles are grown from lipid films deposited on glass, slowly swollen with water. As in living cells, the lipid membrane consists of only two adjacent layers of molecules. These vesicles, once in suspension, are exposed to oscillating air bubbles sitting at a glass surface (Fig.1). Both bubbles and vesicles have typical diameters of 20–100 micrometers. High-speed movies, obtained through a microscope, reveal that vesicles undergo vigorous motion near the bubble (Fig.2). In the process, the vesicles are severely deformed and, if the driving amplitude is large enough, the lipid membrane is broken and vesicle rupture is observed (Fig.3).

The advantage of the present experiment is that all of its aspects can be controlled and understood quantitatively: surprisingly, the bubble oscillation amplitudes needed for vesicle deformation and rupture are not large – only a few percent of the bubble radius. Without violent bubble collapse to deal with, just incorporating gentle oscillations in volume and in center of mass (Fig.4), a quantitative theory of the phenomenon can be developed. The first order unsteady oscillation of the bubble sets up a second order steady flow around it called *acoustic streaming* [3]. The origin of the steady flow is the nonlinearity

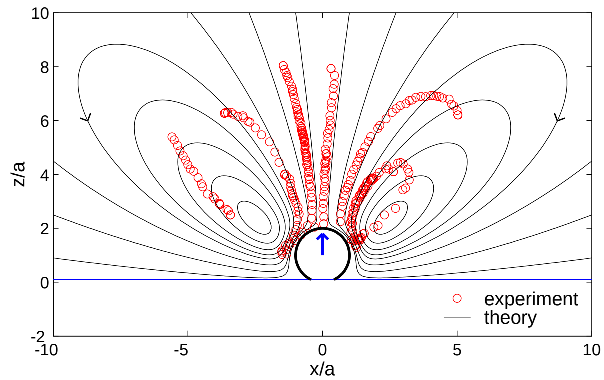

Figure 2: Vesicle trajectories near the oscillating bubble as measured, together with the streamlines of the computed flow field near a wall.

of fluid dynamics itself, especially intense in the thin oscillating boundary layer entrained by the bubble vibration. The thickness of this layer, that surrounds the bubble, is $\delta \sim (\eta/\rho\omega)^{1/2}$, with η the viscosity, ρ the density and ω the sound pulsation. With typical oscillations at 40–200 kHz, it ranges in the micron size, and is much smaller than the bubble radius. Within the boundary layer, the high-frequency oscillations of the liquid are modified such that a small, steady drift adds up from cycle to cycle. On average over time it results in a second order steady streaming velocity, which scales like $\overline{v} \sim \epsilon^2 a\omega$, where ϵ is the vibration amplitude normalised by the bubble radius, and a is the bubble radius. Typical streaming velocities are of the order of mm/s. The streaming in the oscillating boundary layer is coupled to the surrounding fluid and drives a steady low Reynolds number flow around the bubble, that can be described in terms of Stokes singularities. The leading order singularity is a point-force stokeslet directed perpendicularly to the wall, placed at the bubble center (arrow on Fig.2), of intensity $f \sim 8\pi\eta\,\epsilon^2 a^2\omega$. Being proportional to the bubble surface, it dominates other volumic forces at small scales, like buoyancy. While the vesicle membrane follows the resulting steady flow, it senses mechanical forces induced by velocity differences in the flow, and is thus deformed or ruptured. The shear stress generated by the flow is of order $\eta\,\epsilon^2\omega$, independant of the bubble size. It does not diminish with smaller bubbles, which allows us to apply, very locally, strong forces on small objects. The observed flow velocities and vesicle deformation conform closely with the predictions of this theory (Fig.2).

The first order, unsteady, high-frequency motion of the bubble was directly imaged using the ultra high-speed camera Brandaris 128 that takes 128 images at up to 25 million frames per second [4]. This camera was recently built

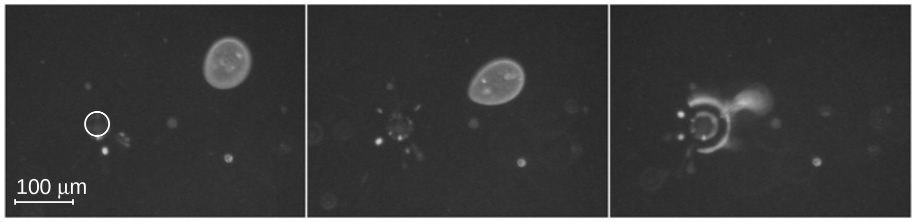

Figure 3: Rupture of a vesicle (diameter of 80 micrometers) with fluorescence-marked lipid membrane approaching a bubble (marked by the white circle), seen from below through the cuvette glass. The vesicle deforms and fragments, leaving fluorescent debris around the bubble.

by a collaboration between our group (Michel Versluis, Detlef Lohse) and the Erasmus Medical Center in Rotterdam (Nico de Jong). The vibration of the bubble showed two components: a volumic one and a translational one (Fig.4). The latter is perpendicular to the wall, and originates from the reaction of the wall on the liquid during the expansion and contraction of the bubble. These two vibrations are not in phase. Therefore the bubble can be seen as a small peristaltic pump: its size is bigger than at rest when it pushes the fluid away, and smaller when it pulls it towards the wall, resulting in a net drag drift at each oscillation, and an efficient steady streaming.

With these results, the groundwork is laid for further experiments: we recently demonstrated that live cells can also be permeated in the same set-up, and that we can use smaller bubbles of a few micrometers in diameter to achieve the same effects (in fact, we have made direct use of ready-made microbubbles manufactured as diagnostic contrast agents). We are gaining skills in manipulating single cells or vesicles, moving, deforming, or rupturing them at will, in essence developing a new ‘toolkit’ for the manipulation of biological materials in the laboratory. A detailed understanding of the membrane rupture will be achieved using the high acquisition frequency of the camera Brandaris 128.

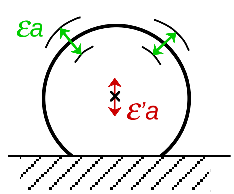

Figure 4: Vibration of the bubble near the wall. In experiments the volumic and translational amplitudes of vibration are of the same order: $\epsilon \sim \epsilon'$.

Possible applications of the microbubble/ultrasound 'toolkit', aside from drug delivery, lie in cell homogenization (a 'gentle' way of rupturing cells and isolating cell organelles), cytometry (e.g. distinguishing normal from cancerous cells by their deformation). We are now exploring microfluidics applications, and we recently designed a microdevice that uses a combination of microbubbles and obstacles to locally transport cells or vesicles, for chemical or mechanical probing as part of a 'lab-on-a-chip' [5]. A world of possibilities is opening up in biotechnology with bubbles.

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ELASTIC PROPERTIES OF THIN SANDWICH PANELS WITH FIBROUS METALLIC CORES

Athina E. Markaki[1], T. William Clyne

Athina E. Markaki won the EUROMECH Young Scientist Prize, awarded at the fifth EUROMECH Solid Mechanics Conference Thessaloniky, August 2003

A sandwich material, based on a pair of thin stainless steel faceplates separated by a core incorporating stainless steel fibres, has recently been developed. This material has the potential to exhibit an attractive combination of properties, while retaining formability and general handling characteristics similar to those of conventional sheet steel. Two different core structures have been investigated: (a) transversely-aligned fibres bonded to the faceplates by adhesive; and (b) a 3-dimensional network of fibres brazed to each other, and also to the faceplates. The beam stiffnesses of these sheets, and also their through-thickness Young's moduli, have been measured and compared with theoretical predictions.

1 Introduction

It has long been recognised that sandwich structures, composed of stiff outer layers held apart by a low density core, offer the potential for very high specific stiffness and other attractive mechanical properties. Most such structures are created by an assembly step of some sort, before or during component manufacture. This limits the flexibility of the production process and is relatively expensive. Nevertheless, there is considerable current interest in sandwich structures of different types, many of them based on metallic faceplates and having metal–containing cores – often made of stochastic cellular metals [1–3] or some more regular structure such as a truss assembly [4–6]. However, traditional approaches to the fabrication of the latter (e.g. investment casting) are cumbersome and economically unattractive. A particular case of cellular metals is that made of a metallic fibre network of some sort. A novel type of a sandwich steel sheet with a fibrous stainless steel core has recently been developed [7] based on a pair of thin ($\sim 200\ \mu$m) stainless steel faceplates. This material has been termed a Hybrid Stainless Steel Assembly (HSSA). It can, in principle, offer a highly attractive set of property combinations, such as low areal density, high beam stiffness, efficient energy absorption during crushing and good vibrational damping capacity. Furthermore, the overall thickness of

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the sheet ($\sim$ 1 mm), and certain features of the core structure, are such that its processing characteristics can be comparable with those of a conventional monolithic metallic sheet. Some work has recently been published on the elastic properties [8] and interfacial delamination behaviour [9] of such material.

