

On the Land, Air and Sea:
Recent Applied Aerodynamics Experiments at the
University of Southampton facilities

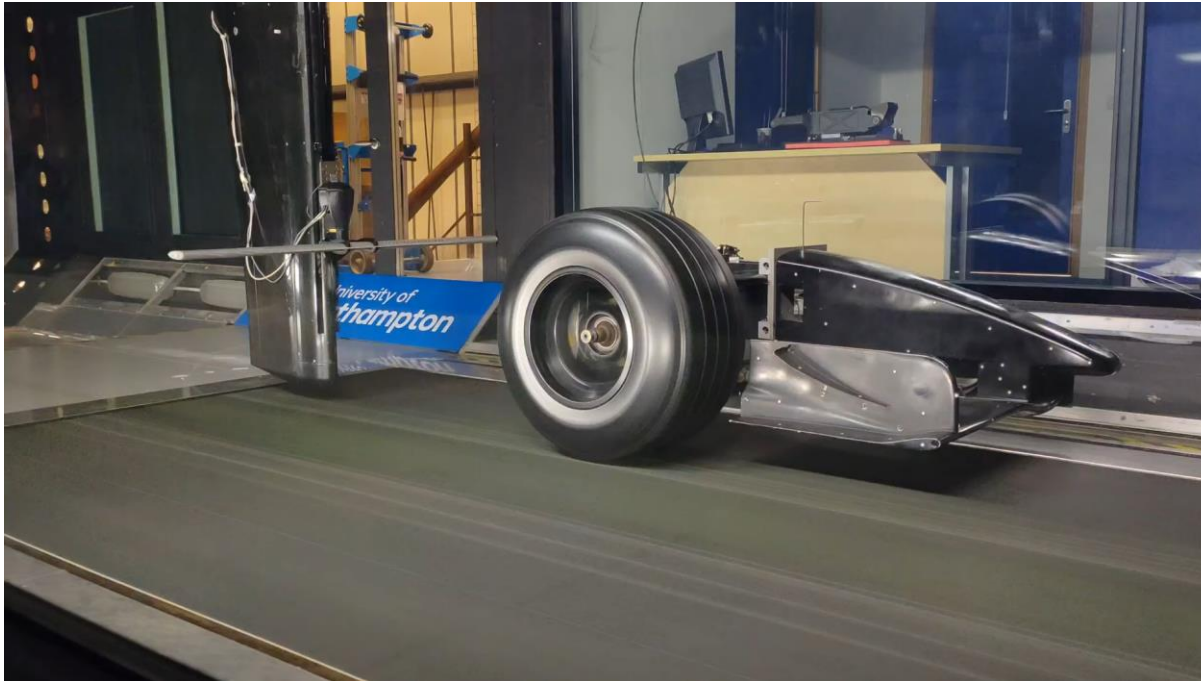


Dr Renan F Soares, B17, RJ Mitchell Wind Tunnel

For the Land

Full-scale F1 legacy setup

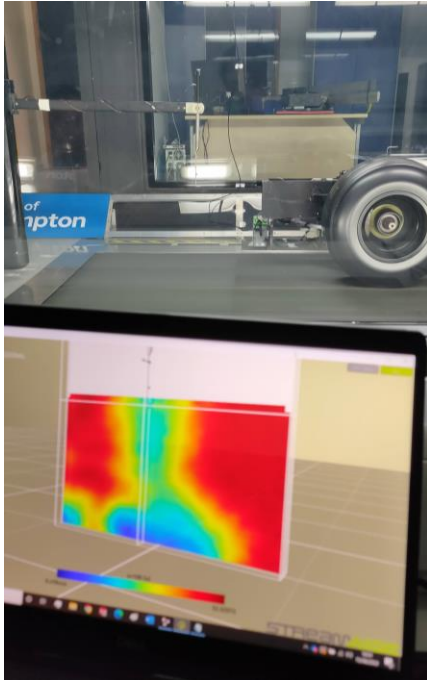
Wheel wake mapping – Linear pressure rake



- Linear Pressure Rake:
53 stagnation probes
- 30 m/s (freestream and moving ground)
- Support strut automated into the crossflow plane (2D remote motion)

Full-scale F1 legacy setup

Wheel wake mapping – 5-hole probe (pressure and 3D velocity properties)

