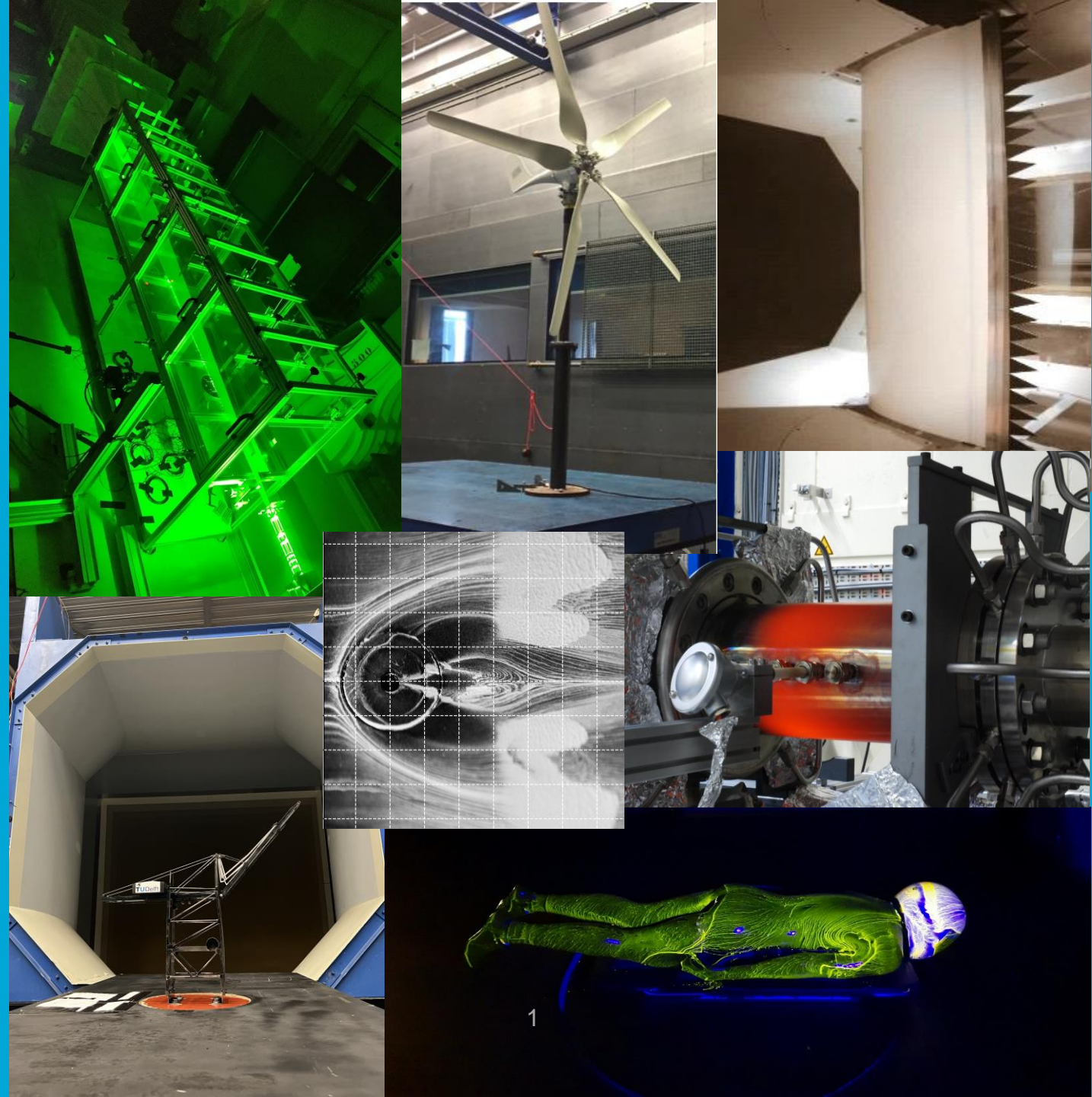


10 November 2023

Administration of Wind Tunnel Facilities at TU Delft

Lessons learned over the past 10 years