In the present paper, a study is presented of the beam stiffness and through-thickness Young's modulus of two different variants of HSSA material. Experimental data are correlated with predictions based on simple analytical treatments.

2 Experimental Procedures

2.1 Material Production

Two core structures have been investigated: (a) transversely-aligned fibres bonded to the faceplates by adhesive (designated 'flocked sheet'); and (b) 3-dimensional brazed fibre array brazed to the faceplates ('short fibre 3-D array sheet'). In both materials, the faceplates were 200 μm thick 316L stainless steel. Manufacturing procedures are briefly outlined below:

(a) *Flocked sheet.* This is made by a flocking process [7], in which short ($\sim$ 1 mm) drawn 316L stainless steel fibres, about 25 μm in diameter, are approximately transversely aligned – see Fig.1(a). The fibre volume fraction in the core is about 8%.
(b) *Short fibre 3-D array.* This consists of a 3-D network of fibres bonded to each other, and also to the faceplates, using a nickel-based braze alloy – see Fig.1(b). The fibres are inclined at various angles to the vertical, with an average value of the order of 60°. They occupy about 10% of the volume of the core and are made of 446 (ferritic) stainless steel, melt extracted to lengths of 2.5 mm.

3 Beam stiffness

Fig.2 shows predicted and measured beam stiffnesses, plotted against the areal density. Fig.2(a) compares plots for solid steel, titanium and aluminium sheets with that for a sandwich composed of 200 μm steel faceplates and an isotropic epoxy core (E_c = 2 GPa, density ρ_c = 1.56 Mg m^{-3}). This demonstrates that such a structure can be simultaneously stiffer, lighter and thinner than a monolithic aluminium sheet. The comparison with experimental results shown in Fig.2(b) indicated that the flocked sheet has only about 50% of the predicted stiffness, while the figure for the short fibre 3-D array sheet is about 70%. This

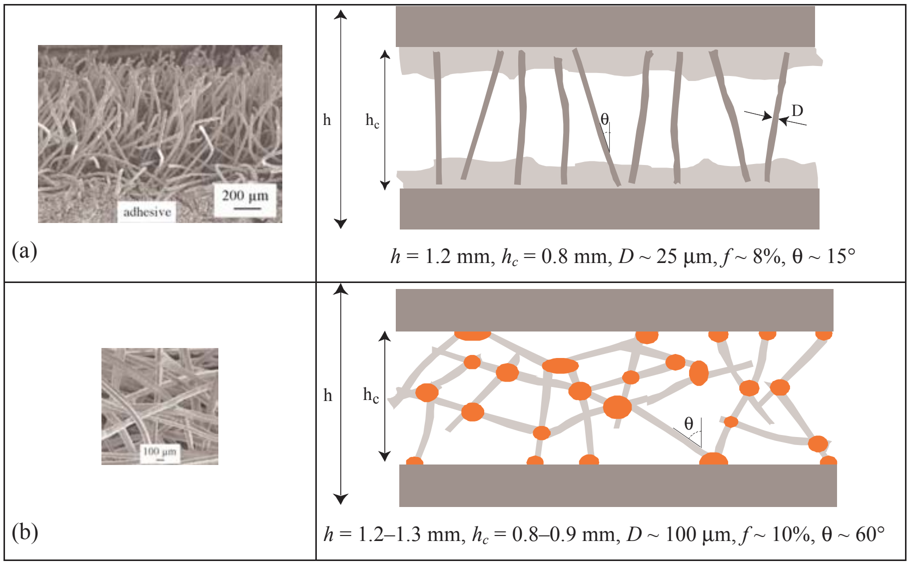

Figure 1: SEM micrographs, showing cross-sectional views of the cores, and schematic depictions of the structure of (a) flocked sheet and (b) short fibre 3-D array sheet.

is attributed to poor resistance offered by the flocked core structure to in-plane shear and lateral compression.

4 Through-thickness core stiffness

Two different approaches, based on a cantilever bending model, have been used to predict the through-thickness stiffness of the sandwich sheet cores. The first is applicable for the flocked sheet, in which the fibres are inclined at a specified angle, whereas the second approach assumes a three-dimensionally random orientation distribution of the fibre axes (short fibre 3-D array sheet).

4.1 Flocked sheet

The Young's modulus of the core in the through-thickness direction can be predicted by considering the behaviour of a single fibre of length L, initially straight and inclined at an angle θ to the direction of the applied load. The situation under load is depicted schematically in Fig.3. All fibres inclined at such an angle will behave similarly under the action of an imposed load W

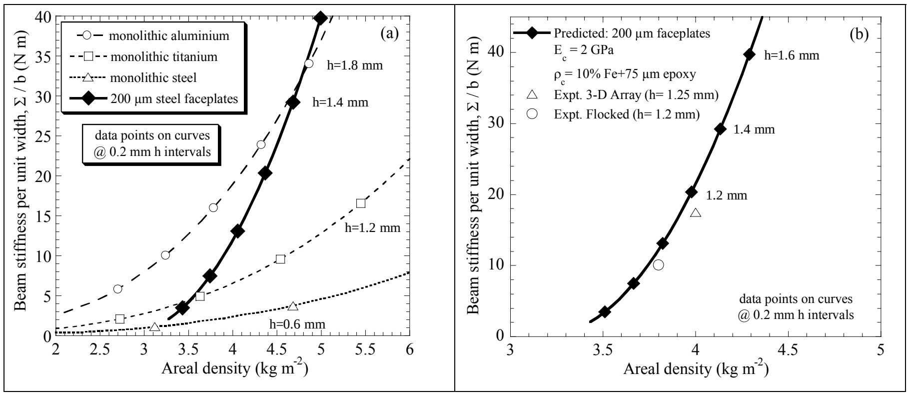

Figure 2: Beam stiffness as a function of areal density, showing (a) benefits of a sandwich structure (isotropic core with $E_c = 2$ GPa, $\rho_c = 1.56$ Mg m^{-3}) and (b) comparison between theory and experiment.

normal to the plane of the sheet, provided any interaction between individual fibres is neglected and assuming that their behaviour remains linearly elastic. From elementary beam bending theory, the normal deflection, δ $(= \Delta z/\sin\theta)$, of the free end of a cantilever beam of length $L/2$, subjected to a load $W \sin\theta$ normal to the beam axis, is given by

$$\frac{\Delta z}{\sin\theta} = \frac{1}{3}\frac{W \sin\theta (L/2)^3}{E_f I} \tag{1}$$

where E_f is the fibre modulus and I is the moment of inertia of the fibre section $(= \pi D^4/64$, where D is the fibre diameter, for cylindrical fibres).

The through-thickness strain of the core, ε_c, is given by

$$\varepsilon_c = \frac{2\Delta z}{h_c} \tag{2}$$

Substituting for Δz from Eqn.(1), and writing the core thickness as $L\cos\theta$ (see Fig.3), leads to

$$\varepsilon_c = \frac{2W\sin^2\theta(L/2)^3}{3E_f(\pi D^4/64)L\cos\theta} = \frac{16W\sin^2\theta L^2}{3E_f\pi D^4\cos\theta} \tag{3}$$

