NEWSLETTER 43
September 2013
EUROPEAN MECHANICS SOCIETY

President's Address

This is my first introductory address as new President of EUROMECH. It is a great honour for me to take over this task from Professor Patrick Huerre, who has led our society during the last ten years with great vision and enthusiasm. During this period EUROMECH has flourished and has clearly shown itself to be the most firmly established scientific mechanics society of Europe. There are quite a few signs of the flourishing of our society. For example, the large EUROMECH Conferences have continued to be very successful, attracting increasing numbers of junior and senior scientists in solid and fluid mechanics from Europe and outside. New initiatives, such as the EUROMECH Specialised Workshops and the European Postdoctoral Fluid Dynamics Conferences have proven to be successful.

Patrick Huerre has played an important, stimulating role in bringing EUROMECH to its present state of a well-established mechanics society, clearly visible and recognised outside Europe. I take this opportunity to thank him for his effective and inspiring leadership during the last ten years.
We are very glad that he will stay on as Vice-President, so that we may continue benefiting from his valuable experience.

Our Secretary-General, Professor Bernhard Schrefler, will step down at the end of this year, although he will continue to be a Council member. Bernhard Schrefler has been active in this office position for nine years, and we are very grateful for his devotion to this job. It is my pleasure to announce that we have been able to find an excellent successor in the person of Professor Pierre Suquet (Marseille, France), who will take up office on 1 January 2014. Professor Suquet is an expert in theoretical solid mechanics, specialising in the mechanics of nonlinear composites. We are looking forward to working with him as new Secretary-General of our society.

Elections for new EUROMECH Council members were held at the beginning of this year, and I am pleased to inform you about the outcome. We welcome to the Council the following distinguished colleagues: Professor Alexander Belyaev (St Petersburg, Russia; Solids), Professor José Gordillo (Sevilla, Spain; Fluids), Professor Paul Linden (Cambridge, UK; Fluids), and Professor Stefanie Reese (Aachen, Germany; Solids). Information about their scientific background may be found in the previous Newsletter, No. 42. These new members will serve on the Council for a period of six years, starting from 1 January 2013. We are confident that we will benefit from their involvement in various aspects of the EUROMECH organisation.

On behalf of the other Council members, I would also like to thank the other candidates that stood for election, but who were not elected at this occasion. It should be mentioned that there was a strong support for them, and we hope that they will continue being actively involved in EUROMECH.

And, of course, we thank the leaving Council members, Professors Jensen, Petryk, and Raous, for their stimulating involvement during their term.

The EUROMECH Council, at its recent meeting in Eindhoven in April this year, unanimously decided to elect Professor Hans Fernholz and Professor Jean Salençon as Honorary Members, as a token of esteem for their achievements in fluid and solid mechanics, respectively, and in recognition of their invaluable work for the Council and on various committees. Hans Fernholz has been active in EUROMECH since the early days: he participated in Colloquium No. 1. He was Secretary of the Committee, he was President and later Vice-President of the society, Chairman of the EUROMECH Fluid Mechanics Conference Committee, and he acted as chairman of several Colloquia. Jean Salençon was a member of the EUROMECH Committee and the main instigator in the founding of the European Journal of Mechanics A and B series. He has been actively involved in the governance of the Académie des Sciences and was President of that prestigious institution in 2009 and 2010.

During the recent Council meeting, ten proposals for EUROMECH Colloquia were (conditionally) approved for 2014 and 2015; for details see elsewhere in this Newsletter. We are pleased that a reasonable number of colloquium proposals on interesting topics in solid and fluid mechanics were submitted this year. We encourage members to submit new proposals, in order to ensure continuity of these activities into the future. Do consider preparing such a proposal for the next round, which is in Spring 2014.

You may have noticed that the EUROMECH Newsletter is now publicly available on the EUROMECH website, so it is also accessible to non-members. The Newsletter serves to provide a concise overview of the various EUROMECH activities, a calendar of upcoming events, and short reports on recent EUROMECH Conferences and Colloquia. The website is an increasingly attractive and efficient medium for conveying information about the EUROMECH organisation, its activities, the solid and fluid mechanics research taking place in various European groups, and so on. In order to make the site even more attractive, we welcome input from your side, e.g. in the form of photographs or movies illustrating your research, whether it be experimental or numerical. As we all know, results in the field of solid and fluid mechanics can often be visualised in a very attractive and aesthetically appealing way. Let us exploit this possibility. Your entries are most welcome.

As your new President, I will do my best to continue supporting and stimulating the EUROMECH Society in the tradition of my predecessors. This will be a challenging, but pleasant task.

GertJan van Heijst
President, EUROMECH

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EUROMECH Fluid Mechanics Prize Paper

"A perspective of Batchelor's research in micro-hydrodynamics"

Professor John Hinch (DAMTP, Cambridge, UK) won the Euromech Fluid Dynamics Prize 2010, wich was awarded at the 8th EUROMECH Fluid Mechanics Conference held in Bad Reichenhall (Germany), 12 - 17 September 2010. In his Prize Lecture, Professor Hinch presented a review of the work of the late George Batchelor on micro-hydrodynamics.
This interesting review has been published in the form of the paper "A perspective of Batchelor's reasearch in micro-hydrodynamics" in the Journal of Fluid Mechanism (vol. 663, pp. 8-17, 2010).

EUROMECH Fluid Mechanics Fellow Paper

"The rheology of dense mobile particulate systems"

Élisabeth GUAZZELLI was named Fellow at the 8th EUROMECH FLUID Mechanics held in Bad Reichenhall, Germany, 2010
Olivier POULIQUEN was named Fellow at the 9th EUROMECH FLUID Mechanics held in Rome, Italy, 2012

Abstract

This short paper summarises our recent work on the rheology of the intermediate regime of dense mobile particulate media using specifically-designed unconventional rheological tools. Pressure imposed rheometry provides accurate measurement very close to the jamming transition. Free surface profilometry leads to the determination of the normal stress differences. The combination of these measurements gives the full description of the stress tensor of dense suspension.

1. Introduction

Mobile particulate systems involve the mechanics, flow and transport properties of mixtures of fluids and solids. They encompass both suspensions and granular media and are ubiquitous in nature and in industrial processes. Suspensions refer to particles dispersed in a liquid or a gas. Familiar examples include aerosols such as sprays, mists, coal dust, industrial fluids such as paints, ink, or emulsions in food or cosmetics. Granular media refer to a collection of particles interacting through contact interactions. Familiar examples of granular media include dry powders, grains, and pills in the food and pharmaceutical industry, sand piles, soil involved in civil engineering or geophysical problems. While the viscous fluid between the particles mediates particle interactions in suspension flows, direct contact interactions are dominant in dry granular media. However, certain situations go beyond this mere division between granular materials and suspensions. Dense or highly concentrated particulate flows belong to an intermediate regime, in which the grains interact both by hydrodynamic interactions through the liquid and by mechanical contact. In order to understand their flowing behaviour, the fundamental problem is to determine the rheological properties of these media (considered as equivalent homogeneous materials) from a knowledge of the mechanics of the particles and the interstitial fluid.

Whereas the mechanics of dilute or semi-dilute suspensions composed of spherical particles and a viscous Newtonian fluid is probably the subject which has matured the most [1,2], there is no general theory to describe the increase in viscosity at higher volume fraction, in particular near jamming when contacts become important and the viscosity diverges. This difficulty has been partially circumvented in dry granular flows. It has been shown that a simple rheological description in terms of a shear rate dependent friction coefficient may be sufficient to capture the major properties of granular flows [3]. The dynamics close to the flow threshold or jamming remain however less understood.

In this short paper, we summarise our recent work on the rheology of the intermediate regime of dense mobile particulate media [4-6]. We show that we can unify suspension and granular rheology under a common framework by transferring the approach of dry granular media to wet suspensions. We also show evidence of non-Newtonian behaviour at large volume fractions and present accurate measurements of normal-stress differences. These new contributions to the understanding of the rheology of concentrated suspensions use unconventional rheological tools.

2. Pressure imposed rheology of dense suspensions

We propose a novel approach to the old question of the rheology of a suspension. In previous studies, the shear stress has been measured as a function of the shear rate at different imposed values of the volume fraction of particles. We tackle the problem by transferring the approach of dry granular media in terms of frictional rheology to wet suspensions [4]. We measure the shear stress as a function of the shear rate at imposed values of the normal stress. The original setup consists of an annular ring closed at the top by a rotating porous plate free to move vertically. The suspension is poured into the annular space and the particles are squeezed by applying a constant force on the top porous plate. The suspension is sheared by the rotation of the top plate. The force applied on the top plate prescribes the particle pressure whereas the volume fraction is free to adjust during the shear.

