Colloquium Final Report
No. 600 – New challenges in finite element technology – from the perspective of mechanics and mathematics

Dates and location: **12/03/2019 - 14/03/2019, Aachen, Germany**

Chairperson **Prof. Stefanie Reese, RWTH Aachen University, Germany**

Co-Chairperson **Prof. Peter Hansbo, Jönköping University, Sweden**

Conference fees

Registration fee 150.00 € for members

Registration fee 180.00 € for non-members

What other funding was obtained? none

What were the participants offered?

The standard finite element method (FEM) is a well established numerical spatial discretization method which – also by means of commercial software packages – has found its way into universities, research institutions and industry. The range of applications for numerical simulation is steadily growing which poses new challenges, in particular with respect to non-linear finite element technology. The colloquium aimed to bring together scientists from mechanics and mathematics to report on progress in the understanding of new issues of finite element technology.

Lunches, drinks, snacks and other refreshments were served. The first day ended with a reception including snacks. A colloquium dinner was served in the evening of the second day.

The colloquium brought together 33 participants, representing 14 countries. The workshop was two half days and one full day long, including a series of presentations and ample time for discussion.

One rather unusual idea was to allow questions and discussions during the talks at any time. Since every speaker had in total only 30 minutes, this could have the consequence that a speaker did not manage to put down all prepared slides. About half of the speakers planned their presentations accordingly and were very open to spontaneous discussions. Many others, however, could not deal with this format very well.

Nevertheless, in particular the young scientists liked the format very much. In the opinion of the organizers, one should continue to try out this format in the future. An additional help would be to

instruct the chairpersons in a more firm way. In this format, the chairpersons have to take a more prominent role in initiating and really steering the discussion.

The full programme (including abstracts) can be found on the colloquium website https://600.euromech.org/program/scientific-program/.

Number of members of Euromech (reduced registration fee) **16**
Number of non-members of Euromech (full registration fee) **17**

Scientific Report

The EUROMECH COLLOQUIUM 600 was devoted to the discussion of the state of the art as well as new challenges in finite element technology from the perspective of mechanics and mathematics with a steadily growing range of applications.

Important challenges, which were addressed in the presentations and further discussed during the event, were:

- modeling of damage and fracture with different approaches (e.g. phase-field of fracture, continuum damage mechanics, cohesive-zone modeling) in conjunction with different spatial discretization methods (e.g. discontinuous Galerkin methods, polynomial and virtual element methods, XFEM) or combinations of them

- modeling of heterogeneous microstructures using different multiscaling approaches, model order reduction techniques as well as machine learning algorithms (e.g. data-driven algorithms, neural networks)

- different sources of nonlinearities in solid mechanics and structural analysis (e.g. contact and friction, piezoelectric composites, gradient elasticity, local frame approaches, tangential differential calculus)

- mathematical analysis of robustness and stability (e.g. reduced integration, cut-cell quadrature, adaptivity in variable-order FEM)

One important objective of the colloquium was to generate fruitful discussions and a beneficial exchange between current knowledge in mechanics and mathematics. This was achieved by a non-conventional format of the colloquium:

- about same number of speakers from mathematics and mechanics

- interaction during presentation (interruptions were possible at any time), each speaker had 30 minutes in total

- time for additional discussions in small groups (besides breaks and social program)

- submission of 3-5 overview slides before the event, purpose: to allow other participants preparation for the topic

Participants

Last name	First name	Title	Organization	Country
Antoulas	Athana-sios	Prof.	RICE University	USA
Aldakheel	Fadi	Dr.-Ing.	Leibniz University Hannover	Germany
Balzani	Daniel	Prof.	Ruhr-Universität Bochum	Germany
Barfusz	Oliver	M.Sc.	RWTH Aachen University	Germany
Bayat	Hamid Reza	M.Sc.	RWTH Aachen University	Germany
Bruls	Oliver	Prof.	University of Liège	Belgium
Bui	Hoang Giang	M.Sc.	Ruhr-Universität Bochum	Germany
Chellappa	Sridhar		Max-Planck-Institute for Dynamics of Complex Technical Systems	Germany
Chouly	Franz	Prof.	University of Bourgogne	France
Codina	Ramon	Prof.	Polytechnic University of Catalonia	Spain
Díez	Pedro	Prof.	Polytechnic University of Catalonia	Spain
Dyck	Alexan-der		Karlsruher Institute of Technology	Germany
Fernan-dez	Mauricio	Dr.	Stuttgart University	Germany
Fries	Thomas-Peter	Prof.	Graz University of Technology	Austria
Gajek	Seba-stian		Karlsruher Institute of Technology	Germany
Hansbo	Peter	Prof.	Jönköping University	Sweden
Huerta	Antonio	Prof.	Polytechnic University of Catalonia	Spain

Klinkel	Sven	Prof. Dr.	RWTH Aachen	Germany
Kunc	Oliver	M.Sc.	Stuttgart University	Germany
Naets	Frank	Prof.	University Leuven	Belgium
Nasedkin	Andrey	Prof.	Southern Federal University	Russia
Noels	Ludovic	Prof.	University of Liege	Belgium
Reddy	Daya	Prof.	University of Cape Town	South Africa
Reese	Stefanie	Prof.	RWTH Aachen	Germany
Remmers	Joris	Dr.	Eindhoven University of Technology	Netherlands
Riessel-mann	Johannes		Ruhr-Universität Bochum	Germany
Rozza	Gianluigi		International School for Advanced Studies	Italy
Upad-hyay	Chandra	Prof.	Indian Institute of Technology	India
Waimann	Johanna	Dr.	RWTH Aachen University	Germany
Weinberg	Kerstin	Prof.	University Siegen	Germany
Wells	Garth	Prof.	University of Cambridge	UK
Wieners	Christian	Prof.	Karlsruher Institute of Technology	Germany
Wihler	Thomas	Prof.	University of Bern	Switzerland

In total, these are 33 participants from 14 countries.

The distribution over countries is as follows:

Austria: 1	Russia: 1
Belgium: 3	South Africa: 1
France: 1	Spain: 3
Germany: 16	Sweden: 1
India: 1	Switzerland: 1
Italy: 1	UK: 1
Netherlands: 1	USA: 1