Now, the applied pressure, P, can be expressed in terms of the value of W and the number of fibres per unit area, N

$$P = NW \tag{4}$$

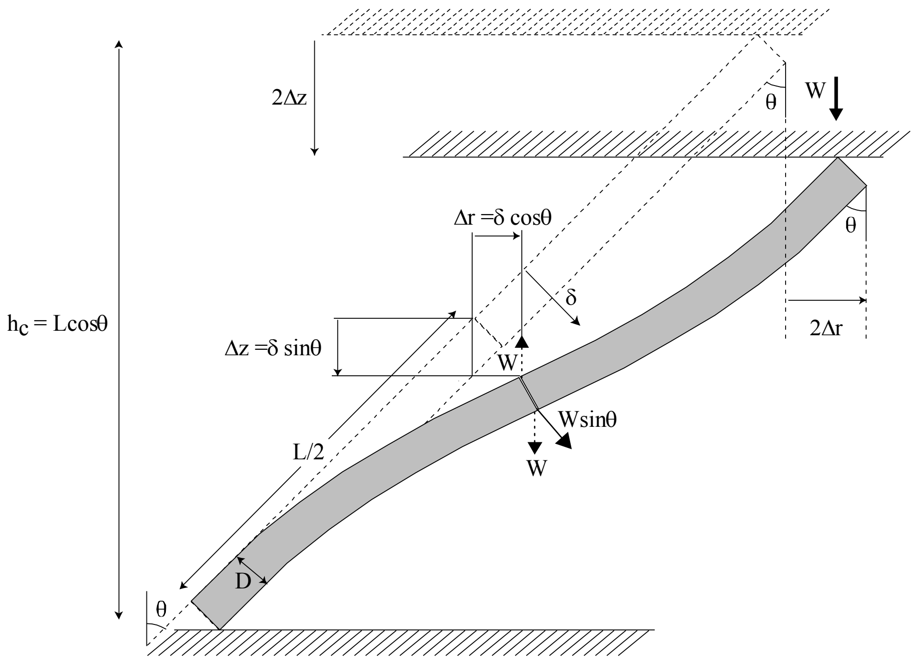

Figure 3: Elevation view of the elastic bending of an inclined fibre under the influence of a vertical load, W.

There is a relationship between N and the fibre volume fraction, f, which can be expressed as the ratio between the volume occupied by fibres in unit area of core and the corresponding volume of core

$$n = \frac{4f\cos\theta}{\pi D^2} \tag{5}$$

Substituting for N from Eqn.(5), the Young's modulus of the core in the through-thickness direction can be expressed as

$$E_c = \frac{P}{\varepsilon_c} = \frac{3NWE_f\pi D^4\cos\theta}{16W\sin^2\theta L^2} = \frac{3(4f\cos\theta)E_f\pi D^4\cos\theta}{16(\pi D^2)\sin^2\theta L^2} = \frac{3E_f f}{4s^2\tan^2\theta} \tag{6}$$

where s $(= L/D)$ is the fibre aspect ratio.

Predictions[2] obtained using Eqn.(6) show that higher stiffness is predicted for fibres inclined at low angles, as expected, since a fibre provides less resistance to vertical displacement when it is inclined at a high angle. It may also be noted that, for a given volume fraction of fibre, there will be more fibres per unit area when θ is close to $0°$(see Eqn.(5)). Also, the fibres will be of lower aspect ratio, for a given core thickness. The net effect is cumulative, so the sensitivity of the stiffness to θ is quite strong ($\tan^2\theta$). Furthermore, it can be seen that the stiffness goes up sharply as the fibre aspect ratio is decreased. An obvious way of increasing the stiffness, for a given core thickness, is to use fibres with larger diameter. An increase in fibre content will also generate increased stiffness, but this is less efficient and, of course, it also raises the density of the core.

4.2 3-D Random Fibre Array

The cantilever bending model (Fig.3) can be also used to predict the elastic stiffness of an isotropic random fibre array. In this case, the fibre being considered does not span the two faceplates, but is just a segment between two fibre-fibre joints (see Fig.1(b)). The deflection is induced by an applied stress, σ (compressive in Fig.3), which generates a force W on each individual fibre segment. These are related by

$$\sigma = NW \tag{7}$$

where N is the number of fibre segments per unit sectional area.

For a 3-D random fibre array, the relationship between N and f is simply obtained by noting that, for a set of prisms with a 3-D random orientation distribution of the prism axes, the area intersected by any plane is twice the area intersected by a plane lying normal to the alignment direction of a set of parallel prisms occupying the same volume fraction [10]. Hence, N here has a value of half that for the case of an aligned set of cylinders ($= f/(\pi D^2/4)$), ie

$$N = \frac{2f}{\pi D^2} \tag{8}$$

As before, the normal deflection, δ, of the end of a cantilever beam of length $L/2$, subjected to a load $W\sin\theta$ normal to the beam axis, is given by

$$\frac{W\sin\theta(L/2)^3}{3E_f\left(\frac{\pi D^4}{64}\right)} = \frac{8W\sin\theta L^3}{3E_f\pi D^4} \tag{9}$$

[2]This treatment clearly breaks down in the limit of $\theta = 0°$, when the predicted stiffness tends to infinity. The value must be upper bounded at fE_f, corresponding to the fibres remaining vertical and being axially compressed. In practice, even this value would not be approached, at least for fibres with relatively high aspect ratios. Realistically, the model may be taken as applicable for angles down to around $5-10°$, which is probably all that is required.

so that, substituting for W from Eqns.(7) and (9) and N from Eqn.(8), the axial deflection is given by

$$\Delta z = \delta \sin\theta = \frac{4\sigma L^3 \sin^2\theta}{3E_f f D^2} \tag{10}$$

The overall deformation expected with a material composed of a three-dimensionally random array of fibres can be analysed, at least approximately, by summing the contributions[3] from individual fibre segment deformations. The segments are assumed to exhibit a spherically symmetric orientation distribution, which has a $\sin\theta$ angular probability distribution about any given axis. The expected overall relative net extension in the direction of an applied stress can therefore be written down by considering the displacements of a set of fibre mid-points, using the expression for the deflection normal to the fibre axis, as a function of the distance along the fibre, given by Eqn.(10). The macroscopic deflection in the loading direction, and hence the strain, can thus be expressed as

$$\varepsilon_c = \frac{\Delta Z}{Z} = \frac{\int_0^{\pi/2} \Delta z \sin\theta \mathrm{d}\theta}{\int_0^{\pi/2} z \sin\theta \mathrm{d}\theta} = \frac{\int_0^{\pi/2} \frac{4\sigma L^3 \sin^3\theta}{3E_f f D^2} \mathrm{d}\theta}{\int_0^{\pi/2} \left(\frac{L}{2}\cos\theta\right) \sin\theta \mathrm{d}\theta}$$

$$\therefore \varepsilon_c = \left(\frac{8\sigma}{3E_f f}\right)\left(\frac{L}{D}\right)^2 \frac{\int_0^{\pi/2} \sin^3\theta \mathrm{d}\theta}{\int_0^{\pi/2} \cos\theta \sin\theta \mathrm{d}\theta} = \left(\frac{32\sigma}{9E_f f}\right)\left(\frac{L}{D}\right)^2 \tag{11}$$

The Young's modulus of the fibre array, $E_c(= \sigma/\varepsilon)$, is therefore given by

$$\therefore E_c = \frac{9E_f f}{32\left(\frac{L}{D}\right)^2} = \frac{9E_f f}{32 s^2} \tag{12}$$

A comparison between experimental results and predictions obtained using Eqn.(6) (flocked sheet) and Eqn.(12) (short fibre 3-D array sheet) is shown in Fig.4. It can be seen that experimental data are broadly consistent with predictions from the model predictions. For the flocked sheet, the measured value of about 100 MPa is in fairly good agreement with predictions obtained using estimated values for s, f and θ of 33 ($= h_c/D\sin\theta$), 8% and 15°respectively. For the short fibre 3-D array, the measured value of about 100 MPa is in fairly good agreement with predictions obtained using estimated values for s and f

[3] In reality, the deflections exhibited by individual fibre segments will be influenced by the configuration of neighbouring segments, so this analysis is clearly not rigorous when the inclination angles vary within the material. For example, the axial deflection of a segment inclined at a substantial angle to the stress axis would be reduced if a closely neighbouring segment were aligned parallel to the axis. However, such interactions are unlikely to generate large errors in the proposed model, at least for an effectively isotropic, homogeneous material.

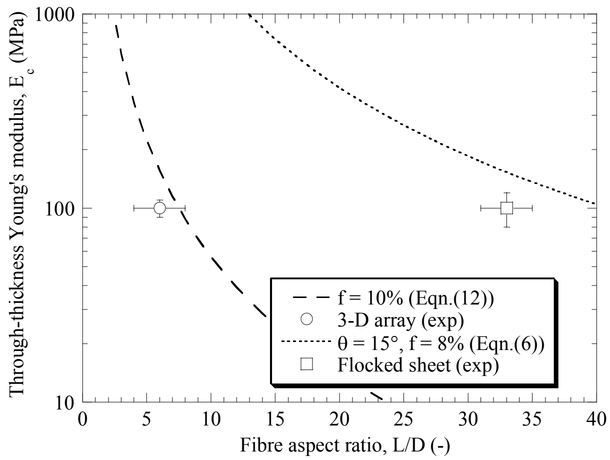

Figure 4: Through-thickness Young's modulus of the core as a function of fibre aspect ratio. The two points correspond to experimental measurements, while the curves are predictions obtained using Eqns.(6) and (12). A value of 200 GPa was used for the stiffness of the stainless steel fibres.

of 6 and 10% respectively. In any event, it is clear that all of these stiffnesses are relatively low (appreciably lower, for example, than would be the case if the cavity were filled with resin, i.e. $\sim 1 - 3$ GPa), and that these results are broadly consistent with the model predictions.

