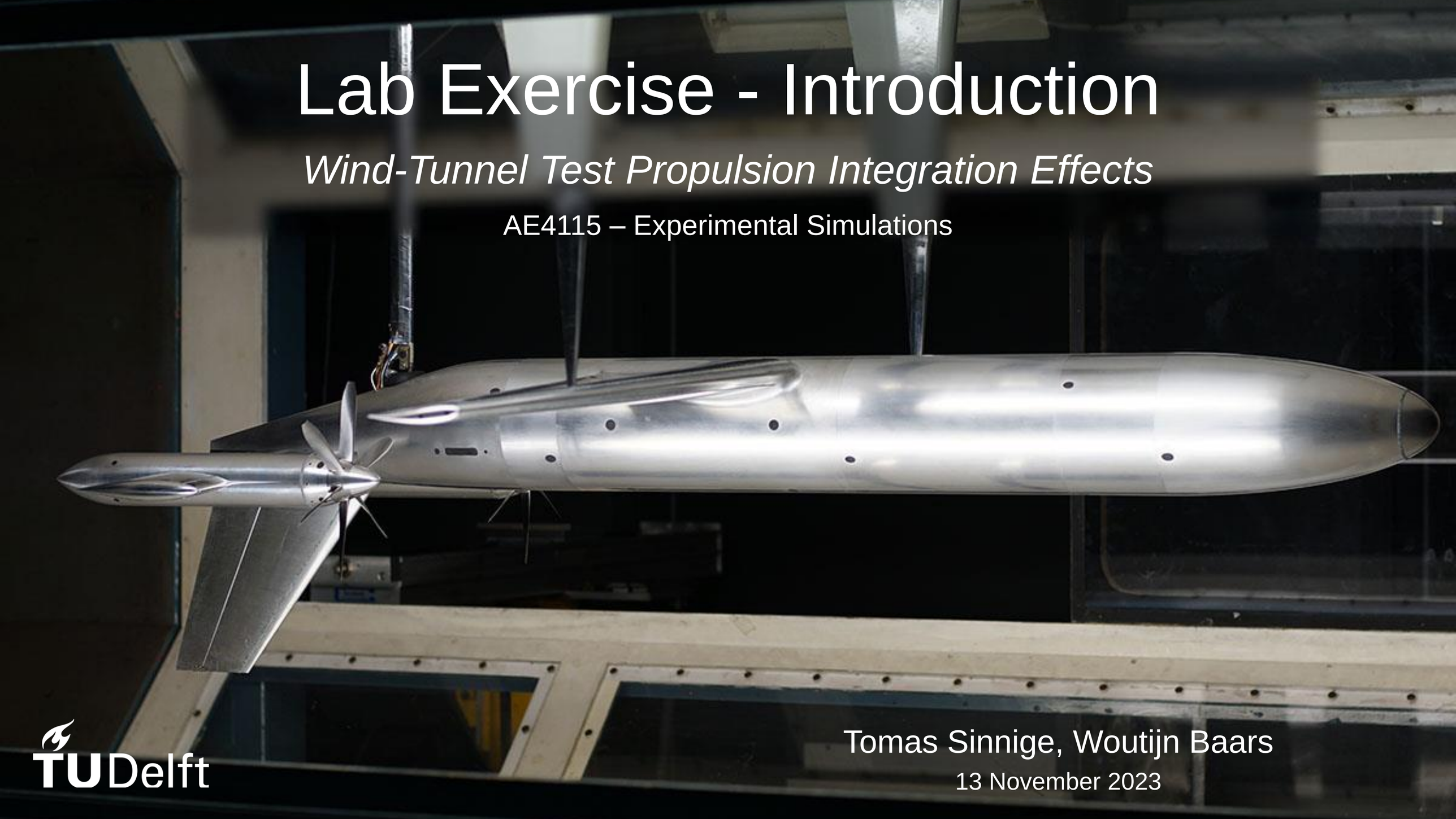
Lab Exercise - Introduction

Wind-Tunnel Test Propulsion Integration Effects

AE4115 – Experimental Simulations



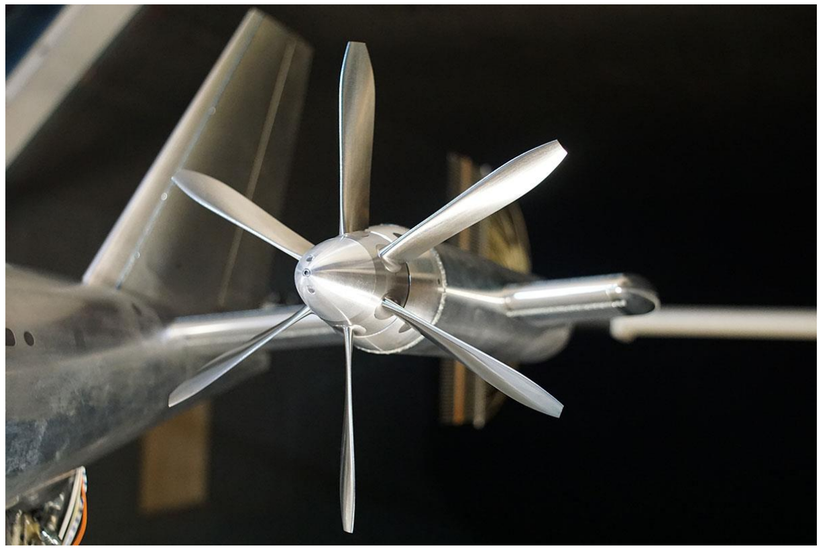
Tomas Sinnige, Woutijn Baars