Dr. Andrea Sciacchitano



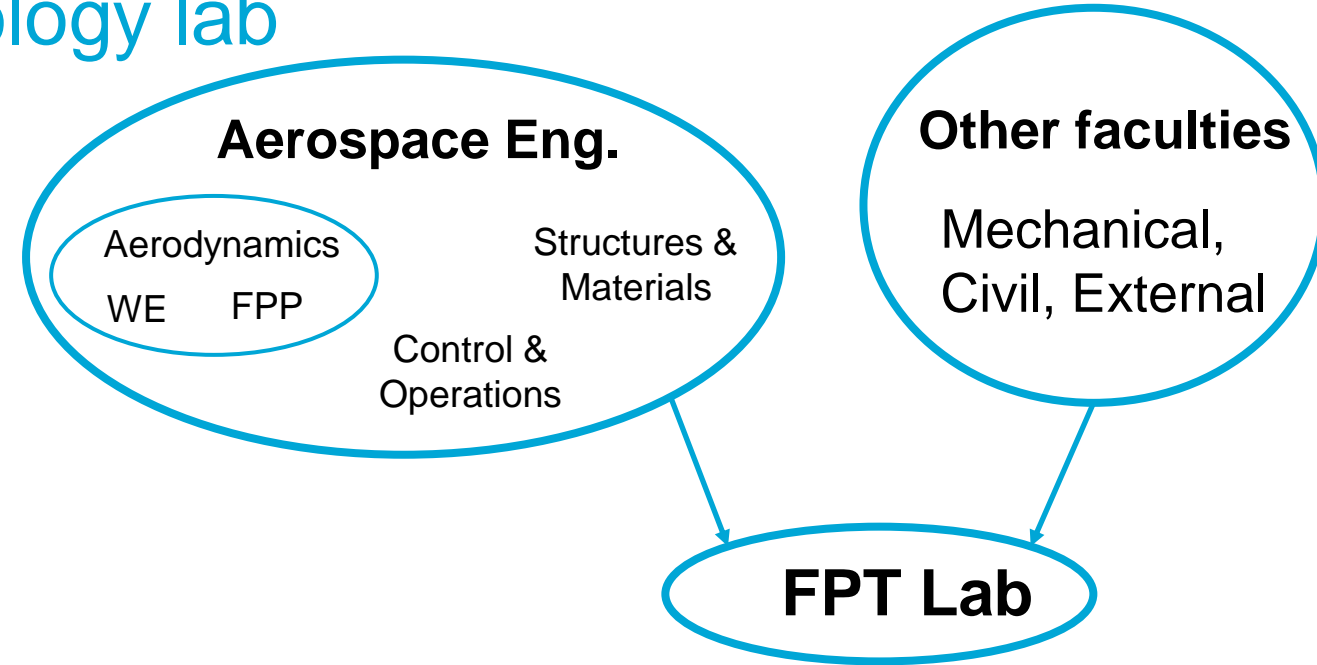
The Flow Physics and Technology lab

Two locations:

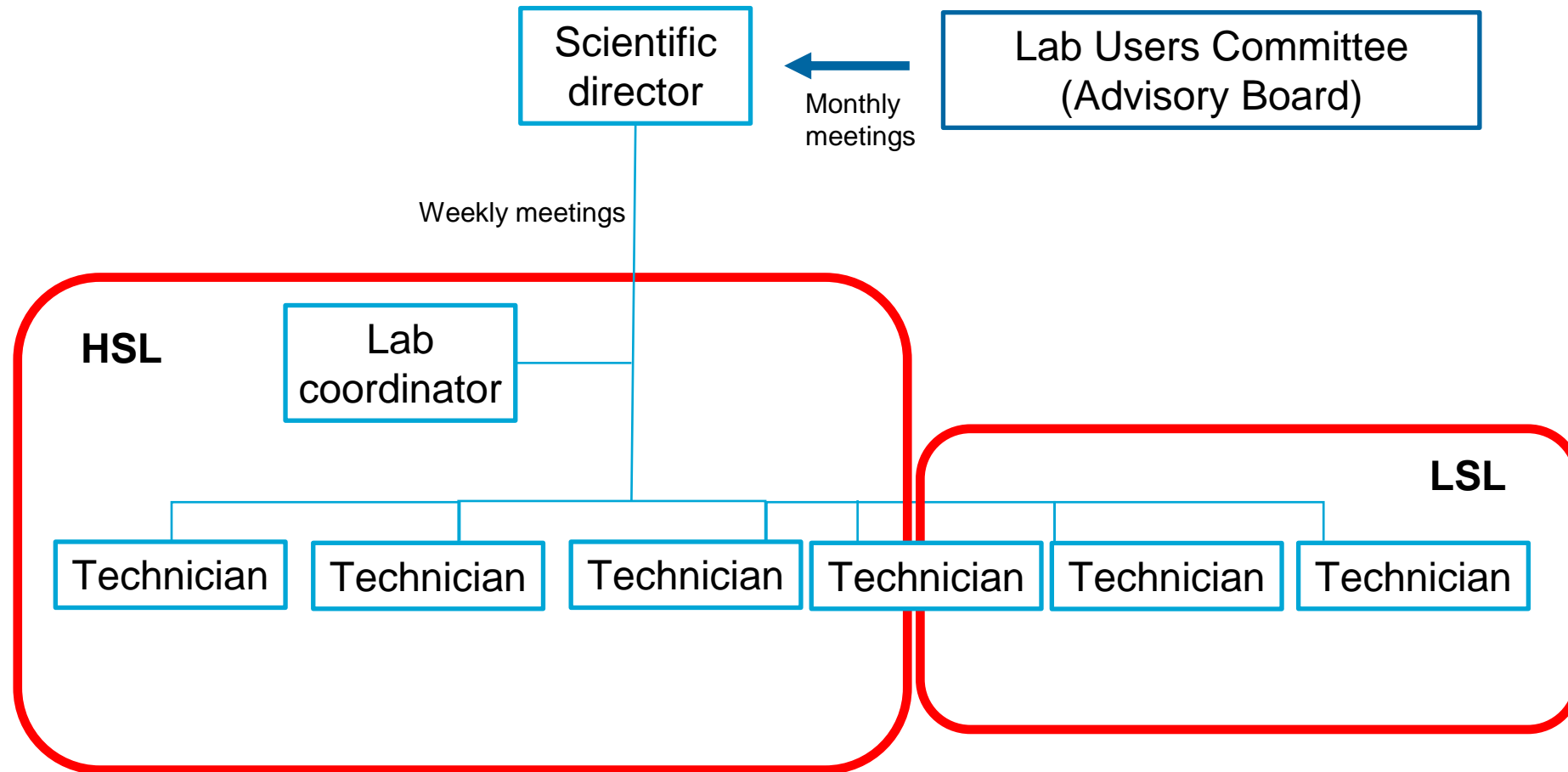
- High-speed laboratory
- Low-speed laboratory

Some numbers:

- 1 scientific director
- 7 technical staff
- 30+ scientific staff, 45+ PhD students
- 10 wind tunnels, clean combustion lab, P&P lab
- 5 practicals



The Flow Physics and Technology lab



Facilities

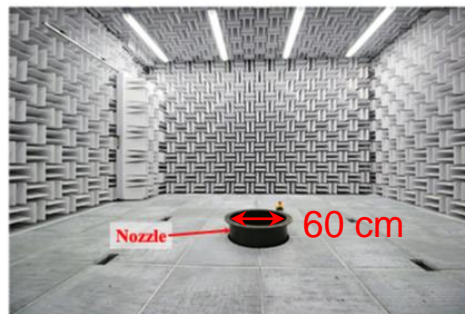
Low speed wind tunnels:

- **Low turbulence tunnel (LTT)**
1.25 x 1.80 m², 120 m/s max
- **Open jet facility (OJF)**
2.85 x 2.85 m², 30 m/s max
- **A-tunnel**
0.6 m diameter, 45 m/s max, anechoic
- **W-tunnel**
0.4 x 0.4 m² to 0.6 x 0.6 m² 35 m/s max
- **M-tunnel**
0.4 x 0.4 m², 35 m/s max
- **SLT**
0.6 x 0.9 m², 50 m/s max



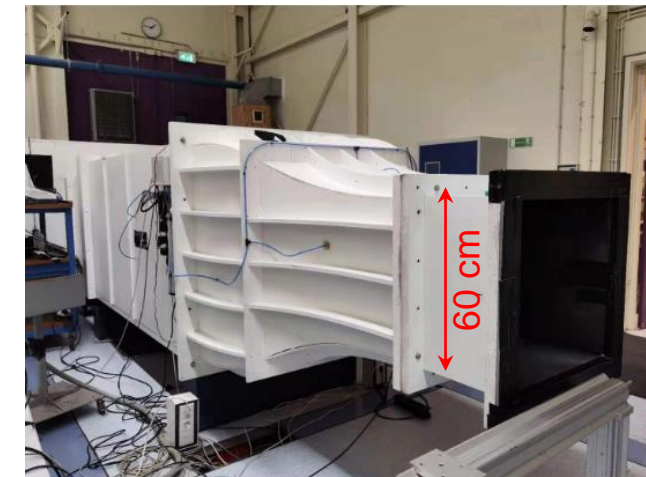
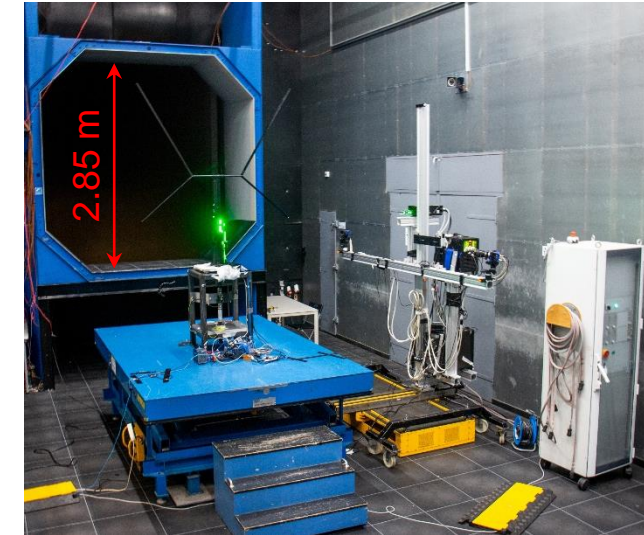
High speed wind tunnels:

- **TST27**
0.27 x 0.28 m², M = 0.3 – 4.2
- **ST15**
0.15 x 0.15 m², M = 1.5 - 3
- **ST3**
0.03 x 0.03 m², M = 2
- **HTFD**
0.350 m diameter, M = 6 -10



Other:

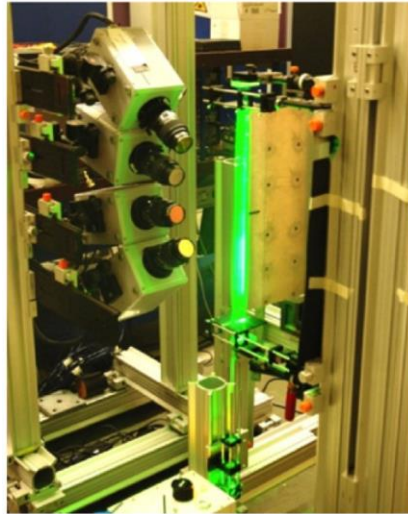
- Combustor
- ORCHID
- ASTER
- Compressor
- Miscellaneous setups