5 Conclusions

The following conclusions can be drawn from this work.

(a) Two variants of a novel, thin sandwich steel sheet, with a steel fibre core, have been characterised in terms of core structure. One variant (flocked sheet) contains strong fibres oriented approximately normal to the plane of the sheet and bonded to the faceplates by adhesive. The second variant (short fibre 3-D array) contains an approximately 3-D random network of coarser fibres, brazed to each other and to the faceplates.

(b) The beam stiffnesses of these sheets have been measured and the results compared with values expected from conventional bending theory, assuming the core to be isotropic. In both cases, the measured stiffnesses were lower than predicted. The measured through-thickness Young's moduli are relatively low ($\sim$ 100 MPa) and are broadly consistent with predictions from an analytical model based on the bending of individual fibres.

In this context, it is worth noting that, in sandwich sheets, the bending stiffness is dominated by the faceplates, so the core does not necessarily need to be very stiff. However, very compliant cores might be problematic, in that they may allow excessive shear between the faceplates or failure to maintain faceplate separation under load, leading to low beam stiffness. The brazed 3-D random fibre array core performs appreciably better than the flocked sheet core in this regard.

Acknowledgements

Support for this work is being provided by the Cambridge-MIT Institute (CMI). The authors wish to acknowledge Mr. Andrew Cockburn, of Cambridge University, who made some of the stiffness measurements and produced the 3-D array sheet., Mr. Jerry Karlsson, of HSSA Ltd, for providing the flocked sheet and Peter Rooney and Lee Marston, of FibreTech, for supplying the fibres.

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EUROMECH
European Mechanics Society
EUROMECH Fellow

The EUROMECH - European Mechanics Society Council has the pleasure to announce the introduction of the category of **EUROMECH Fellow**, starting in 2005. The status of Fellow is awarded to members who have contributed significantly to the advancement of mechanics and related fields. This may be through their original research and publications, or their innovative contributions in the application of mechanics and technological developments, or through distinguished contribution to the discipline in other ways.

Election to the status of Fellow of EUROMECH - European Mechanics Society will take place in the year of the appropriate EUROMECH Conference, EFMC or ESMC respectively, and is limited in total (fluids and solids together) to no more than one-half of one percent of the then current membership of the Society.

Nomination conditions :

- The nomination is made by **two sponsors** who must be members of the Society ;
- Successful nominees must be members of the Society ;
- Each nomination packet must contain a **completed Nomination Form, signed by the two sponsors, and no more than four Supporting Letters** (including the two from the sponsors)

Nomination Process :

- The nomination packet (nomination form and supporting letters) must be submitted before 15 January in the year of election to Fellow (the year of the respective EFMC or ESMC) ;
- Nominations will be reviewed before the end of February by the **EUROMECH Fellow Committee** ;
- Final approval will be given by the **EUROMECH - European Mechanics Society Council** during its meeting in the year of election to Fellow ;
- Notification of newly elected Fellows will be made in May following the Council meeting ;
- The Fellow award ceremony will take place during the EFMC or ESMC as appropriate.

Required documents and how to submit nominations : Nomination packets need to be sent before the deadline (before 15 January of the year of the respective EFMC or ESMC) to the President of the Society. Information can be obtained from the EUROMECH web page **www.euromech.org** and the Newsletter. Nomination Forms can also be obtained from the web page or can be requested from the Secretary-General.

EUROMECH - European Mechanics Society

NOMINATION FORM FOR FELLOW

NAME OF NOMINEE: ....

OFFICE ADDRESS: ....

....

....

EMAIL ADDRESS: ....

FIELD OF RESEARCH: ....

Fluids: ☐ Solids: ☐

NAME OF SPONSOR 1: ....

OFFICE ADDRESS: ....

....

....

EMAIL ADDRESS: ....

SIGNATURE & DATE: ....

NAME OF SPONSOR 2: ....

OFFICE ADDRESS: ....

....

....

EMAIL ADDRESS: ....

SIGNATURE & DATE: ....

SUPPORTING DATA

- SUGGESTED CITATION TO APPEAR ON THE FELLOWSHIP CERTIFICATE
(30 words max)
- SUPPORTING PARAGRAPH ENLARGING ON THE CITATION, INDICATING THE ORIGINALITY AND SIGNIFICANCE OF THE CONTRIBUTIONS CITED
(limit 250 words)
- NOMINEE'S MOST SIGNIFICANT PRINCIPAL PUBLICATIONS
(list at most 8)
- NOMINEE'S OTHER CONTRIBUTIONS
(invited talks, patents, professional service, teaching etc.). List at most 10
- NOMINEE'S ACADEMIC BACKGROUND
(University Degrees, year awarded, major field)
- NOMINEE'S EMPLOYMENT BACKGROUND
(position held, employed by, duties, dates)

SPONSORS DATA

Each sponsor (there are two sponsors) should sign the nomination form, attach a letter of recommendation and provide the following information:

- sponsor's name
- professional address
- email address
- sponsors signature/date

ADDITIONAL INFORMATION

Supporting letters (no more than four, including the two from the sponsors)

Send whole nomination packet to: **Professor Patrick Huerre**
President EUROMECH
Laboratoire d'Hydrodynamique
École Polytechnique
91128 Palaiseau cedex
France
E-mail: huerre@ladhyx.polytechnique.fr

Regulations and Call for Nominations
EUROMECH FLUID MECHANICS PRIZE
EUROMECH SOLID MECHANICS PRIZE

The Fluid Mechanics Prize and the Solid Mechanics Prize of EUROMECH, the European Mechanics Society, shall be awarded on the occasions of Fluid and Solid Mechanics conferences for outstanding and fundamental research accomplishments in Mechanics.

Each prize will consist of 5000 Euros. The recipient is invited to give a Prize Lecture at one of the European Fluid or Solid Mechanics Conferences.

Nomination Guidelines : A nomination may be submitted by any member of the Mechanics community. Eligible candidates should have spent a significant portion of their scientific career in Europe. Self-nominations cannot be accepted.

The nomination documents should include the following items :
- a presentation letter summarizing the contributions and achievements of the nominee in support of his/her nomination for the Prize,
- a curriculum vitae of the nominee,
- a list of the nominee's publications,
- at least two letters of recommendation.

Five copies of the complete nomination package should be sent to the Chair of the appropriate Prize Committee, as announced in the EUROMECH Newsletter and on the Society's Web site **www.euromech.org**. Nominations will remain active for two selection campaigns.

Prize committees :
For each prize, a Prize Committee, with a Chair and four additional members shall be appointed by the EUROMECH Council for a period of three years. The Chair and the four additional members may be re-appointed once. The committee shall select a recipient from the nominations. The final decision is made by the EUROMECH Council.

Nomination Deadline for the Fluid prize : **30 November 2005.**

The members of the *Fluid Mechanics Prize Committee* are :
- D. Abrahams
- D. Lohse
- H.H. Fernholz (Chair)
- W. Schröder
- P. Huerre

Nomination Deadline for the Solid prize : **30 November 2005.**

The members of the *Solid Mechanics Prize Committee* are :

- A. Benallal
- H.M. Jensen
- I. Goryacheva
- B. Schrefler
- F.G. Rammerstorfer (Chair)

Chairmen's Addresses :

Professor H.H. Fernholz (Chair, Fluids)
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Technische Universität Berlin
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Professor F.G. Rammerstorfer (Chair, Solids)
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Fax : +43-1-58801-31799
Email : ra@ilfb.tuwien.ac.at

First Announcement and Call for Papers
8th Euromech-Mécamat Conference – EMMC8
Material and structural identification from full-field measurements
13–15 September 2005
École normale supérieure de Cachan, France
http ://www.lmt.ens-cachan.fr/emmc8

The mechanics of materials and structures, in its continuing effort towards a better understanding of the relationship between microscopic mechanisms governing the macroscopic material behavior and structural response, attempts to find new answers by using full-field measurements and associated inverse and/or multiscale analyses. Nowadays, full-field measurement techniques are often used in universities as well as industrial laboratories. In experiments, in addition to Mechanics, Physics is involved in optical techniques (e.g., holographic interferometry, speckle interferometry, speckle photography, moiré technique, image correlation), infrared thermography, acoustic emission, X-Ray (micro)-tomography, or particle accelerometers (e.g., neutrons).

