Course description and aims

This short course has the aim to present the current understanding and state-of-the-art of atomization fundamentals, their realization in atomizer systems and their application in a wide variety of engineering branches, including spray drying, spray coating, spray cooling, fuel injection, etc.

These aspects are first addressed theoretically in terms of hydrodynamic instabilities of liquid jets and sheets – primary atomization. This is followed by considerations about the break-up of single droplets – secondary atomization. Engineering solutions for realizing the different atomization mechanisms are then presented.

The second day is devoted to experimental descriptors and diagnostics of sprays and droplets. Both non-optical and optical techniques are addressed. Focus is placed on drop size and velocity determination, but an overview is also given about more advanced techniques, allowing temperature and composition to be determined.

The third day presents possibilities for simulating atomization and spray processes. Modelling of primary atomization is discussed, as well as transport processes within sprays and spray/wall interactions.

The final day of the course covers a wide variety of applications and how spray systems have been developed and customized to meet specific requirements and constraints.

The program foresees discussions among the participants and the lecturers. The aim is to address ongoing development and application problems suggested by the participants.

Who should attend?

This course is directed towards practicing engineers, researchers involved in R&D and the application of spray systems, and graduate students performing research on the subject of sprays and atomization. For those with little previous background, the course begins with fundamentals of atomization and proceeds through theoretical, experimental, numerical and application topics.

Course platform and delivery

Pre-recorded lectures will be provided using Webex integrated with the Moodle learning management system. The lecturer will be available during and after the lecture and questions and discussions with lecturers will be moderated through the chat function. All lecture slides are available for download and all lectures can be streamed from their time of airing for a further 24 hours.

Fees and registration

- **Industry:** 200 EUR
- **Academia:** 100 EUR

Course fees are VAT exempt according to article 132 (i) Council Directive 2006/112/EC. Included is live and download access to all lectures during the week and all accompanying documentation (slides).

Registration for this four-day short course can be made online starting February 2021 on the course website: [www.tfi.tu-darmstadt.de/as2021](http://www.tfi.tu-darmstadt.de/as2021)

The number of participants will be limited on a first-come-first-serve basis. For further information, please refer to the course website or contact Prof. Cameron Tropea:

ctropea@sla.tu-darmstadt.de
PRELIMINARY PROGRAM

Monday 17 May 2021
fundamentals

8:45  Session open for joining
9:00  Welcome, Introductions, Overview, Use of WebbEX and guidelines for discussions (Tropea)
9:30  Techniques of Atomization: Overview of Atomizers and their Applications (Tropea)
10:30  Screen break
10:45  Stability Analysis of Liquid Jets and Sheets (Brenn)
12:00  Screen break (Lunch)
12:30  Fundamentals of Atomization (Roisman)
13:30  Screen break
13:45  Breakup and Atomization Models (Ashgriz)
15:00  Screen break
15:15  Secondary Atomization (Tropea)
16:00  Screen break
16:15  Flash Boiling Atomization (Sher)
17:00  Close of first day

Tuesday 18 May 2021
characterization and diagnostics

8:45  Session open for joining
9:00  Spray Characterization – Quantifiers and Standards (Tropea)
9:45  Imaging Techniques (Leick)
10:30  Screen break
10:45  Measurement Techniques (Tropea)
11:45  Screen break
12:00  Measurement of Drop Temperature and Composition (Lemoine)
13:00  Screen break (Lunch)
13:30  Nozzle Designs and their Spray Characteristics (Ashgriz)
14:30  Screen break
14:45  Droplet Impingement Cooling with Evaporation (Stephan)
15:30  Screen break
15:45  Fundamentals of Modelling (Yarin)
16:30  Close of Second Day

Wednesday 19 May 2021
modeling and simulation

8:45  Session open for joining
9:00  Direct Numerical Simulation of Primary Jet Breakup (Weigand)
10:30  Screen break
10:45  A Survey on Numerical Simulation Methods for Multiphase Flows (Bothe)
11:30  Volume-of-Fluid Method for Drop Collision (Bothe)
12:15  Screen break (Lunch)
12:45  Heat and Mass Transfer from Drops: Fundamentals (Brenn)
13:30  Screen break
13:45  Drop/Wall Interactions (Yarin)
14:45  Screen break
15:00  Atomization in Forensic and High Power Applications (Yarin)
15:45  Screen break
16:00  Spray Painting (Chandra)
16:45  Close of Third Day

Thursday 20 May 2021
applications & advanced topics

8:45  Session open for joining
9:00  Atomizers for Fuel Injection (Leick)
10:00  Screen break
10:15  Drop Combustion (Sher)
11:00  Screen break
11:15  Atomization of Complex Fluids (Brenn)
12:00  Screen break (Lunch)
12:30  Powder Production in Spray Processes (Fritsche)
13:30  Screen break
13:45  Spray Coating (Chandra)
14:30  Screen break
14:45  Spray Cooling (Roisman)
15:30  Close of Short Course