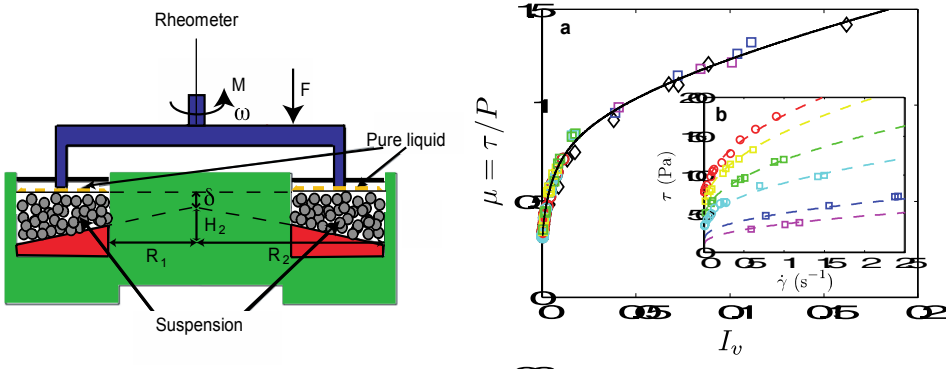

Fig. 1: The pressure imposed shear cell. The top plate is porous and free to move vertically, and applies a pressure P and a shear stress τ on the grains. A rheometer at the top measures the rotation speed (related to the shear rate γ) and the vertical position of the plate (related to the volume fraction). All the data collapse on a single curve when the coefficient of friction (ratio of shear to normal stress τ/P) is plotted as a function of the viscous number Iv (Iv= $\eta\,\gamma/P$).

With this original shear cell, the rheology is studied under a constant pressure condition by contrast with the constant concentration condition measured in a conventional rheometer. First, we can show that describing flow in terms of an effective friction coefficient works for both

granular flows and suspensions, and thus unifies suspension and granular rheology. Second, this new way of looking at suspensions circumvents the divergence observed in concentration-imposed rheometry and allows examination of the rheology extremely close to the jamming transition.

3. Normal stress difference

At large volume fractions, the normal stress is no longer isotropic and suspensions exhibit normal stress differences. Normal stresses are difficult to measure using standard rheological tools. We chose to measure free-surface deflection induced by the anisotropic stresses in (a) a rotating-rod flow and (b) a flow down a tilted trough. The first method is well known in polymers as the Weissenberg or rod-climbing effect. For suspensions, the climbing is down instead of up the rod and measurement of the free-surface profile provides a combination of the normal stress differences.

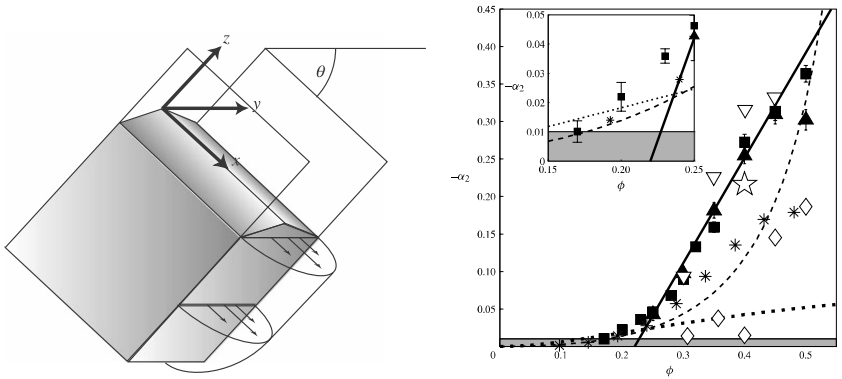

Fig. 2: The titlted trough experiment: a long channel full of suspension is suddenly inclined. Due to normal stress differences, the free surface deforms. The second normal stress coefficient α_2 can be infered from the measurement of the free surface deflection.

The second tilted-trough method provides the second normal stress difference in isolation. Combining both methods yields a complete measurement of the two differences, which are both linear in the modulus of the shear rate [5,6]. The second normal stress difference is negative and becomes large with a strong increase in volume fractions above a volume fraction of 20 percent. The situation is still unclear for the first normal stress difference. We find that it is very small and that it is hard to tell whether it is negative, positive or even zero [6]. Some recent experiments show that it is negative but quite small [7], while some other experiments suggest that it is positive [8].

4. Conclusions

Using unconventional rheometry such as a pressure imposed shear cell and free surface profilometry, we have obtained accurate determination of the constitutive relationships for dense suspensions. These unconventional rheological tools offer a brand new perspective for analyzing more complex particulate systems such as polydispersed or non-spherical mixtures of fluid and particles, soft materials, and suspensions in non-Newtonian fluids.

5. References

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EUROMECH Young Scientist Prize paper:

"A Numerical Analysis of Bumblebee Propulsion"

Sheila Tobing[1]*, John Young, Joseph C.S. Lai*

Sheila Tobing won the EUROMECH Young Scientist Prize, awarded at the 9th European Fluid Mechanics Conference held in Rome, September 9 - 13, 2012.

Abstract

Interest in the flapping wing flight has increased steadily in recent years due to potential applications in the design and development of a small unmanned aircraft known as the Micro Air Vehicle (MAV). The unsteady aerodynamics that governs the propulsive performance of an insect is complex because of a large number of interacting parameters as well as the uniqueness of each insect. There is, therefore, a need to study a variety of insects and flapping kinematics. As bumblebees are capable of carrying heavy load, they are chosen for conducting a numerical analysis to ascertain the effects of wing flexibility on the aerodynamic performance. Three computational models are considered: fully rigid wing, fully flexible wing and partially flexible wing with around one-third of the tip region flexible and the rest rigid. Results show that the leading edge vortex (LEV) is the largest for the fully flexible wing, yielding the highest lift coefficient compared with the rigid and tip flexible wings.

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1 Introduction

Research on flapping wing flight has grown steadily in the past two decades due to the emergence of a new type of aircraft termed the Micro Air Vehicle (MAV) [1]. MAVs can be categorized into four types: fixed wing, rotary wing, ducted fan/propeller and flapping wing. Typical flapping wing MAVs fly in the Reynolds numbers (Re) regime of 10^3 - 10^4, which is similar to insects. For this reason, researchers begin to learn from the best possible example, the Nature's best fliers: insects.

Previous studies on flapping wing aerodynamics and kinematics have uncovered important unsteady aerodynamic mechanisms such as leading-edge-vortex (LEV) generation, rapid end-of-stroke rotation, clap-fling and wake capture [2-5]. Review of recent studies reveals that flapping wing propulsion is influenced by a large number of interacting parameters such as morphology, flapping kinematics, modes-of-flight, as well as type (chordwise and/or spanwise) and degree of flexibility. It is, therefore, not easy to generalise findings based on a limited number of parameters to all flapping objects/insects.

Most computational studies on insect flight have been performed under the assumption of rigid wings, contrary to the flexible wings observed in Nature. This is because of the high level of complexity and high computational cost associated with computations of the aerodynamic performance of flexible wings.

Each insect is unique with different morphology, flapping kinematics, and wing material properties, which possibly result in distinctive aeroelasticity effects.

Bumblebees are avid foragers. They fly from one flower to the next to collect pollen and honey. Bumblebee's heavy-lifting capability is even more impressive as the size of their wings is small as compared to their body, which is reflected by the high wing loading (ratio of body mass to wing area) of approximately 0.17 g/cm^2. Another interesting fact about bumblebees is the flexible tip region of their wings. Other insects usually have veins running from the root to the tip of the their wings. These veins reinforce the wing and, as the outcome, make the wing more rigid/stiff. However, these veins are absent at the tip region of bumblebees' wings. The possible contribution of this flexible wing-tip region to the ability of bumblebees to carry heavy load while flying is something worth further study.

The objective of this study is, therefore to conduct a numerical analysis to examine the effects of wing flexibility on the propulsion of bumblebees (*Bombus terrestris*).

2 Validation

The solver is validated for both the rigid and flexible (Fluid Structure Interaction) cases. Time-step and grid sensitivity tests are also conducted to ensure that both the time-step and grid independence have been achieved.

2.1 Rigid Case

The solver is validated against the numerical results of Xiong and Sun [6] using a pair of bumblebee wings (the four-winged bumblebees are modelled as two-winged because the hind-wings are usually attached to the fore-wings) with a wing length of R = 13.2 mm, a mean chord length of $\bar{c}$ = 4.01 mm flapping under a harmonic motion in hover flight, with a flapping frequency of f = 155 Hz, a flapping magnitude of Φ = 116°, a stroke plane angle of β = 6°, an angle of attack at mid-upstroke of α_U = 21° and an angle of attack at mid-downstroke of α_D = 27° (Re = 2,280).

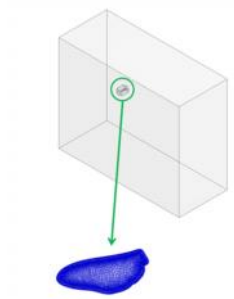

Figure 1 Computational model of the rigid bumblebee wing used in validation

The wing is simulated for laminar flow using the commercial code Fluent with an incompressible solver and second-order upwind spatial discretization. The time discretization in Fluent is limited to first order when the 'dynamic mesh' feature is used. The bumblebee wing is surrounded by a boundary layer zone and an arbitrary-shaped volume, which all move together under a user-defined flapping motion. Only one wing is modelled and simulated. A symmetry boundary is imposed on the X-Y plane to mirror and create the other half of the wing pair (Figure 1).