The researcher or the engineer has access to huge amounts of experimental data (e.g., up to few millions of displacement vectors). This information requires ad hoc data processing as opposed to classical methods that deal with a few measurements. Full-field measurements also allow for identifications of linear and non-linear constitutive equations for heterogeneous physical and mechanical fields in the presence of damage attracted phenomena. The purpose of the meeting is to bring together specialists in the development of experimental techniques, in use in the Mechanics of materials and structures. Various aspects such as the following are concerned :

– recent developments of the experimental techniques in relationship with mechanical applications, combination of different measurement techniques ;
– new experimental strategies using full-field measurement techniques ;
– multiscale experimental characterization (for any type of material or the loading conditions) ;
– new inverse analyses or identification techniques using full-field measurements.

Attention will be focused on the interaction between general fundamental concepts, experimental techniques and specific applications to different material fields such as :

– multiscale description of physical and mechanical properties ;
– non-linear constitutive equations ;
– Continuum Damage Mechanics and Fracture Mechanics.

Co-Chairmen : O. Allix, Y. Berthaud, F. Hild (Cachan) and G. Maier (Milan)

Web : http ://www.lmt.ens-cachan.fr/emmc8

E-mail : claudine.chabaud@lmt.ens-cachan.fr

Announcement and Call for Papers
5th EUROMECH Nonlinear Dynamics Conference
ENOC-2005

7–12 August 2005

Eindhoven University of Technology, The Netherlands

http ://www.enoc2005.tue.nl

The Fifth EUROMECH Nonlinear Dynamics Conference (abbreviated as ENOC-2005) will be held at the Eindhoven University of Technology in The Netherlands from 7–12 August 2005.

The present ENOC Conferences aim at covering the complete field of Nonlinear Dynamics, including Multibody Dynamics and couplings to Control and to Optimization.

Compared to the previous ENOC Conferences the structure of ENOC-2005 has been changed to a far-reaching extent. As usual, a limited number of General Lectures will be delivered by renowned scientists in different sub-fields of Nonlinear Dynamics. Besides, a substantial number of Mini-Symposia on major and challenging topics will be organized by recognized scientists, acting also as chairpersons of those Mini-Symposia.

General Lecturers :

- Prof. Thor Fossen (Norway)
- Prof. Jacques Laskar (France)
- Prof. Mark Levi (USA)
- Dr. Leo Maas (The Netherlands)
- Prof. Gabor Stépán (Hungary)
- Prof. Jon Juel Thomsen (Denmark)

Abstract Submission

Abstracts should be submitted in plane ASCII before 1 December 2004 by using the Abstract Submission menu at the ENOC-2005 website. The maximum length of each abstract is limited to 500 words with up to three references. Only plain text is to be used for the abstracts. All abstracts submitted will be reviewed for presentation at the ENOC-2005 Conference. All abstracts of papers accepted for presentation will be printed in the Abstract Book.

More information can be found on the ENOC-2005 website, which will be updated regularly. Alternatively, information is also available at the ENOC-2005 Conference Secretariat.

Web : http ://www.enoc2005.tue.nl **Email : enoc2005@tue.nl**

First Announcement
6th European Fluid Mechanics Conference – EFMC6
26–30 June 2006
KTH, Stockholm, Sweden
http ://www2.mech.kth.se/efmc6/

The 6th European Fluid Mechanics Conference, organized by EUROMECH (the European Mechanics Society), will take place at KTH, Royal Institute of Technology, Stockholm, 26–30 June 2006.

The conference aims to provide an international forum for exchange of information of all aspects of fluid mechanics, including instability and transition, turbulence, multiphase and non-Newtonian flows, bio-fluid mechanics, reacting and compressible flows, numerical and experimental methods, geophysical flows etc, as well as all types of fluid mechanics applications.

Eight prominent scientists have already accepted the invitation to give keynote lectures in their respective fields of expertise. These are (in alphabetical order) :

– Gustav Amberg (Sweden) - Fluid mechanics of phase change
– Stephan Fauve (France) - Generation of magnetic fields by turbulent flows of liquid metals
– Sascha Hilgenfeldt (USA) - The power of bubbles : Unconventional microfluidics
– Rich Kerswell (UK) - Progress in Reynolds' problem : transition to turbulence in pipe flow
– Hilary Ockendon (UK) - Continuum models in industrial applications
– Norbert Peters (Germany) - Combustion
– Jens Sørensen (Denmark) - Wind turbine wake structures
– Sandra M. Troian (USA) - Microfluidic actuation and sensing for open architecture systems : Fundamentals to applications.

In addition to these 8 invited lectures and one lecture by the EUROMECH Fluid Mechanics Prize winner (not yet selected), contributions are solicited from the worldwide fluid mechanics research community. The paper selection will be made by the EUROMECH Fluid Mechanics Conference Committee on the basis of the extended abstracts submitted at the end of 2005 (details on the submission process will be given on the conference home-page during Spring 2005). For further information please visit the website :

Web : http ://www2.mech.kth.se/efmc6/

Enquiries should be sent to **efmc6@mech.kth.se**

First Announcement and Call for Papers

11th EUROMECH European Turbulence Conference

ETC11

25–28 June 2007

Faculty of Engineering of the University of Porto
Porto, Portugal

ETC11, 11th EUROMECH European Turbulence Conference, organized by the EUROMECH-European Mechanics Society, will take place at the Faculty of Engineering of the University of Porto (FEUP) in Porto, Portugal.

The conference aims to provide an international forum for exchange of information on most fundamental aspects of turbulent flows, including instability and transition, intermittency and scaling, vortex dynamics and structure formation, transport and mixing, turbulence in multiphase and non-Newtonian flows, reacting and compressible turbulence, acoustics, control, geophysical and astrophysical turbulence, and large-eddy simulations and related techniques, MHD turbulence and atmospheric turbulence.

Following the tradition of previous editions, the conference programme will be made up of 8 invited talks (two per day), selected papers and posters sessions.

Contributions are solicited from the worldwide turbulence research community. The paper selection will be made by the EUROMECH Turbulence Conference Committee on the basis of two-page abstracts submitted via the conference webpage, at **www.fe.up.pt/etc11** by 6 October 2006.

All accepted papers and posters will appear in a conference proceedings to be distributed among the participants. A smaller set of papers may be published after the conference in a special issue of a scientific journal. For further and update information, please visit the conference website:

www.fe.up.pt/etc11
or contact the organizers at **etc11@fe.up.pt**.

EUROMECH Conferences in 2005, 2006 and 2007

The general purpose is to provide opportunities for scientists and engineers from all of Europe to meet and to discuss current research. Europe is a very compact region, well provided with conference facilities, and this makes it feasible to hold inexpensive meetings.

The fact that the EUROMECH Conferences are organized by Europeans primarily for the benefit of Europeans should be kept in mind. Qualified scientists from any country are of course welcome as participants, but the need to improve communications within Europe is relevant to the scientific programme and to the choice of leading speakers.

A EUROMECH Conference on a broad subject, such as the ESMC or the EFMC, is not a gathering of specialists all having the same research interests, and much of the communication which takes place is necessarily more in the nature of the imparting of information than the exchange of the latest ideas. A participant should leave a Conference knowing more and understanding more than on arrival, and much of that gain may not be directly related to the scientist's current research. It is very important therefore that the speakers at a Conference should have the ability to make ideas clear and interesting and should select and prepare their material with this expository purpose in mind.

