EUROPEAN MECHANICS SOCIETY

# Colloquium Final Report Form

Please send this report in electronic form to the Secretary General of EUROMECH, within one month after your Colloquium. As an example, please consult the Report of Colloquium 443 (available at www.euromech.org/colloquia/after.htm).

Title: Frontiers in Finite-Deformation Electromechanics

Colloquium No 545 Dates and location: TU Dortmund, 22-24 May 2013

Chairperson : Prof. Dr.-Ing. Andreas Menzel

Co-Chairperson: Prof. Dr.-Ing. Ellen Kuhl, Prof. Dr. Serdar Göktepe

Is there need of another Colloquium on the same or a related subject? Which year?

A colloquium similar to Colloquium 545 was requested by all, no year specified.

Full registration fee: 350 Euros

What other funding was obtained? Euromech funding

What were the participants offered? Coffee breaks, lunch breaks, conference dinner and cultural events

Number of members of Euromech (reduced registration fee) – no reduced fee

Number of non-members of Euromech (full registration fee) – 350 Euros

Number of participants from each country:

| | | | | | |
|---|---|---|---|---|---|
| Austria | 2 | United Kingdom | 1 | Slovakia | |
| Belgium | | Greece | | Slovenia | |



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| | | | | | |
|---|---|---|---|---|---|
| Bosnia | | Hungary | | Spain | |
| Byelorussia | | Ireland | | Sweden | 3 |
| Bulgaria | | Italy | 3 | Switzerland | 1 |
| Croatia | | Latvia | | Ukraine | |
| Czech Republic | | Lithuania | | Serbia | |
| Denmark | | Netherlands | | Montenegro | |
| Estonia | | Norway | | Turkey | 1 |
| Finland | | Poland | | Others (India 1, Israel 1, USA 2) | 4 |
| France | 1 | Portugal | | | |
| Georgia | | Romania | | | |
| Germany | 13 | Russia | | Total | 29 |

List names of Applicants to EUROMECH…see attached list.....

Scientific Report

Please type your report on the following pages. Use additional pages if required. Put the date and your signature at the end.

# Colloquium No. 545 Scientific Report

Euromech Colloquium 545

Frontiers in Finite-Deformation Electromechanics

Date: 22-24 May 2013

Place: TU Dortmund University

Organisation: Andreas Menzel

Co-organisation: Ellen Kuhl, Serdar Göktepe

The experimental investigation, modeling and simulation of smart materials attracts a continuously growing research community from mechanics, biomechanics, material science and applied mathematics. The goal of this EUROMECH colloquium was to actively bring researchers in these fields together and to focus on the modeling and simulation of electromechanically coupled materials as well as of magneto-electromechanical continua, both at large deformations.

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Approximately 40 European and non-European scientists attended the Colloquium at which 25 presentations were given. Each presentation had a length of 30 minutes, whereby no difference was made between keynote talks and other presentations. This equal format, as well as the substantial amount of time offered to the participants between the talks, made an active and lively scientific discussion possible. The location at which the Colloquium „Frontiers in Finite-Deformation Electromechanics“ took place offered a premium platform, due to the availability of different rooms equipped with individual seating and discussion groups. The following topics were amongst those focused on during the scientific exchange at the Colloquium „Frontiers in Finite-Deformation Electromechanics“:

Numerous scientific contributions focused on the numerical solution of electro-mechanical, magneto-mechanical and electro-magneto-mechanical problems for continua undergoing large deformations, for which the Finite Element Method has been established as an appropriate simulation framework. Apart from those contributions on variational approaches, different approaches and representations of Maxwell stresses were discussed on as well.

The multiscale modelling of electromechanical and magneto-mechanical materials turned out to be one of the key aspects of this colloquium. On the one hand, FE-Square-Methods were presented, as well as analytical investigations on electricalmechanically coupled composites with a focus on the instability phenomena of these anisotropic composite materials.

Apart from electromagnetic active polymers, further classes of composite materials were dealt with, as for example within the field of modelling lithium ion batteries. All the talks given with regard to this active field of research made use of innovative and current-edge numerical methods such as phase field approaches in order to describe these materials.

Another key aspect of the EUROMECH Colloquium 545 was the modelling of active biological tissue such as muscle tissue and, in particular, the heart. A major bonus of this colloquium was that the community working on the field of modelling electroactive polymers as well as the one dedicated to electromechanical active biological tissue were able to be brought together. The “history-dependent” electromechanical stimulus in biological tissue, however, is presented differently especially when the heart is activated as it is in the case of classic electroactive



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polymers. Its implementation in connection with active stresses in biological tissue was discussed during several presentations and extrapolated to the special physiology of the heart. In addition to the physical modelling, the simulation of large representative boundary problems was of key importance, which coincides with the concepts of parallel and high-performance computing

Experimental research was also presented during the Colloquium, especially the research on magneto-active polymers. These contributions were of particular interest to the participating community, due to the fact that this specific field of modelling and simulation still lacks appropriate and accurate data resulting from the experimental research on electro-active and magneto-active materials.

The lively discussions during and after the EUROMECH Colloquium 545 showed that there are yet many open issues within the field of „Frontiers in Finite-Deformation Electromechanics“ which will keep the community actively involved in the future. Subsequent to the Colloquium, a special issue in the European Journal of Mechanics / A-Solids was initialised, in which selected contributions were collated in the form of peer-reviewed articles. The feedback from the participants of the EUROMECH Colloquium 545 were all most positiv, and there was a general interest to repeat such kind of colloquium on a similar subject and following the ideas of the EUROMECH Colloquium 545.

We would like to thank EUROMECH for its support which contributed to the success of the Euromech Colloquium 545.

Andreas Menzel

Dortmund, 30 June 2013



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