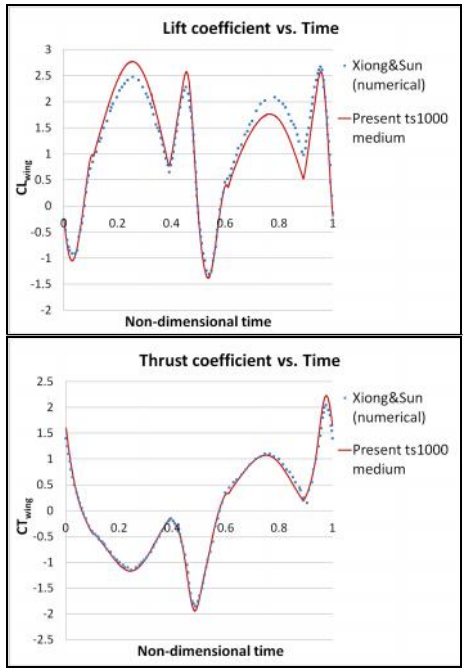

Figure 2 Validation results of the rigid wing

Except for the slight difference in the peak values of the translational period, there is reasonably good agreement in the lift and thrust coefficients with the results of Xiong & Sun [6] (Figure 2). The difference in the peak values is possibly caused by a variation in the wing planform shape. The bumblebee wing in [6] has a concave tip and a convex root with respect to the symmetry plane. The minimum information in the reference paper about the shape of the wing root and the wing tip prevents exact replication of the wing planform.

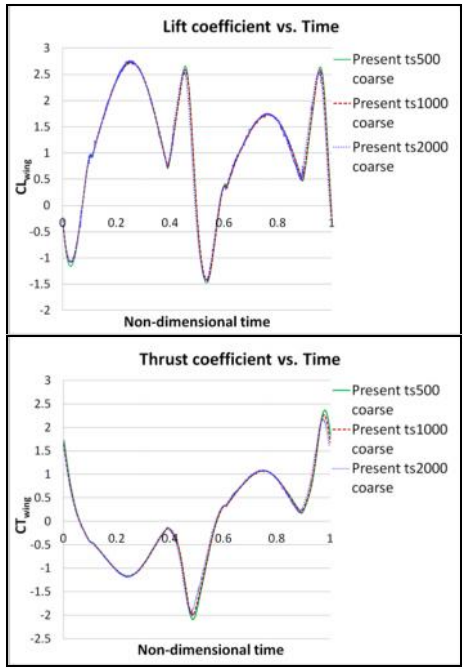

Figure 3 Time-step sensitivity test results of the rigid wing

Three grids and two variations of time-step per flapping cycle are tested for the grid and time-step sensitivity tests. The coarse grid contains 879,251 tetrahedral cells. The medium grid contains 1,687,464 tetrahedral cells. The fine grid contains 3,292,713 tetrahedral cells. A comparison of the lift and the thrust coefficients, C_L and C_T respectively, is made for the three grids with 500 and 1000 time-steps per flapping cycle. An additional run using a time variation of 2000 time-steps per flapping cycle is done on the coarse mesh for the time-step sensitivity test.

The subtle variation of force coefficients with the number of cells and the variation of time-step per flapping cycle shows that the grid and the time-step independence have been achieved (Figures 3 and 4).

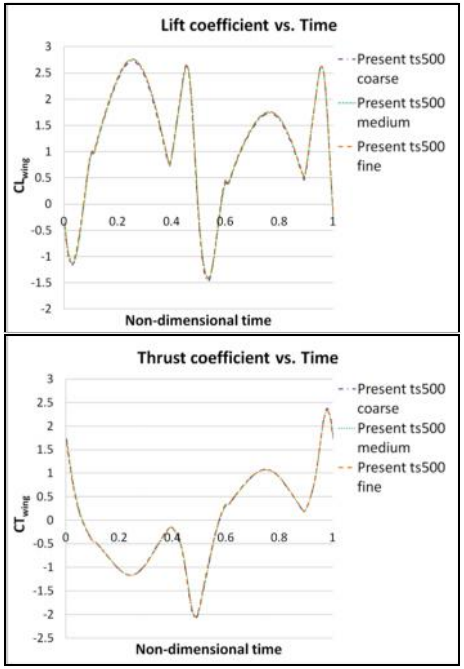

Figure 4 Grid sensitivity test results of the rigid wing

2.2 Flexible Case

The solver capability in solving a flexible or Fluid Structure Interaction (FSI) case is validated against the numerical analysis of Glück, et al. [7]. The reference case is a flexible plate with a height of H = 1.0 m, a width of W = 0.4 m and a depth/thickness of D = 0.06 m. The plate has a Modulus of Elasticity of E = 2.5 MPa, a Poisson's ratio of v = 0.35, and a structural density of ρ_s = 2550 kg/m^3. The fluid has a density of ρ_f = 1 kg/m^3 and a dynamic viscosity μ = 0.2 Pa-s. In the beginning of the simulation, for a duration of 0.5 s, the plate is excited by a constant pressure of 100 Pa.

The flexible plate is simulated by coupling Fluent and ANSYS Mechanical, a Computational Fluid Dynamics (CFD) code and a Finite Element Analysis (FEA) code respectively, via the 'System Coupling' feature in ANSYS version 14.0. In Fluent, the flexible plate is simulated for a laminar flow with an incompressible solver and second-order upwind spatial discretization. The time discretization is limited to first-order due to the usage of the 'dynamic mesh' approach. The deformation of the plate can be accommodated by smoothing the surrounding cells (without remeshing the cells), and thus hexahedral cells can be used in the domain. In Fluent, remeshing is only applicable for tetrahedral cells.

As shown in Figure 5, there is a good agreement in the time varying displacement. The next stage is the simulation of rigid and flexible bumblebee wings.

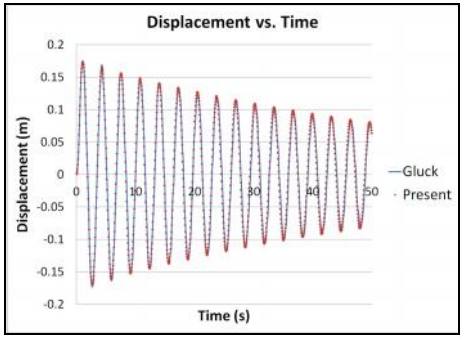

Figure 5 Validation results of the flexible plate

3 Method

Three computational models, one rigid case and two flexible/FSI cases, are built and simulated (Figure 6). The results of the rigid wing case are compared with the flexible ones to assess the effects of flexibility/aeroelasticity on bumblebee propulsion. In the present study, only the wing is considered in the analysis.

The wing of a worker bumblebee, referred as BB01 in Dudley and Ellington [8], is selected for this study. The wing has a length of R = 13.2 mm and a mean chord length of $\bar{c}$ = 4.01 mm. The wing flaps in a low speed forward flight of V = 1 m/s with a flapping frequency of f = 145 Hz, a flapping magnitude of Φ = 112°, a stroke plane angle of β = 16°, an angle of attack at mid-upstroke of α_U = 49.3° and an angle of attack at mid-downstroke of α_D = 58.8°. The wing is modelled as a flat plate with a uniform thickness of 0.03$\bar{c}$ (equal to 0.1203 mm).

The flexible case consists of a fully flexible and a tip flexible models. The former has the whole area of the wing flexible, while the latter has around 30% of the tip area flexible. The flexible part of the bumblebee wing is assumed to be isotropic with a Modulus of Elasticity of E = 5.75 GPa, a structural density of ρ_s = 1,200 kg/m^3 and a Poisson's ratio of v = 0.49. The Modulus of Elasticity is taken from the spanwise measurement of real bumblebees (*Bombus*) [9]. The rigid part of the tip flexible model has a length of 0.7R and is also assumed to be isotropic with E = 400 GPa, ρ_s = 1,200 kg/m^3 and v = 0.49.

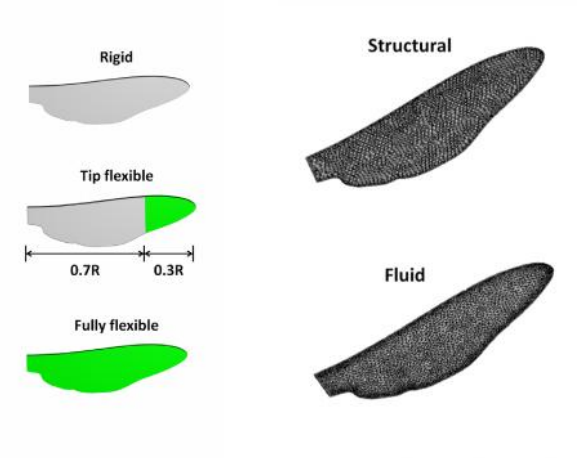

Figure 6 Schematic diagram and the grid for the structural (FEA) and fluid (CFD) solvers

The rigid and flexible models both maintain around six to seven hundred thousand tetrahedral cells throughout one flapping cycle, which consists of 2000 time-steps. The mesh in these three computational models (rigid, fully flexible and tip flexible) is similar to that of the coarse mesh in the rigid validation case. The validation results of the coarse mesh are in a good agreement with the reference data, and thus the same level of accuracy can be expected in this aeroelasticity/flexibility analysis. A flapping cycle is divided into 2000 time-steps to avoid getting an error caused by negative volumes, particularly for the flexible wing cases, where the wing deforms continuously with the fluid.