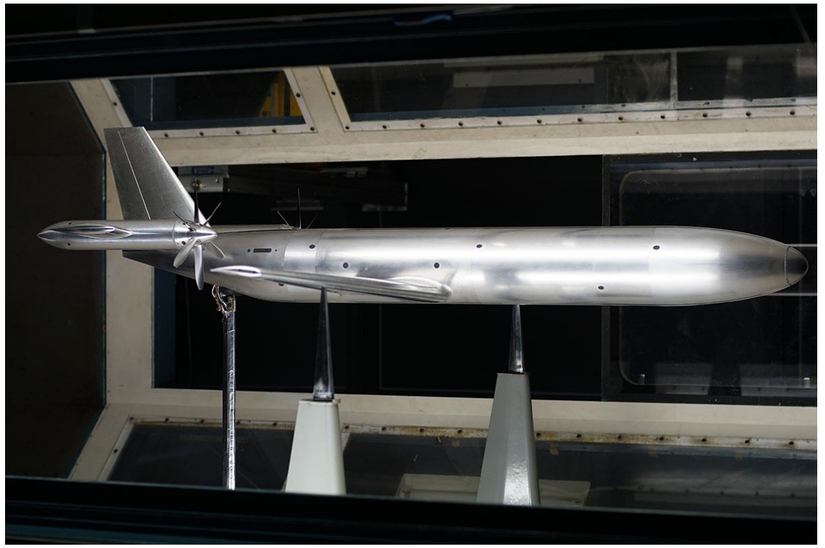
13 November 2023

TU Delft

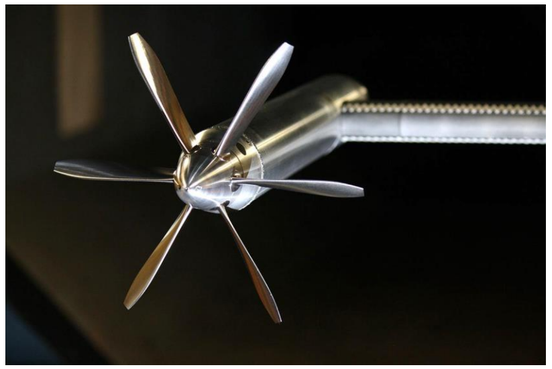
The Lab Exercise

- Hands-on wind-tunnel experience
- Put into practice the things you will learn during the course