ENOC
5th EUROMECH Nonlinear Oscillations 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
Website: http://www.enoc2005.tue.nl

EMMC8
MECAMAT, The 8th EUROPEAN Mechanics of Materials Conference
Dates: 13–15 September 2005
Location: ENS Cachan, 61 Avenue du President Wilson, 94235 Cachan cedex, France
Contact: Claudine Chabaud
E-mail: chabaud@lmt.ens-cachan.fr
Phone: +33 1 47 40 22 39
Website: http://www.lmt.ens-cachan.fr/emmc8

EFMC6
The 6th EUROMECH Fluid Mechanics Conference
Dates: 26–30 June 2006
Location: KTH, Stockholm, Sweden
Contact: efmc6@mech.kth.se
Website: www2.mech.kth.se/efmc6/

ESMC6
6th European Solid Mechanics Conference (ESMC 2006)
Dates: 28 August – 1 September 2006
Location: Budapest University of Technology and Economics (BUTE), Budapest, Hungary
Contact: Prof. Gábor Stépán - chairman; Dr. Ádám Kovács - secretary
BUTE Department of Applied Mechanics, P.O. Box 91 1521 Budapest, Hungary
Fax: +36 1 463 3471
E-mail: esmc2006@mm.bme.hu
Website: http://esmc2006.mm.bme.hu

ETC11
11th EUROMECH European Turbulence Conference
Dates: 25–28 June 2007
Location: Faculty of Engineering of the University of Porto, Porto, Portugal
Contact: etc11@fe.up.pt
website: www.fe.up.pt/etc11

EUROMECH Colloquia in 2005 and 2006

EUROMECH Colloquia are informal meetings on specialized research topics. Participation is restricted to a small number of research workers actively engaged in the field of each Colloquium. The organization of each Colloquium, including the selection of participants for invitation, is entrusted to a Chairman. Proceedings are not normally published. Those who are interested in taking part in a Colloquium should write to the appropriate Chairman. Number, Title, Chairperson or Co-chairperson, Dates and Location for each Colloquium in 2005, and preliminary information for some Colloquia in 2006, are given below.

EUROMECH Colloquia in 2005

460

Numerical Modelling of Concrete Cracking

Chairman: Professor G. Hofstetter, Institute for Structural Analysis and Strength of Materials University of Innsbruck, Technikerstrasse 13,
A-6020 Insbruck, Austria
Phone: +43 512 507 6720
Fax: +43 512 507 2908
E-mail: guenter.hofstetter@uibk.ac.at
Co-chairman: Prof. Günther Meschke, Institute for Structural Mechanics, Ruhr University Bochum, Universitätsstrasse 150, 44801 Bochum, Germany
Phone: +49 234 32 29051
Fax: +49 234 32 14149
E-mail: Guenther.Meschke@ruhr-uni-bochum.de
Euromech contact person: Prof. F. Rammerstorfer
Date and location: 21–23 February 2005, Innsbruck, Austria

461

Vortex and Magnetohydrodynamics - Structure, Symmetry and Singularity

Chairman: Prof. R.L. Ricca, Dip. Matematica, Universita di Milano - Bicocca, Via Biccoca degli Arcimboldi 8, 20126 Milano, Italy
Phone: +39 02 6448 7762
Fax: +39 02 6448 7705
E-mail: ricca@matapp.unimib.it
Co-chairman: to be nominated
Euromech contact person: Prof. P. Huerre
Date and location: April 2005, Italy

462 Cancelled
Fluid Mechanical Stirring and Mixing

463
Size-dependent Mechanics of Materials
CHAIRMAN: Prof. P.R. Onck, University of Groningen, Micromechanics of Materials, Nijenborgh 4, 9747 AG Groningen, The Netherlands
PHONE: +31 50 363 8039
FAX: +31 50 363 4886
E-MAIL: p.r.onck@phys.rug.nl
CO-CHAIRMAN: Prof. Dr. T. Pardoen, Université Catholique de Louvain, Materials Science and Processes Department, PCIM, Bâtiment Réaumur, Place Sainte Barbe 2, B-1348 Louvain-la-Neuve, Belgium
EUROMECH CONTACT PERSON: Prof. E. van der Giessen
DATE AND LOCATION: 13–16 June 2005, Groningen, The Netherlands

464b
Wind energy
CHAIRMAN: Prof. Dr. Peinke, Center for Wind Energy Research, Carl von Ossietzky University of Oldenburg, Faculty V, Institute of Physics, 26111 Oldenburg, Germany
PHONE: +49 441 798 3536
FAX: +49 441 798 3990
E-MAIL: peinke@uni-oldenburg.de
CO-CHAIRMAN: Prof. Dr.-Ing. Schaumann, University of Hannover, Institute for Steel Construction, Appelstrasse 9a, 30167 Hannover, Germany
EUROMECH CONTACT PERSON: Prof. Hans Fernholz
DATE AND LOCATION: 5–7 Octobre 2005, Oldenburg, Germany

465
Hydrodynamics of Bubbly Flows
CHAIRMAN: Professor Dr. Detlef Lohse, Applied Physics, University of Twente, Postbus 217, 7500 AE Enschede, The Netherlands
PHONE: +31 534 898 076
FAX: +31 534 898 068
E-MAIL: d.lohse@utwente.nl
CO-CHAIRMAN: Prof. Leen van Wijngaarden, Impact Institute, University of Twente, Postbus 217, 7500 AE Enschede, The Netherlands
EUROMECH CONTACT PERSON: Prof. Hans Fernholz
DATE AND LOCATION: 6–8 June 2005, Lorenz Center Leiden, The Netherlands

466
Computational and Experimental Mechanics of Advanced Materials 2005
Chairman: Professor Vadim V. Silberschmidt, Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University, Ashby Road, Loughborough, Leics., LE11 3TU, UK
Phone: +44 1509 227504
Fax: +44 1509 227502
E-mail: v.silberschmidt@lboro.ac.uk
Co-chairman: Prof. Ewald Werner, Lehrstuhl Werkstoffkunde und Werkstoffmechanik, Technische Universität München, Germany
Co-chairman: Prof. Helmut Böhm, Institute of Lightweigth Design and Structural Biomechanics, TU Wien, Austria
Euromech contact person: Ahmed Benallal
Date and location: 20–22 June 2005, Loughborough, UK

467
Turbulent Flow and Noise Generation
Chairman: Prof. Dr. rer. nat. Claus-Dieter Munz, Institut für Aerodynamik und Gasdynamik, Pfaffenwaldring 21, 70550 Stuttgart, Germany
Phone: +49 711 685 3433
Fax: +49 711 685 3438
E-mail: munz@iag.uni-stuttgart.de
Co-chairman: Prof. Dr. Patrick Bontoux, Université de Provence, Marseille, France
Euromech contact person: Prof. Werner Schröder
Date and location: 18–20 July 2005, Université de Provence, Marseille, France

468
Multi-scale Modelling in the Mechanics of Solids
Chairman: Acad. N.F. Morozov, Institute for Problems in Mechanical Engineering, Russian Academy of Sciences
Phone: +7 812 321 4788
Fax: +7 812 321 4771
E-mail: morozov@nm1016.spb.edu
Co-chairperson: Acad. I.G. Goryacheva, Institute for Problems in Mechanics, Russian Academy of Sciences
Co-chairperson: Prof. M. Wiercigroch, University of Aberdeen, UK
Euromech contact person: Acad. I.G. Goryacheva
Date and location: 29 June – 1 July 2005, St. Petersburg, Russia

469
LES of Complex Flows
CHAIRMAN: Prof. Dr. N. Adams, Technische Universität Dresden, Institut für Strömungsmechanik, George-Bähr-Str. 3c, 01062, Dresden, Germany
PHONE: +49 351 463 37607
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CO-CHAIRMAN: Dr. habil. M. Manhart, Lehrstuhl für Fluidmechanik, Technische Universität München, Boltzmannstrasse 15, 85748 Garching, Germany
EUROMECH CONTACT PERSON: Prof. Hans Fernholz
DATE AND LOCATION: 6–9 October 2005, Dresden, Germany

471
Turbulent Convection in Passenger Compartments
CHAIRMAN: Dr. C. Wagner, DLR Göttingen, Bunsenstrasse 10, 37073 Göttingen, Germany
PHONE: +49 551 709 2261
FAX: +49 551 709 2404
E-MAIL: claus.wagner@dlr.de
CO-CHAIRMAN: Prof. A. Thess, Technical University of Ilmenau, Germany
EUROMECH CONTACT PERSON: Prof. W. Schröder
DATE AND LOCATION: September 2005, Göttingen, Germany