4 Discussion and Conclusions

We compare three time-averaged coefficients: lift (CL_{mean}), thrust (CT_{mean}) and input/required power (CP_{mean}); and also propulsive efficiency ($\eta_p = \frac{CT_{mean}}{CP_{mean}}$) and power economy ($PE = \frac{CL_{mean}}{CP_{mean}}$), to analyze the effects of flexibility on the bumblebee propulsion (Table 1).

	Rigid	Tip flexible	Fully flexible
CL_{mean}	2.63	2.60	6.07
CT_{mean}	-0.17	-0.08	-0.44
CP_{mean}	4.88	5.30	16.03
η_p	-0.034	-0.015	-0.027
PE	0.54	0.49	0.37

Table 1 Time-averaged lift, thrust, input power, efficiency and power economy of the rigid, tip flexible and fully flexible wing models

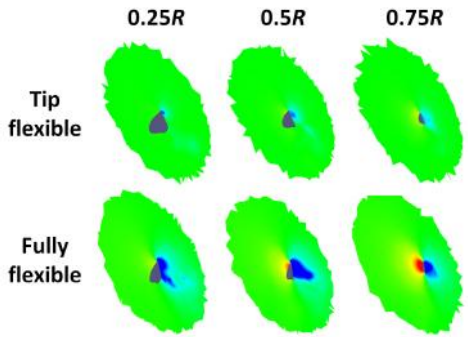

Figure 7 Pressure contour around the tip flexible and the fully flexible wing models

The lift force generated by the rigid and the tip flexible is almost equal. However, the power consumption of the tip flexible wing is slightly higher than the rigid wing. In contrast, the fully flexible wing produces a significantly higher lift (230%) than the rigid wing. Nonetheless, the high lift is accompanied by a leap in the consumption of power (328%). In conclusion, the rigid wing has a higher *PE* than the flexible wings.

The negative value of thrust coefficient implies that both the rigid and flexible wings produces drag instead of thrust. This may be the result of omitting the elevation/feathering angle, which is the angle between the stroke plane and the wing's axis of rotation, in the flapping kinematics [10].

In this study, all three wing models produce drag, the effects of the bumblebee wing flexibility on thrust cannot be assessed with confidence. However, it is found that the tip flexible model generates the least drag among the three wing models.

In addition to checking the aerodynamic forces, a qualitative analysis is performed by comparing the flow phenomena around the wing models. The larger low pressure region (blue colored area) around the fully flexible wing represents a bigger LEV (Figure 7). This low pressure region is reflected in the high lift and drag coefficients (≈ negative thrust) in Table 1.

Acknowledgement

This research was undertaken with the assistance of resources provided at the National Computational Infrastructure National Facility through the National Computational Merit Allocation Scheme supported by the Australian Government. The first author acknowledges
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EUROMECH Fellows: Nomination Procedure

The EUROMECH Council was pleased 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 will take place in the year of the appropriate EUROMECH Conference, EFMC or ESMC respectively. The number of fellows 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 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 of 15 January in 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.

EUROPEAN MECHANICS SOCIETY

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 maximum);
- 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;
- Sponsor's signature/date.

ADDITIONAL INFORMATION

Supporting letters (no more than four including the two of the sponsors).

TRANSMISSION

Send the whole nomination packet to:

Professor GertJan van Heijst
Fluid Dynamics Laboratory, Department of Physics
Eindhoven University of Technology
PO Box 513, 5600 MB Eindhoven, The Netherlands
E-mail: G.J.F.v.Heijst@tue.nl

EUROMECH Prizes: Nomination Procedure

Fluid Mechanics Prize
Solid Mechanics Prize

Regulations and Call for Nominations

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 conferences for outstanding and fundamental research accomplishments in Mechanics.
Each prize consists 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 undertaken a significant proportion 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.

Fluid Mechanics Prize

The nomination deadline for the Fluid Mechanics prize is **15 January in the year of the Solid Mechanics Conference**. The members of the *Fluid Mechanics Prize and Fellowship Committee* are:

- A. Kluwick (Chair)
- O. E. Jensen
- D. Lohse
- P. Monkewitz
- W. Schröder

Chairman's address
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Solid Mechanics Prize

The nomination deadline for the Solid Mechanics prize is **15 January in the year of the Solid Mechanics Conference**. The members of the *Solid Mechanics Prize and Fellowship Committee* are:

- W. Schiehlen (Chair)
- H. Myhre Jensen
- N.F. Morozov
- M. Raous
- B. A. Schrefler

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EUROPEAN MECHANICS SOCIETY

EUROMECH Conferences in 2013

The general purpose of EUROMECH conferences is to provide opportunities for scientists and engineers from all over 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. Much of the communication which takes place is necessarily more in the nature of imparting information than 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 explain ideas in a clear and interesting manner, and should select and prepare their material with this expository purpose in mind.

2013

ETC14
14th European Solid Mechanics Conference
DATE: 2-4 September 2013
LOCATION: Lyon, France
CONTACT: Prof. J. F. Pinton
E-MAIL: jean-francois.pinton@ens-lyon.fr

EMMC13
13th European Mechanics of Materials Conference - ICMM3
DATE: 8-11 September 2013
LOCATION: Warsaw, Poland
CONTACT: Prof. P. Dhuzewski
E-MAIL: icmm3@ippt.gov.pl

EUROMECH Conferences Reports

8th European Solid Mechanics Conference (ESMC-2012)

The 8th European Solid Mechanics Conference took place at the Grazer Congress in Graz, Austria, under the auspices of EUROMECH, during July 9-13, 2012. The purpose of this conference was to provide a forum for scientists and engineers to meet and to discuss current research, new concepts and ideas, and to establish opportunities for future collaborations in different aspects of Solid Mechanics. Throughout the week, advances in solid mechanics were discussed, important new directions were highlighted, and emphasis was placed on the need to combine different disciplines.

There were 18 parallel sessions at the 8th European Solid Mechanics Conference. It is also worth mentioning that there were about 1200 participants, which is likely to have made it the largest ever conference on Solid Mechanics in Europe. We welcomed participants from 63 nations, who came mostly from universities and research institutions. ESMC-2012 had a total of 1082 presentations in General Sessions and 45 Mini-Symposia. Altogether, there were 195 sessions on a wide variety of topics. Germany had the largest representation with 157 participants, followed by France with 154 and Austria with 90.

For several problems, solid mechanics is now interrelated with biophysics, chemistry, biology and medicine to name just a few areas. At ESMC-2012, for example, we had more than 150 presentations in biomechanics. 12 Mini-Symposia were devoted to solid mechanics in the life sciences ranging from the mechanics of cells to biological membranes and aneurysms. The Mini-Symposia having most presentations, with 35 in each, were “Methods to Predict the Structural and Mechanical Properties of Dense Granular Media” and “Nonlinear Elasticity”. Of the General Sessions, “Material Mechanics” was the largest with 86 participants.

We had one General Lecturer, James R. Rice, Harvard University, USA, who gave a talk on “Mechanics Underlying Rapid Ice Sheet Motions”. There were five distinguished plenary lecturers: Ferdinando Auricchio, University of Pavia, Italy; Norman A. Fleck, University of Cambridge, UK; Peter J. Hunter, University of Auckland, New Zealand; Robert M. McMeeking, University of California Santa Barbara, USA; Michael Ortiz, California Institute of Technology, USA.

The EUROMECH Solid Mechanics Prize was awarded to John R. Willis, University of Cambridge, UK, by Patrick Huerre, the EUROMECH President. EUROMECH Fellow status was conferred on Marc Geers (Eindhoven University of Technology, The Netherlands), Jean-Baptiste Leblond (Université Pierre et Marie Curie, Paris VI, France) and Javier LLorca (Polytechnic University of Madrid, Spain). Two Young Researcher Awards – researchers with ages under 35 – were awarded for the best presentations during the closing ceremony to Katia Bertoldi (Harvard University, USA) and Francisco López Jiménez (Ecole Polytechnique, Palaiseau, France).

The conference has confirmed that solid mechanics is a vital and thriving subject area; it is moving towards embracing a much more interdisciplinary role with an extensive perspective and a broad range of applications. The need to combine different disciplines was evident in many of the problems discussed. Many presentations have helped to foster interactions between researchers in different disciplines. A large number of the participants were PhD-students, and several of them gave their very first talk at an international conference. The number of PhD students attending indicated that the subject is in a very healthy state, which bodes well for the future.

The joint EUROMECH/ERCOFTAC Mini-Symposium on ”Virtual Testing of Composites” was made possible by support from the European Project E-CAero ”European Collaborative Dissemination of Aeronautical Research and Applications” (www.e-caero.com).

9th European Fluid Mechanics Conference (EFMC-2012)

The 9th European Fluid Mechanics Conference (EFMC9) was held at the Università di Roma "Tor Vergata" Rome, Italy in the period 9–13 September 2012. The conference aimed at covering the whole field of Fluid Dynamics, from the most fundamental aspects to recent developments. It provided a world-wide forum for scientists to meet each other and exchange information about all areas of fluid mechanics.