Equipment and Measurement Techniques

Particle Image Velocimetry

- Low-speed (Hz)
- High-speed (kHz)
- 2D (planar, stereo)
- 3D (tomo-PIV and LPT)
- Large-scale PIV
- Robotic PIV



Hot wire anemometry

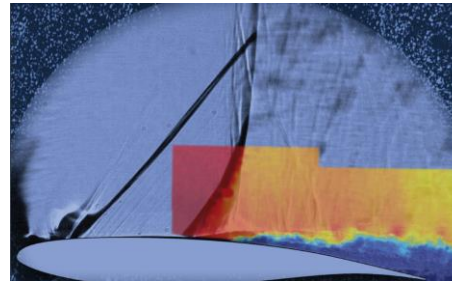
- 1C and 2C

Force balance

- 3C 50 N
- 6C 250 N in x, 3500 N in z

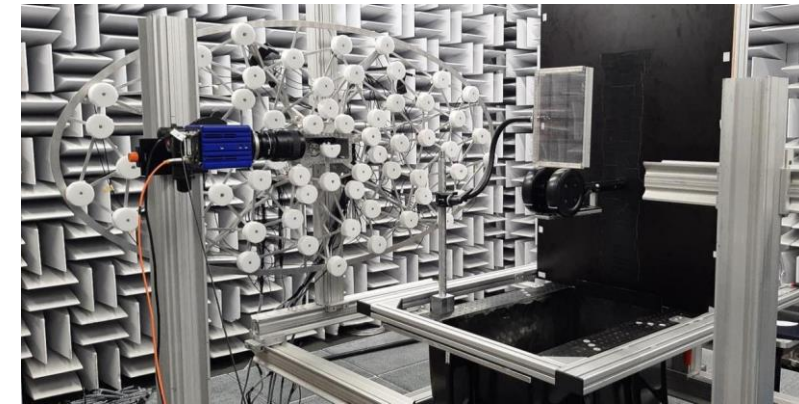
Pressure measurements

- Pressure sensors from 160 Pa to 16 kPa



Acoustics

- Microphone array



Other

- Infrared thermography
- Schlieren/Shadowgraphy
- Oil flow visualization
- Smoke flow visualization
- Traversing systems



Planning and Reservations

10 years ago

Whiteboard at the coffee corner



Pros

- Accessible to everybody;
- Very easy to make/update reservations.

Cons

- No control of the reservations;
- Possibility of mistakes/double bookings;
- No track of changes;
- People sometimes modifying reservations of others.

Planning and Reservations

3 years ago

Excel sheet

			Week Number	January 52	January 1	January 2	January 3	January 4	February 5	February 6	February 7	February 8	March 9	March 10	March 11
			Week	52	1	2	3	4	5	6	7	8	9	10	11
			Date	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F	M T W T F
Planner Triagram, Project Nr. Description	Applicant, Supervisor	Applicant contact data		1	3	10	17	24	31 1	7	14	21	28 1	7	14
FDD Drag measurem. of testplates with chevrons			Julio Carrasco Grau/Olaf/Ferry+4917657863340												
Plasma Room															
HSL															
OJF (tunnelhall 4)															
Planned Maintenance															
Drones	Bart Remes	015 27883707													
Dare	Esmee Menting														
Eco-runner	Martijn Kanger	+31 (0) 6 30763014													
Op 1	Sebastiaan Mulders	06 5573 6149													
W-Tunnel (Tunnel Hall 3)															
Planned Maintenance															
FDD Drafting effects in skating, scaled model	Wouter Terra/Sciacchitano	0624660025													
FDD Cylinder-foil aeroelastic regimes L1810	A. Paranjape/Andrea, Gabriel	0613933778													
FDD Folding Wingtip HOMER L01810	Christoph Mertens/Andrea	0619942692													
FDD TBL resonators for passive flow control	Renko Siebels/Giulio/Woutijn	0626315031													
FDD Open-loop flow control with wall-normal jets	Giulio Dacome/Woutijn/Mario	0650565312													

- Managed by technicians
- Reservations by sending email or talking to technicians

Pros

- Read access to everybody;
- Write access to only a few people (technicians);
- Planner stored in the cloud (data cannot be lost).

