Non-Equilibrium Turbulence and Cascade Dynamics

DTU Turbulence Research Lab (DTU TRL)

February 16, 2023

Course content

The course content is focused on non-equilibrium turbulence, advanced analysis methods and related experimental studies at the DTU TRL. The main topics are:

- Review of the main classical views of turbulence, including

    - The Kolmogorov/Richardson/Batchelor (K41) equilibrium theory
    - Rapid Distortion Theory
    - Classical statistical approaches to understanding turbulence

- Historical and more recent developments of non-equilibrium turbulence research

- Experimental/computational approaches used @ DTU TRL (including design tools for design of PIV/PTV experiments)

- Proper Orthogonal Decomposition (POD) techniques and developments @ DTU TRL

The course includes a tour of the newly established DTU TRL laboratory facilities at DTU Construct.
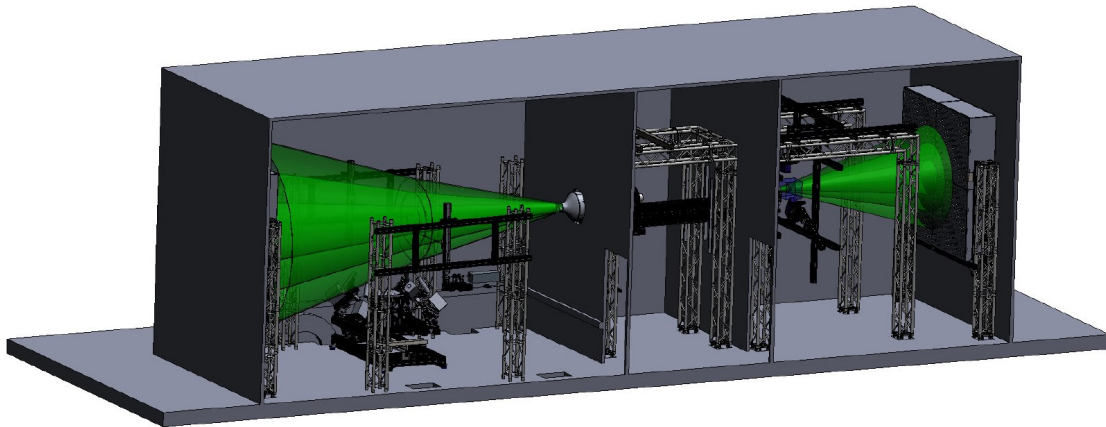
Student target group

The course is intended primarily for PhD-students that have an interest in (non-equilibrium) turbulence, advanced experiments and/or advanced analysis tools for turbulence research. The participants should have general knowledge of fluid mechanics/turbulence and basic programming. We will cover the basic principles behind the POD method as well as those of optics necessary to attain a basic understanding of the course content. The course has an upper limit of 30 participants.

# Course Credits and Expected Work Load

With assignments, the course corresponds to a total of 3 ECTS credits, or 84 hours (pass/no pass). A course certificate can be provided upon request and finalized course: Please fill the following form and write 'specialized course with Clara Marika Velte' in the field 'Course number and title (1)'.

Activities to obtain ECTS credits: At the beginning of the course, you will give a 5 minutes poster presentation of your PhD-project. The course work will also include one of the following, dependent on the main interest of the student:

- POD analysis of measurement data from the DTU TRL lab facilities. You may use a programming language of your own choice to analyze the data. A guiding script in Python(?) will be made available.

- Design of a planar or volumetric (laser or LED based) experiment for turbulence measurements.

Based on the chosen task from the list above, you will write a report (in the form of a 'paper', 5 pages) as part of the course work. This is to be submitted no later than 2 weeks after the course end (i.e. June 16). Preparatory reading materials is recommended reading before the course start.