There were over 700 participants from 44 different countries and about 620 presentations. This included six key-note lectures by R. Klein (Berlin), C. Meneveau (USA), P. Orlandi, (Rome), F. Pinho (Porto), O. Pouliquen (Marseille) and L. Tuckerman (Paris). The first lecture after the opening was given by Y. Couder (Paris) who had been awarded the EUROMECH Fluid Mechanics Prize. On the last day of the Conference the Young Scientists Awards were given to S. Tobing (Canberra) and H. Brauckmann (Marburg) for the best oral presentations and their content. Three new EUROMECH Fellows (O. Pouliquen, F. Toschi and R. Verzicco) have been nominated by the EUROMECH President Prof. P. Huerre.

The quality of the talks was generally high and the following discussions were very active. In several cases, the discussion had to be interrupted by the chairman in order to keep to the schedule; this was an essential issue, because the talks were accommodated into 11 parallel sessions and their synchronization was mandatory. The Conference program allowed for more extensive scientific discussions during the coffee, tea and lunch breaks.

The main topics addressed in the talks and the discussions were:

- Acoustics;
- Atmospheric Flows;
- Biofluids;
- Control;
- Experimental;
- Fluid Structure Interaction;
- Gas Dynamics;
- Geophysical Flows;
- Heat Transfer, Industrial Flows;
- Instability;
- Magneto Hydro-dynamics;
- Micro-Fluidics;
- Multiphase Flows;
- Numerical Methods;
- Reactive Flows;
- Shear Flows;
- Turbulence;
- Vortical Flows.

Two additional sessions labeled as "Other" were necessary to accommodate eight talks that could not be fitted easily into any of the above categories. Within the program of the Conference, five Mini–Symposia were held on:

- Aeroacoustics;
- CO2 Sequestration;
- Lattice-Boltzmann methods;
- Pattern Formation in Sedimentary Environments;
- Quantum Fluids.

All the various aspects of the Conference organization ran smoothly and the common feeling was it has been a success. The atmosphere was lively and relaxed but at the same time with a lot of interaction among the participants during scientific discussions. The organization of the Conference was rendered possible by support from exhibitors and scientific organizations, listed as section sponsors on the site: www.efmc9.eu. The joint EUROMECH-ERCOFTAC mini-symposium on "Aeroacoustics" was made possible by support from the European Project E-CAero "European Collaborative of Aeronautical Research and Applications" (www.e-caero.com).

EUROPEAN MECHANICS SOCIETY

EUROMECH Colloquia in 2013

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 2010, and preliminary information for some Colloquia in 2011 and 2012, are given below.

2013

533. Biomechanics of the Eye
Chairperson: Dr. Rodolfo Repetto
Department of Civil, Environmental and Architectural Engineering
University of Genoa
Via Montallegro 1,
16145, Genoa, Italy
Email: raous@lma.cnrs-mrs.fr
Co-chairpersons: Dr. Jennifer Siggers; Dr. Alessandro Stocchino
Dates and location: 22-24 July 2013, Genova, Italy
http://www.dicca.unige.it/euromech-533/index.html

541. New Advances in the Nonlinear Dynamics and Control of Composites for Smart Engineering Design
Chairperson: Prof. Stefano Lenci
Department of Architecture, Buildings and Structures
Polytechnic University of Marche
via Brecce Bianche
I-60131 Ancona, Italy
Email : lenci@univpm.it
Co-chairpersons: Prof. Jerzy Warminski
Dates and location: 3 -6 June 2013, Senigallia, Italy
http://www.dipmat.univpm.it/euromech541/

542. Progress in statistical theory and pseudo-spectral DNS
Chairperson: Dr. Claude Cambon
LMFA
Ecole Centrale de Lyon
36 rue de Collongue
69134 Ecully cedex, France
Email: claude.cambon@ec-lyon.fr
Co-chairpersons: Prof. Ananias Tomboulides
Dates and location: 15-18 January 2013, Lyon, France
http://lmfa.ec-lyon.fr/index.php?p_id=lmfa.003.005.000

543. Quantification of uncertainties in modelling and predictive simulations of fluids
Chairperson: Prof. Nikolaus. Adams
Technische Universität München
Lehrstuhl für Aerodynamik und
Strömungsmechanik
Boltzmannstrasse 15
D-85747 München, Germany
Email: Nikolaus.Adams@tum.de
Dates and location: October 2013, München, Germany

544. Dense flows of soft objects: bringing together the cases of bubbles, droplets and cells
Chairperson: Dr Gwennou Coupier
Laboratoire Interdisciplinaire de Physique (LIPhy)
CNRS et Université J. Fourier-Grenoble I,
BP 87, 38402 Saint-Martin d'Hères, France
Email: gwennou.coupier@ujf-grenoble.fr
Co-Chairpersons: Prof. Dr. Ralf Seemann, Dr. Philippe Marmottant
Dates and location: 13-15 May 2013, Grenoble, France
http://www-liphy.ujf-grenoble.fr/Euromech544

545. Frontiers in Finite Deformation Electromechanics
Chairperson: Prof. Andreas Menzel
Institute of Mechanics
Technische Universitaat Dortmund
Leonard Euler Str. 5
Dortmund, Germany
Email: christina.mcdonagh@tu-dortmund.de
Co-Chairpersons: Prof. Ellen Kuhl; Prof. Serdar Goktepe
Dates and location: 21-24 May 2013, Dortmund, Germany
http://www.euromech545.de/

546. Combustion Dynamics and Combustion Noise
Chairperson: Prof. Christian Oliver Paschereit
Chair of Fluid Dynamics, TU Berlin
Müller-Breslau-Str. 8
D- 10623 Berlin, Germany
Email: oliver.paschereit@tu-berlin.de
Co-Chairperson: Dr. Jonas P. Moeck
Dates and location: 13-17 May 2013, Loveno di Menaggio, Italy

547. Trends in Open Shear Flow Instability
Chairperson: Prof. Lutz Lesshafft
Laboratoire d'Hydrodynamique
CNRS - Ecole Polytechnique, France
Email: lutz@ladhyx.polytechnique.fr
Co-Chairpersons: Prof. François Gallaire
Dates and location: 1-3 July 2013, Ecole Polytechnique, Palaiseau, France

548. Direct and Variational Methods for non smooth problems in Mechanics
Chairperson: Prof. Géry de Saxcé
Laboratoire de Mécanique de Lille
Villeneuve d'Ascq, France
email: gery.desaxce@univ-lille.fr
Co-Chairpersons: Prof. Gianpietro Del Piero
Dates and location: 1-3 June 2013, Amboise, Indre-et-Loire, France

549. Current status and future research directions in the development and application of Immersed Boundary Methods
Chairperson: Dr. W.P. Breugem
University of Technology Delft
Laboratory for Aero and Hydrodynamics
Leeghwaterstraat 21
2628CA Delft, Netherlands
Email: w.p.breugem@tudelft.nl
Co-Chairperson: Prof. Roberto Verzicco
Dates and location: 17-19 June 2013, Leiden, the Netherlands
http://www.pe.tudelft.nl/~wim/euromech549/

550. Multi-physical couplings in solid polymers: experiments and modeling
Chairperson: Dr. S. Castagnet
Institut Prime
Department of Physics and Mechanics of Materials
ENSMA, 1 Avenue Clement Ader, BP 40109
86961 Futuroscope cedex, France
Email : sylvie.castagnet@ensma.fr
Co-Chairperson: Prof. Alexander Lion
Dates and location: June 2013, Poitiers, France

551. Mechanics Fibre reinforced Materials: Theory and Applications
Chairperson: Prof. R. Ogden
School of Mathematics and Statistics
University of Glasgow,
Glasgow, UK
Email: Raymond.Ogden@glasgow.ac.uk
Co-Chairpersons: Prof. Kostas P. Soldatos; Prof. José Merodio
Dates and location: 2-5 September 2013, Nottingham, UK
http://fibre-reinforced-materials.co.uk/

552. Modelling Atmospheric and Oceanic flows: insights from laboratory experiments and numerical simulations
Chairperson: Dr. Thomas von Larcher
Freie Universitaet Berlin
Dept. of Mathematics & Computer Sciences
Institute for Mathematics
Arnimallee 6,
D-14195 Berlin-Dahlem, Germany
Email: larcher@math.fu-berlin.de
Co-Chairpersons: Dr. Paul D. Williams, Dr Wolf-Gerrit Fruh
Dates and location: 24-27 September 2013, Berlin, Germany

555. Small-scale numerical methods for multi-phase flows
Chairperson: Prof. Stéphane Vincent
I2M-TREFLE
16, avenue Pey-Berland
33607 Pessac Cedex, France
Email: vincent@enscbp.fr
Co-Chairpersons: Prof. Ruben Scardovelli
Dates and location: 28-30 August 2013, Pessac, France

EUROMECH Colloquia Reports

EUROMECH Colloquium 541
"New Advances in the Nonlinear Dynamics and Control of Composites for Smart Engineering Design"
3-6 June 2013, Senigallia, Italy
Chairperson: Prof. Stefano Lenci
Co-Chairperson: Prof. Jerzy Warminski

As stated in the original application, EUROMECH Colloquium 541 was "aimed at constituting an event to join scientists working on linear and, mainly, on nonlinear dynamics, chaos and control of systems and structures made of composite materials for smart applications. Indeed, the goal of the proposed Colloquium is that of gathering people working on the most recent modelling, theoretical, analytical, numerical, experimental and control achievements in the nonlinear dynamics of composites."