Cons

- Possibility of double-booking of equipment

Planning and Reservations

Now

Online tool



	Monday, 10/30/23	Tuesday, 10/31/23	Wednesday, 11/1/23	Thursday, 11/2/23	Friday, 11/3/23	Saturday, 11/4/23	Sunday, 11/5/23	Monday, 11/6/23	Tuesday, 11/7/23	Wednesday, 11/8/23	Thursday, 11/9/23	Friday, 11/10/23	Saturday, 11/11/23	Sunday, 11/12/23	Monday, 11/13/23	Tuesday, 11/14/23	Wednesday, 11/15/23	Thursday, 11/16/23	Friday, 11/17/23	Saturday, 11/18/23	Sunday, 11/19/23	Monday, 11/20/23	Tuesday, 11/21/23
12:00 AM		12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM	12:00 AM
1) Facility outside Labs																							
1) LTT	Ferry Schrijer Dynamic stall														Ferry Schrijer 2nd year wind tunnel practical AE2130-II								
1) M tunnel																							
1) OJF	Delphine De Tavernier FloaTech		Wouter Terra NOC*NSF: Sailing garments and posture								Axelle Viré Floating Renewables Lab - Hybrid testing for wind turbine												
1) TST 27	Alessandro D'Aguanno Schlieren campaign FFAW3211 Abhyuday							Alessandro D'Aguanno TUPLE - PIV															
1) W tunnel	Woutijn Baars Wall-normal vorticity with flow separation														Max Knoop Characterization experiment spanwise running belts								

- Reservations done via the online tool
- Two facility-responsible persons (scientific staff) approve the reservations or provide feedback

Pros

- Easy to perform reservations and select equipment via drop-down menu;
- Control of soundness of the reservation by scientific staff members;
- Planner stored in the cloud (data cannot be lost);
- No possibility of double booking;

Cons

- Limited number of licenses (50)
- Requires contact with the tool developers to make changes in the graphics

Centralized info on facilities and equipment

TU Delft Wiki

Welcome to the Experimental Wiki

In this wiki, experimental hardware and procedures are presented. In the following sections have been created:

- [TunnelsWiki](#)
- [PIVsystemsWiki](#)
- [HwaWiki](#)
- [SchlierenShadowBOSWiki](#)
- [InfThermWiki](#)
- [WorkshopWiki](#)
- [PressMeasWiki](#)
- [BalancesWiki](#)
- [AcousticMeasurementWiki](#)

Welcome to the PIV system Wiki

Large scale systems

- [HfsbFluidSupplyUnits](#)
- [Robotic Volumetric PIV System](#)

Acquisition

- [Photron Fastcam Cameras](#)
- [sCMOS Camera](#)
- [Bobcat Camera](#)
- [16 Mpix Camera](#)

Illumination

- [LED Units](#)
- [Quantronix \(High-Speed Laser\)](#)
- [MESA-PIV](#)
- [Evergreen](#)

PIV Processing

- [PIV Servers](#)

Davis Manuals

- [Davis Manuals](#)

PIV high speed acquisition system

In this page an overview on how to connect the Photron Fastcam Cameras for PIV acquisitions will be given. In order to complete the connection the following systems, which will be described further on, are required:

- Photron Fastcam Camera/s
- High Speed Controller
- Gigabit Switch
- High Speed Acquisition PC