Test Objectives



- You will gain insight into:
  - Possibilities and limitations of wind-tunnel testing
  - Correction procedures of wind-tunnel data
  - Choices of experimental techniques
  - Power integration effects on aircraft performance
  - Dominant noise sources of propeller aircraft
  - Successful definition of a test plan

Testing approach

Flow physics

Planning

Assignment

- You will design your own test plan, acquire data, process data, analyze data
  - Groups of at most 4 students
  - You will be in charge → expect a challenge!

- Test to be designed for assigned measurement challenge
  1. Power effects on longitudinal stability and control
  2. Power effects on directional stability and control
  3. Directional stability and control in one-engine-out condition
  4. Braking and energy-harvesting during approach
  5. Aircraft performance as function of propeller rotation direction

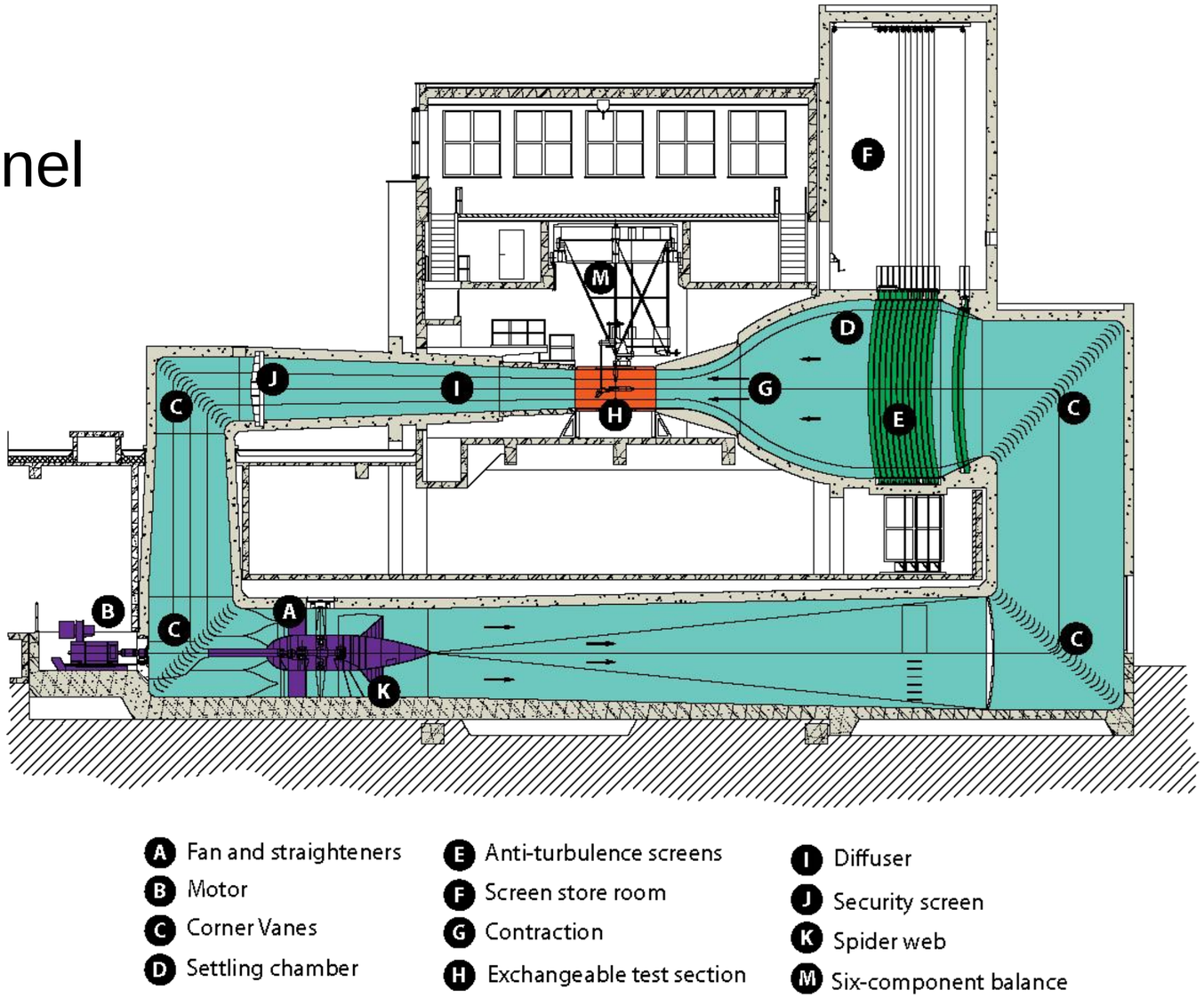
Assignment

- Two deliverables
  1. Pre-test report: test plan, test matrix (wk 2.9) → pass/fail
  2. Final report: data analysis and discussion (wk 3.8) → mark, 1/2 of course grade

- Oral exam will include defense of lab exercise and examination of other course material

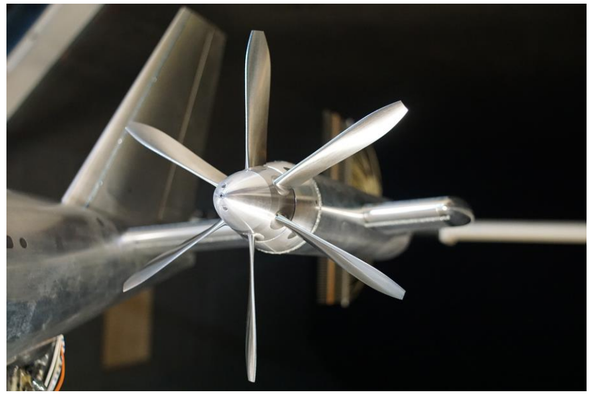
Wind-tunnel facility

- TU Delft Low-Turbulence Tunnel
  - Low speed
  - High flow quality