There were 51 participants in Colloquium 541, meeting the original target of 50 participants. Of these, 15 came from host country Italy, with others coming from 20 different countries (including USA, UK, France, Germany, China, Japan and Brazil), and from all the continents apart from Oceania. The worldwide representation demonstrated the international relevance of the Colloquium.

There were 50 regular presentations plus the following 4 keynote lectures:

- Holm Altenbach and Victor Eremeyev: Analysis of Vibrations of FGM Plates Using the Direct Approach;
- Claude-Henri Lamarque, Alireza Ture Savadkoohi and Michael Naudan: Vibratory energy exchange between Bouc-Wen type and nonlinear oscillators considering two special cases;
- Ekaterina Pavlovskaia, Marian Wiercigroch and James Ing, Grazing Induced Bifurcations;
- Oded Gottlieb, Giuseppe Habib, Emanuel Fainshtein and Kai Wolf, Model-based estimation of nonlinear material properties governing the dynamics and orbital stability of piezoelectric microcantilever sensors.

The regular presentations where organized in the following 11 sessions:

- Impacts and friction;
- Continuum Mechanics;
- Theoretical Developments;
- Dynamical systems;
- Energy transfer and vibration absorbers;
- Beams and laminates (1);
- Beams and laminates (2);
- Pendula and Bridges;
- Structural Health Monitoring and Energy Harvesting
- Control (1);
- Control (2).

Discussion during the presentations and in the free-time meetings between the colleagues had been strongly encouraged. The main open questions relating to nonlinear dynamics, chaos, control and applications of composites were discussed. The subjects attracting particular attention were:

Modelling

Work dealing with the modelling of purely mechanical as well as multi-physics behaviors, including thermo-electrical-mechanical coupling, was presented. The emerging frontier of modelling multi-functional laminates covers complex structures where layers devoted to other functions strongly interact with layers providing the mechanical strength. The development and the assessment of reduced order dynamical models, as well as efficient numerical algorithms developed to detect complex mechanical and dynamical behaviors, was discussed.

Control

Another key issue was the exploitation of classical and modern control methods for optimizing the performances of composites materials and structures. This was discussed in the two dedicated sessions. Both open-loop and closed-loop applications of control methods have been investigated with the goal of improving performance and/or reducing costs. Particularly interesting papers were those where these goals were obtained by exploiting the nonlinear dynamics of the composite system.

Applications

The third major discussion area concerned the transfer of theoretical results towards modern and innovative applications of composites, in any field of science and engineering. The richness of nonlinear dynamical behavior, on one side, and the richness of the mechanical behavior of composites, on the other side, can now be focused on technological developments, in order to reduce the gap between theory and practice. It was agreed that this is a challenging research theme for the community during the next years.
Finally, as far as the methodological approach is concerned, both multidisciplinary and multi-approach researches have been the subject of various presentations and discussions.

The participants were very satisfied with the logistic and scientific organization, and congratulated the organizers for offering many things with an affordable Colloquium fee. We thank EUROMECH for making the Colloquium possible, and for financial and organizational support. A special issue of "Meccanica", containing invited papers from EUROMECH Colloquium 541, has been agreed by the Editor-in-Chief of the Journal.

EUROMECH Colloquium 537
"Trends in Open Shear Flow Instability""
1-3 July, 2013, Ecole Polytechnique (Palaiseau, France)
Chairperson: Prof. L. Lesshafft
Co-Chairperson: Prof. F. Gallaire

Modern computational capabilities have spurred active development of new conceptual approaches and methods for hydrodynamic instability research in recent years. EUROMECH Colloquium 547 succeeded in presenting a broad and rather complete overview of the state of the art, both from a physical and from a technical perspective.
58 researchers participated in Colloquium 547, among them 19 PhD students and post-docs. Indeed, a large proportion of the leading experts in the field was present. Participants came from institutions in eight different European countries as well as one each from the USA and from Chile.

There were 38 oral presentations in total, spread out over the three days of the colloquium, and 12 posters were presented in a dedicated session. The keynote lecture was given by Patrick Huerre (LadHyX), with another special lecture by Peter Monkewitz (EPFL). Most sessions started with an introductory lecture of 40 minutes, given by the invited speakers: C. Caulfield (Cambridge), J.-M. Chomaz (LadHyX), T. Colonius (Caltech), N. Peake (Cambridge) and E. Wesfreid (ESPCI, Paris). All regular presentations were 20 minutes long, and organized in the following sessions:

- shear layers;
- wall-bounded flows;
- wakes;
- jets;
- geophysical and environmental flows;
- complex flows;
- aeroacoustics.

The large majority of presented studies concerned numerical and analytical work. A few general trends can be observed: the computation of two- and even three-dimensional linear eigenmodes of non-parallel flows has become a commonplace tool for flow analysis. At the same time, the accessibility of these so-called "global modes" has not made the more traditional "local" instability analysis obsolete; many presenters have stressed the importance of local analysis, principally for physical interpretation of "global" results, but also for ease of application in industrial contexts. It is remarkable that transient growth and optimal initial perturbations, although immensely popular a few years ago, did not play an important role in the Colloquium 547. Instead, among the most recurring topics were:

- nonlinear analysis,
- the study of the flow response to harmonic forcing, as well as
- the question how the effects of turbulence can be appropriately accounted for in a linear instability analysis.

The response from participants has been overwhelmingly positive. Although the scientific program was intensive, much social interaction took place during coffee breaks, a dinner banquet and a cocktail reception. Financial support was provided by Euromech, Eucass, E-CAero, Ecole Polytechnique and LaSIPS.

A small number of contributions from Colloquium 547 will be selected for publication in a special issue of the European Journal of Mechanics B/Fluids, titled after the colloquium, and for which the colloquium organizers act as guest editors.

EUROMECH Colloquium 514
"New trends in Contact Mechanics"
27-31 March 2012, Cargese, Corsica
Chairperson: Prof. M. Raous
Co-Chairperson: Prof. P. Wriggers

EUROMECH Colloquium 514 took place at the Institut d'Etudes Scientifiques in Cargese (Corsica, France) on 27-31 March 2012. The attractive and well equipped location encouraged friendly exchanges and scientific discussions throughout the colloquium.

There were 77 participants from 15 countries, with 70 presentations. Among them were lectures by 8 keynote speakers, namely:

- Tod Laursen(Khalifa University of Science, United Arab Emirates)
- Barbara Wohlmuth (Technische Universität München, Germany).
- David Stewart (University of Iowa, USA)
- Stefan Luding (Universiteit Twente, The Netherlands)
- Ilker Temizer (Bilkent University of Ankara, Turkey)
- Jean-Pierre Vilotte (Institut de Physique du Globe de Paris, France)
- Georges Cailletaud (Ecole des Mines, France),

The presentations were selected by the Chairmen with the help of a Advisory Board: Pierre Alart (LMGC, Montpellier, France); Christoph Glocker (IMES, Zurich, Switzerland); Manuel Monteiro Marques (CMAF, Universidade de Lisboa, Portugal); Giorgio Zavarise (Università di Salento, Italy).

The aim of Colloquium 514 was to cover the various fields of contact mechanics, especially theoretical, mathematical, modelling and computational aspects, and also engineering applications. The objective was to gather specialists in these various fields, in order to reinforce interchange between the communities on these different topics and to stress the complementarities of the contributions for mutual progress in contact modelling. In that way the Colloquium could be considered as part of the series of the Contact Mechanics International Symposia (CMIS) initiated by Alain Curnier in 1992 and which takes place approximately every two years (the last one was organized in Chania, Crete in 2009 by Georgios Stravoulakis).

The communications were gathered organized around 4 main topics, in a total of 15 sessions.

1. New models, interface laws, damage and friction

- Adhesion and wear;
- Contact formulation;
- Mechanics of the interfaces;
- Contact modelling.

This topic concerns developments in contact laws taking into account more sophisticated models than the usual Coulomb friction law. Interface damage and adhesion or viscous effects are now considered in order to describe the more complex behaviors which are encountered in different scientific domains. These include: materials science (composites such as nano-materials), civil engineering (masonry, FRP, etc.), ductile cracks and geomechanics. One keynote lecture was devoted to interface modelling for earthquake rupture dynamics, another to the contribution of mechanics of materials to study of contact problems, a third to energy balance for Kelvin-Voigt viscoelasticity.

2. Formulation and mathematical analysis

- Critical bounds for friction coefficients;
- Mathematical aspects and analytical approaches;
- Dynamics;
- Mathematical aspects.

The majority of presentations related to theoretical aspects of contact mechanics, underlining the strong focus of the community on the difficult problems due to the non-smooth character of the unilateral contact law and of the friction laws. Recent progress on critical bound analysis for the friction coefficient in various contexts were presented. Special attention has been given to dynamics and impact. Kane's paradox about the energy gain in frictional impact has been solved. Globally, the mathematical tools are those of convex and non-convex analysis. A unified contact formulation based on surface potential has been given.

3. Advanced computational methods

- Computational strategies I;
- Computational strategies II;
- Computational strategies III;
- Multigrid and domain decomposition;
- Error control and XFEM methods.