472
Microfluidics and Transfer
CHAIRMAN: Prof. Michel Favre-Marinet, LEGI BP 53, 38041 Grenoble cedex, France
PHONE: +33 4 7682 5049
FAX: +33 4 7682 5271
E-MAIL: michel.favre-marinet@hmg.inpg.frCO-CHAIRMAN: Dr. Patrick Tabeling, MMN ESPCI, 24, rue Lhomond, 75231 Paris cedex 05, France
EUROMECH CONTACT PERSON: Prof. Emil Hopfinger
DATE AND LOCATION: 6–8 September 2005, Grenoble, France

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Failure and Fracture of Composite Materials
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Co-chairman: Prof. A.M. Balaco de Morais, Departamento de Engenharia Mecânica, Universidade de Aveiro, Aveiro, Portugal
Co-chairman: Prof. P. T. de Castro, Departamento de Engenharia Mecânica e Gestão Industrial, Faculdade de Engenharia da Universidade do Porto, Porto, Portugal
Euromech contact person: Prof. J. Ambrosio
Date and location: 27–29 October 2005, Porto, Portugal

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Material Instabilities in Coupled Problems
Chairman: Prof. A. Benallal, LMT-Cachan, 61 Avenue du Président Wilson, 94235 Cachan, France
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Co-chairman: Prof. D. Bigoni, Trento University, Italy
Euromech contact person: Prof. P. Huerre
Date and location: 30 August – 1 September 2005, Troyes, France

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EUROMECH Colloquia in 2006

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Recent Development in Magnetic Fluid Research
Chairman: Dr. Stefan Odenbach, ZARM, University of Bremen, Am Fallturm, 28359 Bremen, Germany
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E-mail: odenbach@zarm.uni-bremen.de
Co-chairman: Prof. Dr. Elmars Blums, Institute of Physics, University of Latvia, Salaspils, Latvia
Euromech contact person: Prof. W. Schröder
Date and location: February 2006, Bremen, Germany

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Fluid Dynamics in High Magnetic Fields
Chairman: Prof. A. Thess, Department of Mechanical Engineering, Ilmenau, University of Technology, P.O. Box 100 565, 98684, Ilmenau, Germany
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E-mail: thess@tu-ilmenau.de
Date and location: February 2006, Ilmenau, University of Technology, Germany

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Real-time Simulation and Virtual Reality Applications of Multibody Systems

CHAIRMAN: Prof. J. Cuadrado, Escuela Politecnica Superior, Universidad de La Coruña, Mendizabal s/n, 15403 Ferrol, Spain
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CO-CHAIRMAN: Prof. W. Schiehlen, Institute B of Mechanics, University of Stuttgart, Germany
EUROMECH CONTACT PERSON: Prof. J. Ambrosio
DATE AND LOCATION: March 2006, Ferrol, Spain

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Particle-laden Flow: from Geophysical to Kolmogorov Scales

CHAIRMAN: Prof. B.J. Geurts, Mathematical Sciences, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands
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EUROMECH CONTACT PERSON: Prof. D. Lohse
DATE AND LOCATION: June 2006, University of Twente, The Netherlands

EUROPEAN CONFERENCE FOR AEROSPACE SCIENCES (EUCASS)

4–7 July 2005 - Moscow

Co-organized by ONERA and TsAGI
Supported by AAAF and CEAS

Moscow 2005 Honorary Chairmen

J. Blamont	CNES and French Académie des Sciences
V. Fortov	IHED and Russian Academy of Sciences
V. Dmitriev	Director of TsAGI

Objectives :

This first Conference on Aerospace Sciences is a unique initiative in Europe. It provides a stimulating forum where scientists and engineers can exchange information and experience. It is an ideal showcase for decision makers in public authorities, Industry and Agencies. It is an opportunity for young scientists to interact within a European dimension, and establish contact with industry.

The conference will :

1 - Review the state of the art in the field of Aerospace Sciences ;

2 - Present innovative solutions to the current problems of Aerospace Research and Technology ;

3 - Promote industrial understanding of the evolving scientific state of the art and promote a synergy between Aeronautics and Space ;

4 - Inform Agencies and decision makers about novel perspectives and future directions in Aerospace Sciences, and procure them with an opportunity to present their future programmes.

It will highlight advances in key aerospace sciences in 5 parallel symposia. Papers are solicited on **Research and Development, modelling, simulation and testing** in the following fields of aerospace sciences :

- System Integration on aircraft and space/launch vehicles ;
- Flight Physics for aircraft and launch vehicles including re-entry bodies.
- Flight Dynamics and GNC for Space and Aeronautical applications (Planes, drones, launch vehicles, spacecraft, helicopters...) ;
- Structures and Materials for aerospace structures and propulsion units with respect to Safety, Performance, Reliability, Environmental Impact, Lifetime Cost ;
- Propulsion Physics, new developments in engines and propellants modelling and testing.

Authors must email a detailed one page-long abstract (500 words plus optional figures and key references) by 29 November 2004 to :

AAAF - 61, Avenue du Château
78480 Verneuil sur Seine, France
PHONE : +33 1 39 79 75 15
FAX : + 33 1 39 79 75 27
E-MAIL : secr.exec@aaaf.asso.fr

with copy to programme co-chairman Max Calabro :
E-MAIL : max-calabro@wanadoo.fr

Miscellaneous Information

The registration fee is 650 euros for non-CIS nationals. For citizens of Russia and other CIS nationals, the fee is 150 euros. A fee of 50 euros will be applied for students. The fee will be raised by 150 euros on registrations received after 31 May 2005 for those paying the normal fee, and by 50 euros for all others.

Information can also be found on the conference website at :
http ://www.onera.fr/eucass/.

EUROMECH Conference Reports
5th EUROMECH Fluid Mechanics Conference EFMC5

Chairperson: Jacques Magnaudet

The fifth Euromech Fluid Mechanics Conference was held in Toulouse (France) from 24–28 August 2003. It was attended by 565 researchers coming from all European countries and also from the rest of the world. The countries that sent most participants were France (about 170), UK (about 70), Russia (about 60), the Netherlands (about 45), Germany (about 40), Italy and United States (about 25 each), Israel (18), Spain (16) and Ukraine (12).

The conference was held over five days. It comprised 9 plenary lectures of 45 mn each, 72 oral sessions split in a succession of 9 times 8 parallel sessions based on presentations of 12 mn each and 3 poster sessions including a brief oral summary of each poster. On the afternoon of 26 August, the participants had the opportunity to visit the Sainte Cécile cathedral and the Museum Toulouse-Lautrec in the city of Albi. In the same evening a Gala Dinner took place in the Château de Croisillat.

The scientific programme of EFMC 2003 was built around eleven major topics and three mini-symposia. The eleven topics were: *Aerodynamics* (4 sessions) *Two-phase Flows* (9), *Hydrodynamic Instabilities* (7), *Industrial Applications* (1), *Granular Flows and Non-Newtonian Fluids* (4), *Reactive Flows and Combustion* (3), *Microfluidics and Bio-fluids* (5), *Turbulence* (6), *Geophysical Flows* (5), *Transition and Control* (7), *Waves and Interfaces* (8). The three mini-symposia focused on *Aero-acoustics* (3), *Experimental Techniques involving Light and Sound* (2), and *Microgravity Fluid Mechanics* (8).

The conference started with the 2003 EUROMECH Fluid Mechanics lecture delivered by Professor Henry Keith Moffatt from Cambridge University and entitled *The Navier-Stokes equations and the finite-time singularity problem.* It turned out that Professor Moffatt was also chosen during the Spring of 2003 by the Euromech Council to be the first recipient of the newly established Euromech Fluid Mechanics Prize (see the Euromech Newsletter number 24), so that this opening lecture combined with the Euromech Fluid Mechanics Prize Lecture.

Young conference participants below 35 competed for the Best Oral and Best Poster Presentation Prizes. The committee in charge of these prizes chose Philippe Marmottant from Twente University (The Netherlands) who presented a contribution entitled *How ultrasound driven bubbles act on lipid membranes* as the recipient of the Best Oral Presentation Prize while the Best Poster Presentation Prize was awarded to Silke Guenther from Darmstadt University for her contribution entitled *Vibrating grid turbulence scaling laws in inertial and rotating systems.*

This conference turned out to be extremely positive in several aspects. It made it possible to strenghten the links between the various branches of the European scientific community in Fluid Mechanics, including those from the former USSR. The vast range of topics covered by the conference allowed all tendencies of the community to exchange their views by ensuring an efficient stirring between the various research methodologies and between 'applied maths'–oriented and 'physics'–oriented topics. Finally, owing to its size, this conference gave a good instantaneous picture of the strong axes of research currently followed in Fluid Mechanics throughout Europe.