Wind-tunnel model

- Full aircraft model with powered propellers
  - Connected to external balance
- Horizontal-tailplane-mounted propellers
  - Driven by integrated electric motors
  - Independent speed control left/right motor
  - Prop rotation direction can be varied
- Fuselage equipped with near-field microphones
  - Unsteady pressure measurement for noise characterization



T.Sinnige@tudelft.nl

Logistics

1. Formation of groups and group enrolment
2. Definition of test plan and writing of pre-test report
3. Discussion of pre-test report and possible update of test plan
4. Execution of wind-tunnel test
5. Processing and analysis of data and writing of post-test report

Event	Deadline
Group enrolment	**22 November 2023**
Pre-test report due	23 January 2024
Wind-tunnel test	19 Feb – 08 Mar 2024 (academic wks 3.2-3.4)
Post-test report due	03 April 2024

Group Enrolment

- Enrolment through Brightspace
  - AE4115 → Collaboration → Groups
  - 30 groups of at most 4 students, more will be opened if needed
- Each group corresponds to a specific time slot and measurement assignment (see manual)
- **Planning is not flexible** → make sure you have no other obligations during the timeslot of the test of your group
  - Presence at the wind-tunnel test is mandatory
- **Deadline for group enrolment is 22 November 2023 (next week Wednesday!)**

