AALBORG UNIVERSITY
DENMARK

Ph.D. course

on

Analysis and Gradient Based Optimization of Laminated Composite Structures

14–18 May 2018 (week 20)

at

Department of Materials and Production
Aalborg University
Fibigerstræde 16, room 1.101, DK-9220 Aalborg, Denmark

Organized by

Aalborg University
The Faculty of Engineering and Science
The Doctoral School of Engineering and Science
(http://www.phd.engineering.aau.dk)

Department of Materials and Production, Aalborg University
(www.mp.aau.dk)

DCAMM, Danish Center for Applied Mathematics and Mechanics
(www.dcamm.dk)

Lecturers

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Department of Materials and Production, Aalborg University

Course Content

Background and motivation:
Polymeric resin fibre reinforced materials (FRP´s or composite materials) are being used increasingly for structural applications where properties such as high strength, high stiffness and low weight are determining design parameters. The driving force behind the development and application of these materials has been the demands posed by the aerospace industry, but the use of advanced composite materials is expanding rapidly to other industrial sectors as well. Pertinent examples of this include applications for ship structures, automotive and train applications, wind turbine blades and civil engineering applications including bridge structures.

Objectives and contents:
The purpose of the course is to present the participants with a general overview and an introduction to recent advances and modern techniques for analysis and gradient based design optimization of advanced laminated composite structures. The following topics will be treated:

- Laminae and laminates: fiber and resin materials, modelling of the laminae, classical lamination theory (CLT), shear-deformation plate theories
- Fracture and failure of composite materials including fatigue – focus on failure criteria and their use
- Finite element analysis of laminated composite structures with focus on shell and solid shell formulations
- Introduction to basic concepts of gradient based structural optimization
- Parameterization choices for laminated composites (continuous fiber angles and thicknesses, lamination parameters, Discrete Material Optimization (DMO), Discrete Material and Thickness Optimization (DMTO), etc.)
- Efficient methods of Design Sensitivity Analysis for gradient based structural optimization
- Inclusion of manufacturing constraints
- Gradient based design optimization of laminated composite structures for linear and nonlinear problems including buckling problems

Course Language

The course will be given in English.

Teaching Material

Lecture notes will be made available for registered course attendees.
Furthermore, a Matlab skeleton script for analysis and design optimization of laminated composite plates using isoparametric finite elements is provided as basis for part of the assignments.
The first part of the course is to some extent covered by the text book R. M. Jones: *Mechanics of Composite Materials,* Taylor & Francis, London, 1998, 519 pp., ISBN 156032712X.

Course Format and Work Load

The course will consist of a condensed session comprised of 5 full days of lectures, work on assignments, and discussions at AAU. After the course session the course participants (PhD students) are expected to solve and submit homework assignments. Diplomas will be issued on the basis of course participation and evaluation of homework assignments, and entitle Ph.D. students to 5 ECTS, corresponding to 140 hours of work load.

Participants

Participants are expected to have a basic knowledge in mechanics of solids corresponding to undergraduate level (Mechanical, Aero, Civil or Ship/Maritime engineering). The course is aimed specifically at Ph.D. students, but the course is also recommended for industrial engineers and engineering scientists. University staff and final year M.Sc. students are welcome as well. University staff, M.Sc. students and participants from industry may be exempted from the homework assignments and the course evaluation/examination. Course assignments are based on Matlab scripts, and it is expected that participants have Matlab installed. The public domain code Octave can also be used (https://www.gnu.org/software/octave/index.html).

Earlier Events

The course has been held biannually since 2004 as “Analysis and Design Optimisation of Laminated Composite Structures”. However, in 2016 the course was revised and changed to the current title such that more focus is put on gradient based methods for the design optimization part.

Accommodation - Hotels

Aalborg offers a variety of accommodations. An overview over the city and the accommodations can be found at http://www.visitaalborg.com. The organizers will recommend one hotel that is conveniently located and with low prices:

Cabinn Hotel Aalborg (http://www.cabinn.com/english/aalborg/aalborg.html)
Fjordgade 20, DK-9000 Aalborg
Hotel CABINN Aalborg is the newest hotel in the city and opened in October 2009. The hotel is located in the centre of Aalborg. Prices from DKK 499.

Even cheaper accomodation is possible at the Aalborg Hostel, see http://uk.danhostelaalborg.dk/

Registration and Deadline

Further information and registration can be found at
https://phd.moodle.aau.dk/course/view.php?id=945

If you are from outside Aalborg University and you wish to enroll in one of our PhD courses, you must create a profile. This is done by clicking on “create new account” and filling out the form.

Deadline for registration: 27 April 2018.

Course participation is free for national Ph.D. students and university staff.
Participants from industry will be charged DKK 12,500 (DKK 2,500 pr. ECTS).
International Ph.D. students and university staff get a discount of 90% and will be charged DKK 1,250.

Important information concerning AAU PhD courses:
The Doctoral School has over some time experienced problems with no-shows. Therefore, the Doctoral School has decided to introduce a no-show fee of DKK 5,000 for each course where the student does not show up. Cancellations are accepted no later than 2 weeks before start of the course. Registered illness is of course an acceptable reason for not showing up on those days.

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