The 6th EUROMECH Fluid Mechanics Conference will be held in Stockholm, Sweden – see the First Announcement in this Newsletter

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7th EUROMECH-MECAMAT Conference EMMC7

Adaptive systems and materials: constitutive materials and hybrid structures

Co-chairpersons: Christian Lexcellent, Étienne Patoor

This international conference was held between 18–23 May 2003, in the 'Villa Clythia' belonging to the CAES of the French *Centre National de la Recherche Scientifique* – CNRS, at Fréjus (France).

The scope of this EMMC7 conference was about the use of smart materials which permit the conception of some adaptive systems for industrial applications. Special attention was devoted to active and passive controls of damping in structures. The use of this new class of materials (shape memory alloys, piezoelectric ceramics, TRIP steels, ferromagnetic shape memory alloys, . . .) implies the development of numerical tools for computer assisted design processes.

The complexity of the material behaviour involved requires a deep understanding of strain mechanisms (martensitic phase transformation, reorientation process of domains), the use of accurate experimental techniques and advanced modelling approaches at various scales (micro, meso, macroscopic).

For this purpose, it is necessary to use coupled calculations, connecting different fields of physics such as thermal physics, electromagnetism, electricity and the mechanics of materials.

The conference topics gave the opportunity for fruitful discussions between the mechanics of materials community and the specialists of damping or passive control.

The scientific program contained nine oral sessions:

- Experimental characterization of the thermomechanical behavior of shape memory alloys (two sessions);
- Modeling of the thermomechanical behavior of shape memory alloys (two sessions);
- Ferromagnetic shape memory alloy behavior (one session);
- Piezoelectric ceramic behavior (one session);
- Transformation induced plasticity steel behavior (one session);
- Hybrid structures, including smart materials such as sensors or actuators (one session);
- Adaptive structures for vibration control (one session).

There was also a Poster session.

The conference program consisted of 50 lectures. 57 scientists were present and came from 14 different countries: 20 from France, 7 from Germany, 6 from Italy, 4 from Russia, 4 from Finland and 5 from the USA ...

The scientific program allowed all the participants the chance to exchange their opinions and deepen their knowledge on 'the state of art' in smart materials and adaptive systems.

In order to prepare the Proceedings of the EMMC7 Conference (Les Editions De Physique 'Journal de Physique IV') each paper was reviewed by two experts belonging to the International Scientific Committee or other specialists. We thank them for their very important contribution to the scientific quality of the Proceedings.

We also thank the sponsors of the Conference: the Délégation Générale de l'Armement (DGA), Ministère de la Recherche, Université de Metz, ENSAM, CNRS, Association Française de Mécanique et Institut des Microtechniques de Franche-Comté, the members of the organizing committee, the EUROMECH-MECAMAT committee for entrusting the organisation of this conference to us, Les Editions De Physique for the Proceedings, the 'Villa Clythia' team for their help in the practical organization,

... and all the participants.

EUROMECH Colloquia Reports
EUROMECH Colloquium 452
Advances in Simulation Techniques for Applied Dynamics
Chairperson: Martin Arnold

EUROMECH Colloquium 452 on 'Advances in Simulation Techniques for Applied Dynamics' was held from 1–4 March 2004, at the Martin-Luther-University Halle-Wittenberg, Germany. There were 55 participants, among them 8 from industry. Delegates came from 11 EU countries and from Russia.

In engineering, advanced mechatronical systems consist of mechanical, electrical and/or hydraulical components as well as control devices with computer hardware and software. The design of such systems requires novel modelling and simulation techniques to analyse the dynamical behaviour of coupled physical phenomena. On the one hand, a heterogeneous engineering system may be described in a unified modelling framework to cover multibody dynamics, structural mechanics, hydraulics and electronics. Modelling languages are typical representatives of this approach. On the other hand, the individual system components may be modelled separately by standard methods and the coupling conditions are added within a co-simulation framework. Both the unified modelling approach and the co-simulation technique are used successfully in industrial applications.

EUROMECH 452 focused on the theoretical background and modelling of coupling conditions, on different approaches to modelling and dynamical simulation of coupled mechanical systems and on adapted numerical solution methods and related theoretical and numerical subjects. Case studies and industrial applications found special interest.

The scientific activities were addressed in 10 sessions:

- Simulation and time integration,
- Mechatronic systems,
- Multifield problems,
- Analysis of dynamical systems,
- Electro-mechanical systems,
- Vehicle dynamics, Flexible multibody systems,
- Simulation and optimization,
- Time integration methods for flexible multibody systems,

- Time integration of hybrid and coupled systems,
- Optimal control, Miscellaneous.

In addition, in the Willi Kortüm Memorial session, papers on vehicle dynamics and simulation were delivered by P. Lugner (Vienna), H. True (Lyngby, Denmark), R. Sharp (London), A. Wickens (Loughbourough, UK), A. Eichberger (Oberpfaffenhofen, Germany), W. Krüger (Oberpfaffenhofen, Germany) and M. Valášek (Prague). All these sessions were well received by the participants.

Selected papers of the colloquium will be published in a special issue of Multibody System Dynamics edited by the chairmen of this colloquium.

The discussion during the colloquium resulted in a proposal to held a future EUROMECH Colloquium on '*Real-time simulation and virtual reality applications of multibody systems*' with J. Cuadrado and W. Schiehlen as chairmen.

EUROMECH Colloquium 453
Internal Stresses in Polymer Composite Processing and Service Life
Chairpersons: Alain Vautrin, Giuseppe Mensitieri

EUROMECH 453 addressed the problem of the identification and modelling of the internal stresses arising in polymer matrix composites in processing and service life. The cure of the polymer matrix and the heterogeneous stress state of the composite control the mechanical behaviour of composites. The in-service conditions create time-dependent mechanical and hygrothermal stresses, which add to the residual stresses. Finally, the occurrence and growth of internal stresses during processing and service life can lead to dimensional variation, material damage or structural instability which should be studied, predicted and controlled. The present lack of models to describe coupled phenomena in polymer matrix composites under time-variable process temperature and pressure or hygrothermal in-service conditions is critical and should be overcome to draw full benefit from this type of materials. It was expected that the present colloquium, gathering researchers from different fields: mechanics, physical chemistry of polymers, could clarify some aspects of this topic.

The Colloquium took place at the École des Mines de Saint-Étienne on 1–3 December 2003 and was jointly organized by the University Federico II of Naples (Italy) and École des Mines de Saint-Étienne (France). There were 60 participants from 11 countries. A total of 35 oral contributions, comprising 29 regular papers and 6 invited lectures, have been presented in 5 thematic sessions each of them introduced by an invited paper:

- Residual Internal Stresses in Processing,
- Internal Stresses and Mechanical Behaviour,
- Modelling of Coupled Phenomena,
- Hygrothermal Stresses in Composites,
- Analysis of Internal Stresses and Mechanical Effects.

The conclusions that could be drawn from presentations and discussions are the following:

- Significant advances in the understanding, numerical modelling and predictive tools of the effect of the different curing steps: gelation, vitrification and final cooling, on the residual stresses and dimensional changes (spring-in) have been made;
- Novel experimental approaches, including Raman spectrometry, optical fibre based in-situ sensors and full-field optical measurement techniques, can provide a refined knowledge of the mechanical state of composite structures; benchmarking and well-founded opto-mechanical analyses are still required;
- Predictions of the hygro-thermal-mechanical behaviour of pure polymer matrix seem well under control but advances on the coupled effects of moisture and temperature on the mechanical behaviour and damage of composites are to be investigated.

No paper dealt with the specific role of the matrix/fibre interface and the main attention was paid to the meso-scale. As a result, it is believed that the colloquium will stimulate new joint projects combining Mechanics and the Physical Chemistry of polymers and composites. In particular, projects considering coupled phenomena occurring during the manufacturing process are requested by industry to produce controlled quality components. The organizers contemplate holding a future colloquium on that topic in 2006 to contribute to, and strengthen this topic.

The Organizers are grateful to the different partner organizations which supported the Colloquium, in particular regional institutions Regione Campania (Italy), Région Rhône-Alpes, Saint-Étienne City and Loire Councils (France), scientific societies, such as ESCM, AFM, AUM, Saint-Étienne Composites and industrial companies Hexcel and EADS CCR.

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.