PhD Course Description
We offer a one week PhD course/workshop on "Uncertainty Quantification".

The PhD course is offered as a part of activities and with support from the DTU Compute PhD School and the Danish Center for Applied Mathematics and Mechanics (DCAMM) at Technical University of Denmark, see www.dcamm.dk.

PhD Course objective
The aim of the course is to introduce the students to some of the methods and algorithms used in uncertainty quantification (UQ), and let the students experience these methods on elementary computer experiments. The PhD course covers several topics in UQ: uncertainty parametrization, uncertainty propagation, sensitivity analysis, inference and uncertainty reduction. Related methods (e.g. Monte-Carlo simulation, spectral decompositions, surrogate modeling, Bayesian inference, Gaussian models) will be reviewed and some of them illustrated during computer experiments and projects. The objective is to give the student an overview of the "tools" available and how they can be modified for particular UQ applications.

- ✓ Understand problems and questions addressed by UQ methods.
- ✓ Understand how methods are used as building blocks to address UQ questions.
- ✓ Be able to choose a suitable method depending on the situation and problem.
- ✓ Implement some of these methods in C++.
- ✓ Skillfully perform numerical experiments and interpret the results.
- ✓ Perform sensitivity analyses and explain the behavior of the UQ methods.
- ✓ Identify and exploit the properties and structure of an uncertain model to select suitable approaches.

PhD Course Homepage
http://www2.compute.dtu.dk/~apek/UQ2018/

Organizers and Lecturers
CNRS Senior Researcher Olivier Le Maitre
Laboratoire d'Informatique pour la Mechanique et les Sciences de l'Ingeneur (LIMSI), Paris, France.

Associate Professor Allan P. Engsig-Karup
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DTU Compute
Technical University of Denmark.

Associate Professor Mirza Karamehmedovic
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DTU Compute
Technical University of Denmark.

Participants
The course is intended for PhD students, PostDocs and MSc students with a fundamental knowledge of numerical analysis and linear algebra and must be able to program in C++.

Work Load
Approximately 40 scheduled hours (lectures, discussions and computer exercises) during the course and approximately 40 hours for the completion of an assignment problem after the duration of the workshop. Also, to prepare for the course it is required that participants read the literature proposed below in advance.

Literature
The course is partly based on the books
[1] Le Maître and Knio, "Spectral Methods for Uncertainty Quantification".
See http://www.springer.com/la/book/9789048135196
[2] Rasmussen and Williams, "Gaussian Process for machine learning".
See http://gaussianprocess.org/gpml/chapters/
[3] Sivia, "Data analysis a Bayesian Tutorial".
See https://global.oup.com/academic/product/data-analysis-9780198568322?cc=fr&lang=en&

Language
All lectures will be given in English.

Registration
Sign up by sending an E-mail to one of the DTU organizers.

Registration Fee
There is no registration fee for students enrolled at universities and public research institutions. For researchers employed at universities and public research institutions the registration fee is €500. For all other participants the registration fee is €1500. Payment information will be given upon signing up for the workshop.

Deadline
The submitted request for registration must be received by the course secretariat no later than **March 9th, 2018 (limited seats, so sign up early is recommended).** Information on enrollment will be posted within a week after this date. Signup is on a first-come first-serve due to limited seats.

Evaluation and Diplomas
To pass the course, active participation and the satisfactory completion of an assignment problem after the duration of the course are required. **ETCS points: 2.5** (equivalent to 1.5 week effective full time work).

Course Contents
The following topics will be covered in the course
1. Introduction to Uncertainty Quantification.
2. Stochastic Spectral Methods.
3. Non-Intrusive Methods for Polynomial Chaos Expansions.
4. Bayesian Inference and Gaussian Models.
5. Advanced topics (exposure only).

Talk to the DTU advisors for more details.

Lunch

The DTU Compute PhD School and DCAMM are sponsoring a daily lunch for participants that are enrolled at universities and public research institutions.

Housing

Accommodation in hostels/hotels can also be arranged by the participants themselves, see e.g. the Wonderful Copenhagen website at www.woco.dk and course webpage.

Internet Resources

For facts on the Technical University of Denmark and visitors' information: See http://www.dtu.dk. Information about teaching and research at DTU Compute can be found at http://www.compute.dtu.dk, and for DCAMM at http://www.dcamm.dk.

About ITMAN

The DTU Compute Graduate School ITMAN (IT MAN) administers the PhD program at DTU Compute. ITMAN promotes cross-disciplinary research, matching information technology and mathematical modelling with other disciplines, often in collaboration with external collaborators: Other research institutions and private companies.

ITMAN is based on the idea of optimizing the relationship man - knowledge - IT as a key to growth for Danish companies in the global innovation and productivity competition. If one is to understand the role of IT, it is essential to view IT as more than "computers and software": IT is always a factor in the intricate net of machine, man and market.

ITMAN aims to strengthen research education through a series of initiatives: Specialized PhD courses and summer schools, quality assurance of supervision, PhD processes and procedures, research environment, implementation of a mentor program, help with IPR, social activities, etc.

**DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS**

The Danish Centre for Applied Mathematics and Mechanics, DCAMM, is an informal framework for internationally oriented scientific collaboration between staff members at a number of departments at the Technical University of Denmark (DTU), Aalborg University (AAU), Aarhus University (AU) and University of Southern Denmark (SDU). The Departments cooperating within DCAMM are:

- Dept. of Applied Mathematics and Computer Science, DTU
- Dept. of Civil Engineering, DTU
- Dept. of Mechanical Engineering, DTU
- Dept. of Wind Energy, DTU
- Dept. of Civil Engineering, AAU
- Dept. of Mathematical Sciences, AAU
- Dept. of Materials and Production, AAU
- Dept. of Engineering, AU
- Dept. of Technology and Innovation, SDU

DCAMM is an informal construction that was founded October 27, 1969. The day to day activities are coordinated by the chairman of the Center (pt. Associate Professor Niels Leergaard Pedersen Department of Mechanical Engineering, Solid Mechanics), while the formal governing body of DCAMM is the Scientific Council.

**The Technical University of Denmark
DTU Compute & DTU Mechanics**

**Section for Scientific Computing
&
DTU Compute Graduate School (ITMAN)**
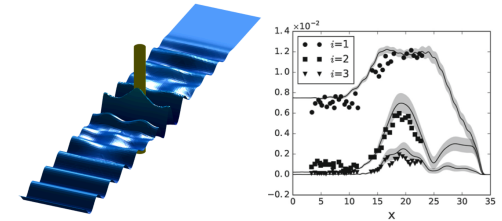
PhD School on

Uncertainty Quantification

Kgs. Lyngby, Denmark

March 19th to March 23rd, 2018

DTU Compute
Department of Applied Mathematics and Computer Science