Supervision

- Responsible instructor: Tomas Sinnige

- Lab-exercise supervisors

Ramon Duivenvoorden

Martijn van Sluis

Robert Nederlof

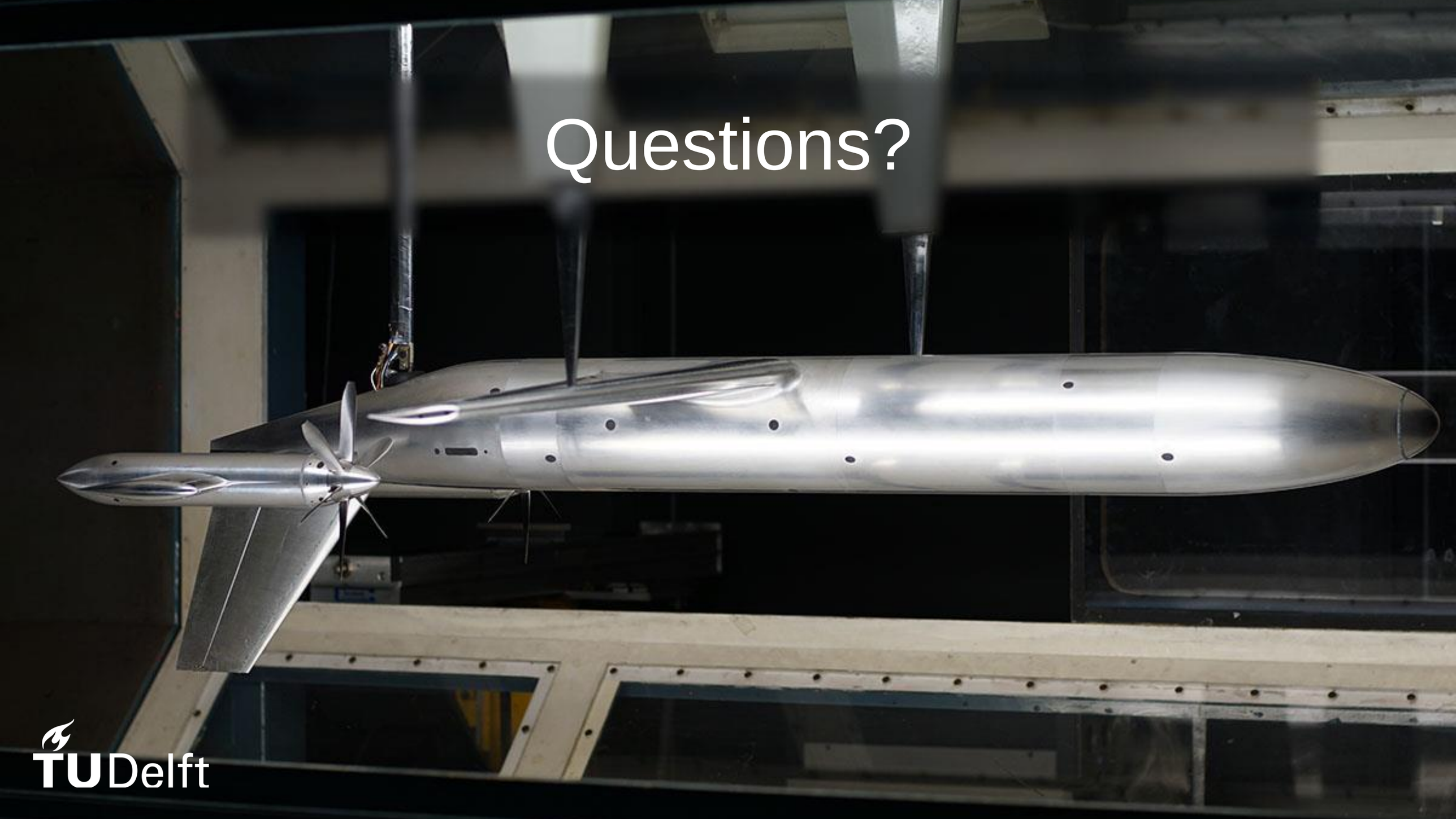
Fernanda Monteiro

Aaron Sequeira

Tomas Sinnige

Further Information

- Lab exercise video (Brightspace)
- Lab-exercise manual (Brightspace)
- Brightspace discussion board
- **It is important to read carefully the manual as soon as possible**


Questions?