This topic is a very active branch. The community is particularly concerned with development of efficient and rapid numerical methods to solve very large sized problems (even with very simple contact laws) and also problems involving more complex contact laws coupling different effects in a nonlinear way. The contributions concerned both computational aspects and numerical analysis of the discretization scheme. The extensions to contact problems of powerful methods such as XFEM, multigrids and subdomains were presented. One keynote lecture concerned recent developments in Mortar methods and extension to embedded and enriched interface strategies, another concerned the numerical analysis of variationally consistent discretization schemes. Strong activity in this field is also demonstated by the

organization of specific conferences such as the ECCOMAS thematic conferences ICCCM (International Conference on Computational Contact Mechanics); another has been planned for 10-12 July 2013 in Lecce by G. Zavarize, P. Wriggers and L. de Laurenzis.

4. Multiscale approaches and multiphysics

- Multiscale approaches
- Multiphysics

Interest in these approaches is increasing rapidly and Colloquium 514 gave a good opportunity to show a panorama of progress on this topic. New approaches now exist for connecting micro, nano and even atomic analysis to the macro contact behavior. Two ways may be differentiated. The first one characterizes laws obtained by considering the behavior of thin layers when either the thickness or the spatial frequency of the asperities tends towards zero. The second approach relies on multilevel analysis which bridges different scales starting from a very small scale up to structure level. Contributions were also presented on coupling with thermal or electromagnetic effects. One keynote lecture concerned multiphysics interface homogenization for lubrication, with a second focused on adhesive frictional powders.

EUROMECH Colloquium 528
"Wind Energy and the impact of turbulence in the conversion process"*26-28 March, 22 – 24 February 2012, Oldenburg, Germany*
Chairperson: Prof. J. Peinke
Co-Chairperson: Prof. S. Ivanell

Wind energy converters (WEC) are located in the atmospheric boundary layer (ABL), which has special characteristics with respect to turbulence intensity, velocity gradient with increasing height and temporal and spatial correlations (gustiness), to name just a few. Changing wind speeds and directions cause fluctuations in acting forces and loads on the wind turbines. The goal of EUROMECH Colloquium 528 was to bring together senior researchers from all over the world who carry out research on fundamental aspects of fluid dynamics like turbulence, with those working on the power conversion process of WECs. The spectrum of contributions ranged from basic turbulence, stochastic wind field description, experimental investigations and simulations of the interaction of single wind turbines (or model wind turbines) with turbulent wind fields to consideration of whole wind parks.

The program of invited talks, oral and poster presentations was structured around the following main topics:

1. Rotor aerodynamics – dynamic stall, flow control

Changing wind speed and direction causes fluctuating aerodynamic forces and loads on the rotor blades of the wind turbines. Fast changes can result in dynamic stall, where flow separation occurs, and even higher forces. Many research topics deal with flow control, where researchers try to actively influence the flow around the airfoil to induce or delay flow separation.

2. Atmospheric turbulence

The inherent characteristics of atmospheric wind fields are very different from laboratory turbulence. Higher order statistics like the velocity increments show intermittent behaviour with higher probability for wind changes on all scales compared to Gaussian prediction.

3. Dynamics and loads of wind turbines

The turbulent atmospheric wind fields with their special characteristics result in fluctuating loads acting on the blades of wind turbines. Under-prediction of these fluctuating loads can lead to fatigue, which cause wind turbine components (e.g. pitch motors, gear box etc.) to fail long before the end of their designated life time. Basic understanding of these loads will help to improve wind turbine components so that they last longer. Advanced / intelligent wind turbine control strategies can also help to reach that goal.

4. Wind energy and wind turbines
Although three-bladed wind turbines are installed all over world, there are still new / alternative concepts that are subject to research. Special locations (integrated in buildings) and scaling issues (small wind turbines on e.g. roofs or boats, etc.) favour designs other than the traditional three-bladed wind turbine.

5. Flow modelling – CFD/LES
Research focuses on getting the correct wind field statistics as well as temporal and spatial correlations reproduced in artificial wind fields. New models are being investigated, using simplifications that reduce computational time without unacceptable loss of fidelity.

6. Wake and farms
Wind turbines interact with the wind field and induce extra turbulence to their wakes. In a farm configuration, these turbulence wakes hit wind turbines located inside the farm. Research focuses on the induced turbulence and how it is interacting with wind turbines. Without changing the design for turbines located inside the farm to account for the local conditions, changes in the control strategies can be made. Additionally, new approaches aim at controlling the whole wind farm to optimize its output, instead of optimizing each tribune individually.

7. Experiments
Experimental investigations focus on e.g. reproducing the statistics of atmospheric turbulence at laboratory scales. One approach is the so-called active grid, using flaps that can be controlled individually by stepper motors to condition the flow. Such artificially generated wind fields can be used for experimental investigations on blade segments and model wind turbines under more realistic inflow conditions.

8. Turbulence
Basic turbulence research is needed to advance characterisation of atmospheric wind fields. Additionally, investigations using fractal grids revealed intermittent behaviour of fractal generated wind fields that can be used for experimental investigations.

9. Stability
The atmospheric boundary layer has different stable conditions depending on temperature gradients. Detailed description based on measurements is still a subject for research that will help to improve models for different stable atmospheric conditions.

10. CFD and control
In addition to experiments, CFD simulations can be used to investigate new approaches, including local flow control for individual rotor blades or control strategies for whole wind turbines. Results from a combination of flow modelling and measurements on existing wakes and farms can be applied in this area in order to get a more complete description.

EUROMECH Colloquium 530
"Structural Control and Energy Harvesting"
25-27 July 2011, University of Bristol, UK
Chairperson: Dr S. Neild
Co-Chairperson: Prof D. Inman

The aim of EUROMECH Colloquium 530 was to bring together researchers in two key areas of smart structures research, namely the areas of structural control and energy harvesting. In addition, the aim was to explore the overlaps between these two areas with a view to moving towards self- or low-powered structural monitoring and control.

Structural control has the potential to allow us to develop slender and lightweight systems, while maintaining or even enhancing dynamic integrity. Increasingly, semi-active control strategies are being adopted for structural and automotive applications in preference to passive devices. Semi-active control was introduced as an alternative to active control and involves replacing a conventional actuator by a modulated semi-active device. Most commonly, the device is a damper with variable damping, such as a magneto-rheological damper. Such devices are passive in that they can only dissipate energy, unlike actuators which can feed energy into a system as well as remove it. As such, semi-active devices potentially consume less power and are inherently stable. A potential power source for such devices is an inbuilt energy harvester. In Colloquium 530 we concentrated on vibration-based which can often be modelled in a similar way to tuned-mass-dampers (TMD) that are used in structural control (Den Hartog, 2008). In common with TMDs, such harvesters extract energy from a structure and often exploit nonlinearity to widen the bandwidth of effective operation. Overlaps between the two fields include for example the use of electrical damping of TMDs which can both reduce vibration and harvest electrical energy.

Colloquium 530 brought together researchers working on vibration-based energy harvesters and structural control strategies to discuss in detail the links between them. The colloquium attracted 39 attendees from Europe and USA. There were 28 technical presentations and two keynote speakers: Prof Preumont (Université Libre de Bruxelles) and Prof Gammaitoni (Università di Perugia). Colloquium 530 led to a special issue of the Journal of Intelligent Material Systems and Structures, Volume 23(18), 2012.

EUROMECH Colloquium 532
"Time-periodic systems – Current trends in theory and application"
27-30 August 2012, Frankfurt, Germany
Chairperson: Dr. Fadi Dohnal
Co-Chairperson: Prof. Jon Juel Thomsen, Prof. Peter Hagedorn

Dynamical systems with time-periodic coefficients, also called parametrically excited systems, have been studied for a long time, starting already in the middle of the 19th century. Since then considerable progress was achieved in understanding the basic phenomena. Most but not all the investigations were focused almost exclusively on single degree of freedom systems, obtained by special assumptions or model reduction methods. The main task from the practical point of view is to predict the stability boundaries for a safe system operation if time-periodicity is present in a system. There are still many open problems in classical nonlinear systems, quasi-periodic systems and multi-degree of freedom systems. Emerging fields in physics and engineering on the micro- and nano-scale are rediscovering the potential and benefit of introducing an intentional time-periodicity in order to improve its vibration or sensing performance, e.g. spin wave excitation, structural filters, or atomic mass sensors. These developments open further challenging questions and demand improvements on both the theoretical and application aspects.

The purpose of EUROMECH Colloquium 532 was to promote vigorous interchange between different disciplines of engineering, natural science and mathematics and to identify the current state of the art in this field. The colloquium provided a forum for experts in applied mathematics and physics, mechanics and engineering (civil, mechanical and electrical) to exchange ideas and gain awareness of trends in the analysis and real application of time-periodic systems.
The following topics were addressed during Colloquium 532:

- Analytical, semi-analytical and numerical solution techniques of linear and nonlinear time-periodic systems (using averaging method, strobodynamics, method of multiple scales, harmonic balance, Chebyshev approximation, central manifold approach and proper orthogonal modes);
- Bifurcation, stability and energy transfer of TPS, including efficient analysis of complex structures;
- Control concepts for systems having time-periodic features;
- Dynamics of continuous structures and thin-walled composites;
- Practical examples like a centrifugal pendulum absorber, an offset printing machine, a model for voice production, a two-bladed wind turbine, disc brake squeal and MEMS gyroscopes;
- Fundamentals and physical interpretation of space-time material periodicity and parametric anti-resonance.

