

EUROMECH Colloquium 603

“Dynamics of micro and nano electromechanical systems: multi-field modelling and analysis”

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Colloquium EUROMECH 603 was devoted to the discussion of the state of the art and future perspectives in the analysis, characterization, modelling, application and design of electromechanical dynamical systems with dimensions of a few micro or nanometres. This is a very relevant topic since, due to the recent progress in micro and nanotechnology, small-scale electromechanical systems are becoming increasingly common in various disciplines of engineering and applied science. Furthermore, micro and nano electromechanical systems open a number of exploratory research areas in science and engineering, due to the necessity of joining diverse fields of applied sciences or to consider issues that are not noticeable at macro scales. Applications of these small-scale systems often require the knowledge of their dynamic behaviour.

Forty seven researchers, from nineteen countries, participated in EUROMECH 603. Three invited lecturers and 41 regular communications were delivered.

Analytical, numerical and experimental studies were presented and discussed.

The following topics were addressed in the presentations:

- modelling of small-scale structures, from non-classical continuum theories to atomistic-based models;
- multi-field problems at small length scales, including the analysis of structural elements under piezoelectric or electrostatic sensing/actuation, subjected to thermal fields or interacting with fluids;
- linear and, chiefly, non-linear dynamics of diverse micro and nano electromechanical systems.

Presentations on related topics, as properties and failure of nanostructures and CNT reinforced composites, also took place.

There was time for discussions, namely after each presentation, during breaks, along the social program, and in the closing session. Some issues considered in these discussions are mentioned in the ensuing paragraphs, in a somewhat general overview. More detailed analysis can be found in the extended abstracts and short papers published in an electronic book of proceedings (ISBN 978-989-746-185-9). Papers based on some contributions presented at the colloquium will be published in a special issue of the International Journal for Non-linear Mechanics.

Many participants in the colloquium feel that non-linearities are not, as was considered for many years, something to avoid. Instead, non-linearities represent an opportunity to improve performances in existing devices and for the realisation of new ones. There appears to persist, nonetheless, some resistance from industry to adopt non-linear systems and non-linear analyses, possibly because industry is often averse to change and gives emphasis to reliability. On the other hand, maybe the research community should look more often into practical outcomes of nonlinear dynamics. The importance of bringing the Mechanics and Physics communities in touch was also highlighted.

Still in connection with non-linear behaviour, the importance of dynamical integrity was stressed in discussions. The fact that theoretical predictions, as saddle node bifurcation, cannot exactly be reached in practical experiments should be taken into account in identification algorithms.

The relevance of damping, how to model it and, in particular, if non-linear effects ought or not to be included in damping models, were other points discussed.

The topic of non-classical continuum theories for small scale structures was an issue of contention. Some researchers believe that these theories are sound, theoretically, under the hypothesis they are based upon, but depend on parameters that are not easy to identify. Others think that there are so many uncertainties at small scales, that it is not very useful to implement these theories.

It appears to the organisers that a colloquium on this or a closely related topic would be appropriate within two years.

As a closure, the organisers would like to gratefully thank EUROMECH, FEUP, the University of Porto and Santander Bank, the secretariat, the authors, the participants, the scientific committee and the reviewers for their contribution to the success of this meeting.