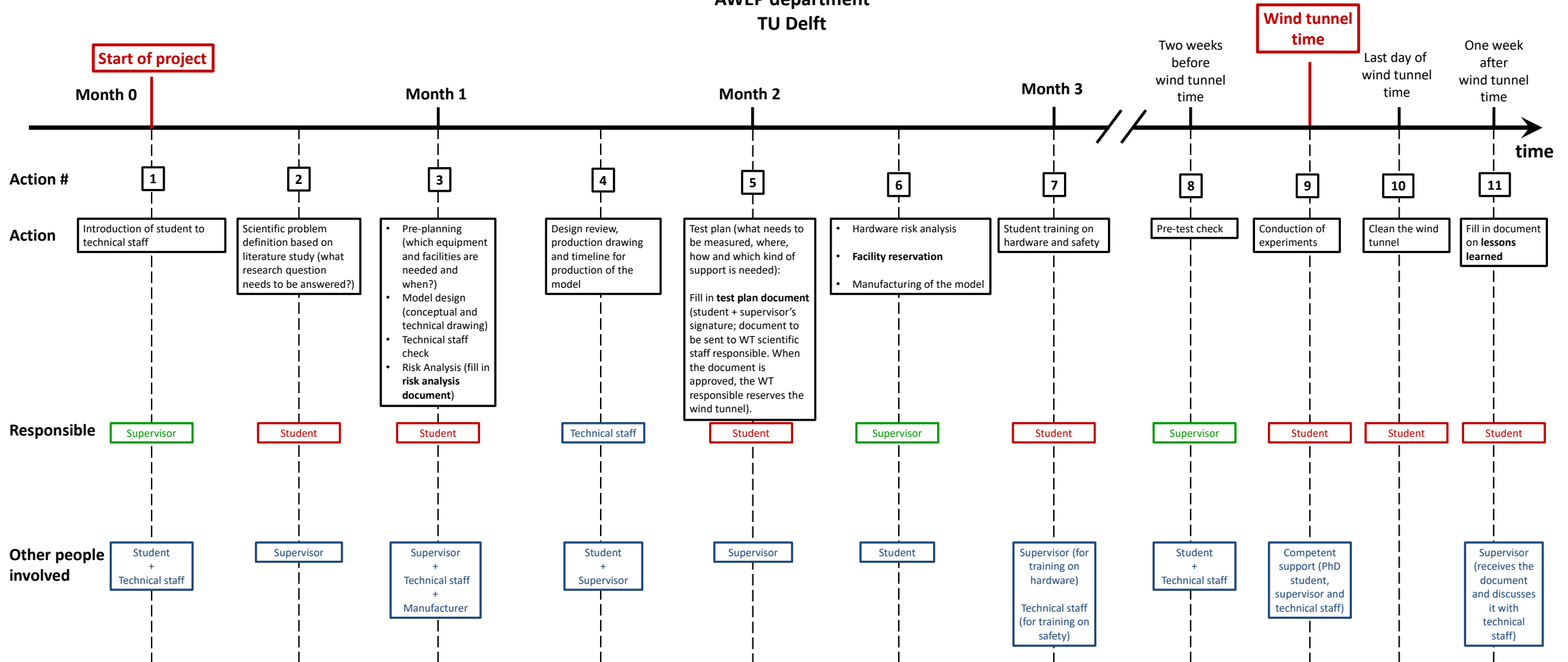


Figure 1: Photron Fastcam Camera (left) with rear view (right)

General properties of the camera

Photron Cameras (Figure 1) are high speed cameras with a sensor of 1024 x 1024 pixels and a pixel size of 20 x 20 μm . The maximum frequency of acquisition at full resolution is 5400 Hz, with the possibility of increasing it even further, by cropping the sensor of the camera. The Photron Camera has two acquisition modes: single pulse mode and double pulse mode (necessary for high speed flows as in transonic or supersonic applications). In single pulse mode the time separation between the two pulses of the camera can be selected as small as 1 μs .

Experiments Planning Time-line AWEP department TU Delft



Open issues

Mainly related to too many and diverse users

- How to ensure proper planning / safety of all experiments?
- How to ensure proper usage and storage of equipment?
- How to handle malfunctioning/broken equipment?

Conclusions

- Shared use of facilities and equipment among many users is a challenge
- Use of “professional” online tools for reservations and sharing information may be helpful
- Communication among the lab users is the key!

Thank you for your attention

Questions?