As an option, it is possible to follow the course and lectures without earning course credits.
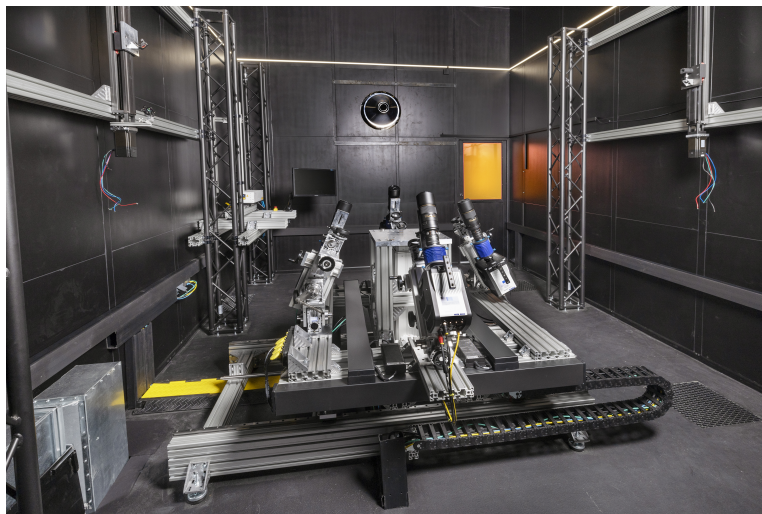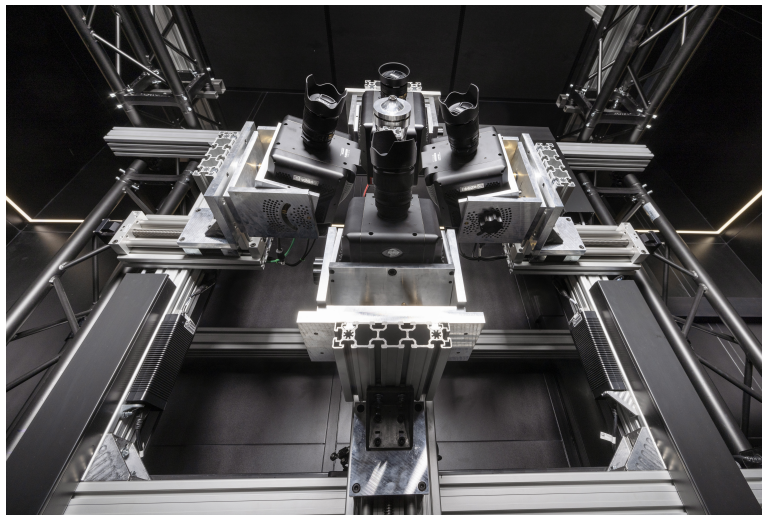
Preliminary Program

Tuesday, May 30:

08.30-09.00 Registration
09.00-10.20 Course introduction, participant poster presentation (Clara Velte)
10.30-12.00 The classical view of turbulence and the need for an updated description (Clara Velte)
12.00-13.00 Lunch
13.00-14.30 Tour of the laboratory facilities
14.40-17.00 Statistical tools in turbulence (Jakob Mann?)

Pizza and soda/wine/beer, inner yard

Wednesday, May 31:

08.30-10.00 Introduction to POD, incl. different bases (Peder J. Olesen)
10.15-12.00 POD vs. Fourier modes on measured signals (Peder J. Olesen)
12.00-13.00 Lunch
13.00-15.00 Particle POD (Martin Schiødt)
15.10-17.00 POD exercise(s) (Peder and Martin)

Thursday, June 1:

08.30-10.45 Light, optics and cameras (Haim Abitan)
11.00-12.00 Design of a PTV/PIV experiment (Haim Abitan)
12.00-13.00 Lunch
13.00-17.00 Facilities and principles for direct measurement of the instantaneous dissipation rate tensor (Simon L. Ribergaard)

Dinner at Restaurant Fortunen / Brede Spisehus (walking together from lab at 17:30)

Friday, June 2:

08.30-12.00 Facilities and principles for volumetric measurement (Yisheng Zhang)
12.00-13.00 Lunch
13.00-14.30 Final remarks (Clara Velte)

Registration, Travel and Accommodation

Registration can be done under this link.

- The course is free for students enrolled at DTU or other DCAMM institutions.

- Other Ph.D.-students pay 300 EURO.

- For researchers employed at universities and public research institutions the registration fee is 500 EURO.

- For all other participants the registration fee is 1150 EURO.

The course venue is located on DTU's main campus in Lyngby, about 15 km north of Copenhagen. It is easy to get to DTU by public transportation from e.g. Copenhagen airport CPH. Travel information can be found on the DTU homepage.

Course participants can obtain a special rate for accommodation at the Zleep Hotel Lyngby, located only 600 m from the lab and course venue. Please mention the code ... when booking.
HOTEL CODE, VLT LINK, LINK TO COURSE WEB PAGE INCL. ASSIGNED READING MATERIAL, LINK FOR REGISTRATION, HOW PROMOTE (LINKEDIN, HOMEPAGE, VLT, DCAMM)

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