



# SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS957

22 August 2019

A DCAMM seminar No. 744 will be presented by

**Professor Ayech Benjeddou** <sup>1,2</sup>

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The title of the lecture is

**Piezoelectric finite element analysis of smart materials and structures experiments:  
mathematical, mechanical and technological key issues**

**Abstract:**

This seminar discusses mathematical, mechanical and technological key issues for performant model/test correlation with smart materials and structures applications. After introducing the piezoelectric mathematical constitutive behaviours, technological dominant response modes resulting from the polarization and electrodes configurations, variational formulations and finite element (FE) discretisations of the electromechanical equations for sensing, actuation and vibration, the through-the-thickness quadratic induced potential (IP) effect and its implementation in common commercial and in-house FE codes are first discussed. Then, the effects of the physical equipotential (EP) mathematical constraints, resulting from piezoelectric patches electrodes, on the correlation with smart structures applications experiments are highlighted. It is shown, in particular, that the technological EP effect is higher than the mathematical IP one. Next, the technological and mechanical issues of series and parallel electric connections according to the polarizations configurations and their FE implementation are illustrated for trimorph (symmetric) smart structures. Some comments on mechanical modelling of unimorph (asymmetric) configurations are also given. Finally, practical FE simulation of the experimentally observed field-dependent nonlinear piezoelectric actuation response is presented for adhesively bonded shear macro-fibre composite patches.

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| DATE:  | <b>Thursday, 5 September 2019</b>                       |
| TIME:  | <b>15:00 – 15:45</b>                                    |
| PLACE: | <b>414-065E</b><br>DTU, Technical University of Denmark |

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Niels Leergaard Pedersen

**DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS**

- **TECHNICAL UNIVERSITY OF DENMARK**
- **AALBORG UNIVERSITY**
- **AARHUS UNIVERSITY**
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