EUROMECH Colloquium 532 was organised at the Spenerhaus (Frankfurt, Germany). An international forum of 31 experts from 10 countries discussed the problems described above, during a 4 day program. A total of 5 keynote lectures and 20 oral presentations were given (2 scheduled oral presentations were cancelled). Each keynote lecture was given by a distinguished scientist working in the field of time-periodicity and related modern areas of research and applications. The keynote presentations were scheduled for 50 minutes presentation time and up to 15 minutes discussion time with a subsequent coffee break. This schedule allowed an efficient exchange of ideas between the participants. The 22 oral presentations were held by a balanced mix of PhD students, experienced researchers and three distinguished experts. Each presentation was scheduled to last 20 minutes with a subsequent 10 minutes for discussion (see the full programme, the list of participants and the scientific committee for more details). All contributions were published in a book of abstracts (ISBN 978-3-9814163-9-8) by the host institution, Technische Universität Darmstadt, Structural Dynamics Group, Germany.

We took special care to provide a pleasant and motivating environment, that would encourage open and constructive discussion. On the last day, a final discussion took place on where we stand in terms of research in time-periodicity. Several participants felt it was the best discussion environment they had experienced in a long time. The participants agreed on the need to have this kind of discussion on a two-year basis. A possible opportunity was identified as the organisation of a mini-symposium on time-periodic systems within the scope of the upcoming ENOC in 2014.

Summarising, the participants felt that they benefited greatly from a EUROMECH Colloquium that was a mixture of a conference and a workshop. Ideas were exchanged on the recent developments and potential collaborations within this new community were initiated. The near future will show what impact the colloquium had. We thank EUROMECH, the host university and the scientific committee for making this meeting possible and for financial and organisational support.

EUROMECH Colloquium 539
"Mechanics of Unsaturated Porous Media"
27-30 August 2012, Utrecht University, The Netherlands
Chairperson: Prof. S. Majid Hassanizadeh
Co-Chairpersons: Jacques Huyghe, Ehsan Nikooee

The formulation of the effective stress in unsaturated porous media is one of the fundamental questions in unsaturated poromechanics. During the five past decades, many have addressed this question, have extended our understanding and touched the problem from different perspectives. Despite a wealth of effort to illuminate the subject, no consensus has been reached.

The goal of EUROMECH Colloquium 539 was to encourage researchers from different disciplines to share their knowledge from different viewpoints, thereby exposing new opportunities for experimental and theoretical developments. The mutual interactions during the discussions could also extend our common understanding. We believe the colloquium has been successful in this regard and we have received positive feedback on achievement of this objective.

There were in total 49 participants and 39 presentations (7 keynote lectures, 11 contributions selected from submissions, 18 invited lecturers, 3 lectures by 3 co-chairs). State-of-the-art and general theme lectures were presented by internationally known experts. The keynote speakers were Eduardo Alonso (UPC, Spain), Ning Lu (Colorado School of mines, USA), John Cushman (Purdue University, USA), Eric Lemarchand (ENPC, France), Patrick Dangla (ENPC, France), Ghassem Habibagahi (Shiraz University, Iran), Nasser Kahlili (UNSW, Australia).

The program allowed considerable time for informal discussion between the sessions and presentations. A separate panel discussion was held at the end of Colloquium 539 to explore possible directions for further advances in this topic. The panel consisted of internationally known experts: Nasser Khalili (UNSAW), John Cushman (Purdue University) and Patrick Dangla (ENPC), moderated by S.M. Hassanizadeh.

The issues addressed during Colloquium 539 can be categorized under main headings, with bullet points to highlight key areas of discussion:

1. **Micromechanical approach to effective stress including theoretical and experimental studies**
   - State-of-the-art reviews of the common micromechanical approaches to the effective stress principle;
   - The concept of the suction stress characteristic curve, with associated experimental evidence;
   - Basic concepts and capabilities of a poro-mechanical approach to describe coupled phenomena.

2. **Micromechanical approach: modelling aspects**
   - The question of off-diagonal terms and the contribution of contractile skin forces. A Bishop-like equation does not contain any off-diagonal tensorial term to account for such effects;
   - Evidence from DEM simulations;
   - Different measures of stress and deformation in unsaturated porous media;
   - Use of semi-empirical equations for effective stress, based on the DEM simulations.

3. **The role of micro-structure in the effective stress approach**
   - Development of conceptual models, which account for the distinct macro-scale behaviour of the micro-pores and macro-pores;
   - Formulation of constitutive equations for double porosity and aggregated soils;
   - Experimental observations at different scales;
   - Basic elements of the constitutive modelling of aggregated media;
   - The role of soil micro-structural features in effective stress formulation;
   - Possible changes in micro-structure due to mechanical deformation.

4. **The role of hydro-mechanical coupling and hydraulic hysteresis in the effective stress approach**
   - Definition of a coupled hydro-mechanical model which accounts for air and water flow. The keynote lecture by Prof. Khalili reviewed some of the current benchmarks for unsaturated soil mechanics and demonstrated the improved accuracy of state-of-the-art formulations. He introduced bonding surface plasticity theory and its application to the mechanics of unsaturated porous media;
   - Variation of the effective stress in the full hydraulic cycle and key elements of a thermodynamic approach to capture such variation;
   - Formulation of the effective stress in non-equilibrium conditions.

5. **Coupled processes**
   - Modelling of coupled processes such as electro-hydro-mechanical processes and the application of an effective stress-based model;
   - Advanced models, which can account of gas generation and transport.

6. Other approaches to effective stress: Pore scale models, Artificial intelligence based approaches

- Fundamentals of artificial-intelligence-based approaches and advances in their applications to the mechanics of unsaturated soils;
- Fundamentals of porous network, also known as pore network, models and their applications. These models, first introduced in petroleum engineering for modelling two-phase flow, are going to be an important ingredient of multi-scale approaches to the mechanics of unsaturated porous media.

7. Thermodynamic approaches to effective stress

- Major contributions by the late Prof. Coussy to the thermodynamics of unsaturated porous media and his approaches to effective stress formulation in unsaturated poromechanics;
- Determination of material parameters which appear in Coussy theory;
- Consideration of micro-scale properties in a macro-scale thermodynamic approach.

8. Effective stress in unsaturated swelling porous media

- Fundamentals of mixture theories for swelling porous media, current challenges and directions for future studies;
- Examples of swelling concepts in bio- and geo-mechanics and the influence of mineralogy in swelling response of clays;
- Modelling of ionized media and different issues involved in such modelling;
- Advances in formulating effective stress for swelling porous media based on homogenization techniques.

9. The legacy of Prof. Coussy in unsaturated poromechanics

The last session was devoted to the legacy of the late Prof. Coussy in unsaturated poromechanics. Dr. Jean-Michel Pereira from ENPC, a close co-worker of Prof. Coussy, reviewed Prof. Coussy's major findings, contributions, and lines of thought.

10. Panel discussion

Colloquium 539 ended with a panel discussion. The following future research directions were highlighted:

- Effective stress formulation in multiphase situations. A general theory for formulating effective stress needs to be established;
- Formulation of the effective stress in insular, funicular, and pendular regimes. Almost all current theoretical approaches are devoted to investigation of one or two of these states and do not go further;
- Application of pore network models to unsaturated poromechanics, their coupling with real time imaging of the experiments and/or with DEM models;
- Solution of present problems in using real time imaging techniques for measuring microstructural features;
- Formulation of the effective stress in transient conditions and the importance of non-equilibium effects. For example, hillslope landslides can take only a few hours while present theory is based upon equilibrium datapoints which can take months to establish. There are clear challenges in measuring non-equilibrium mechanical parameters;
- Formulation of the effective stress in unsaturated freezing porous media;
- Crystal growth and its formulation.

Based on the discussions and presentations during EUROMECH Colloquium 539, it was concluded that there are promising directions for further advances in unsaturated poromechanics. The results of such advances should be re-assessed in a future colloquium.

EUROPEAN MECHANICS SOCIETY

Objectives of EUROMECH, the European Mechanics Society

The Society is an international, non-governmental, non-profit, scientific organisation, founded in 1993. The objective of the Society is to engage in all activities intended to promote in Europe the development of mechanics as a branch of science and engineering. Mechanics deals with 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 cooperation developed in EUROMECH Colloquia.
In particular, the Society will pursue this objective through:

- The organisation of European meetings on subjects within the entire field of mechanics;
- The establishment of links between persons and organisations 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 all those who are interested in the advancement and diffusion of mechanics. It also bestows honorary membership, prizes and awards to recognise scientists who have made exceptionally important and distinguished contributions. Members may take advantage of benefits such as reduced registration fees to our meetings, reduced subscription to the European Journal of Mechanics, information on meetings, job vacancies and other matters in mechanics. Less tangibly but perhaps even more importantly, membership provides an opportunity for professional identification; it also helps to shape the future of our science in Europe and to make mechanics attractive to young people.

European Journal of Mechanics - A/Solids

ISSN: 0997-7538

The *European Journal of Mechanics A/Solids* continues to publish articles in English in all areas of Solid Mechanics from the physical and mathematical basis to materials engineering, technological applications and methods of modern computational mechanics, both pure and applied research.
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European Journal of Mechanics - B/Fluids

ISSN: 0997-7546

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