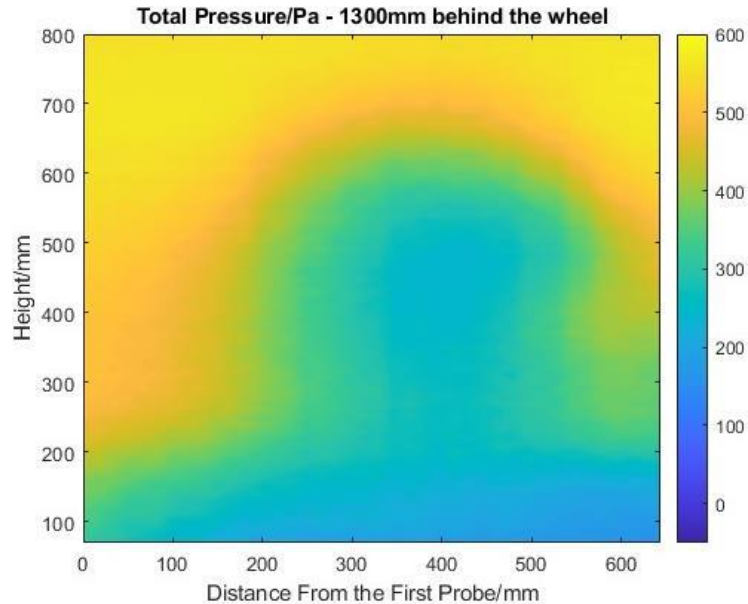


- ProCap system:
5-hole probe with
motion tracking
- Both pressure and
converted 3D velocity
vector mapping.
- Ideal for qualitative
analysis prior more
accurate methods.

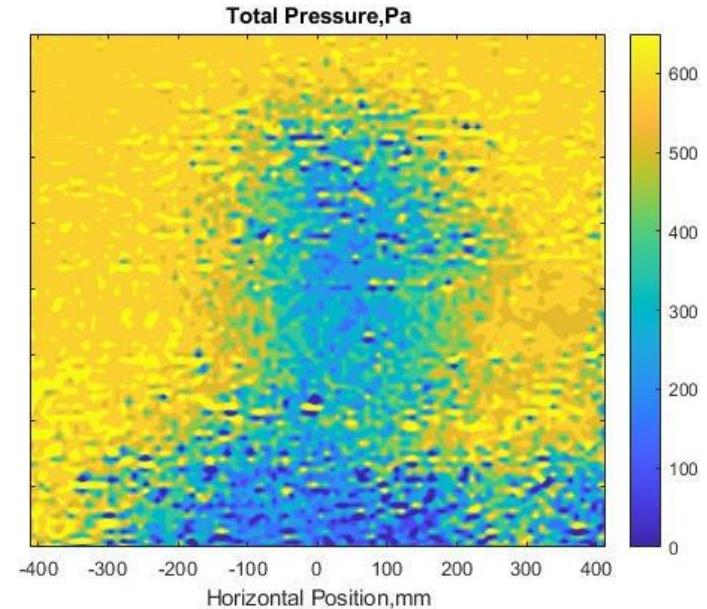
Full-scale F1 legacy setup

Wheel wake mapping – Experimental methods assessment

Pressure rake

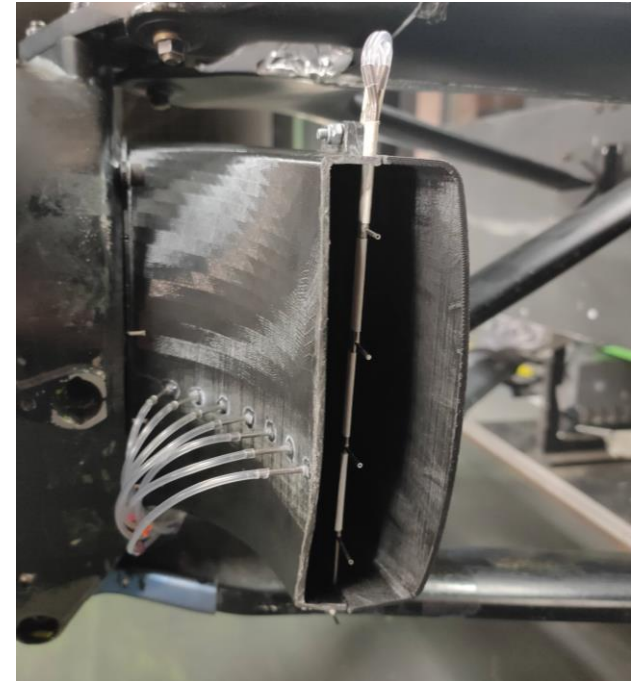
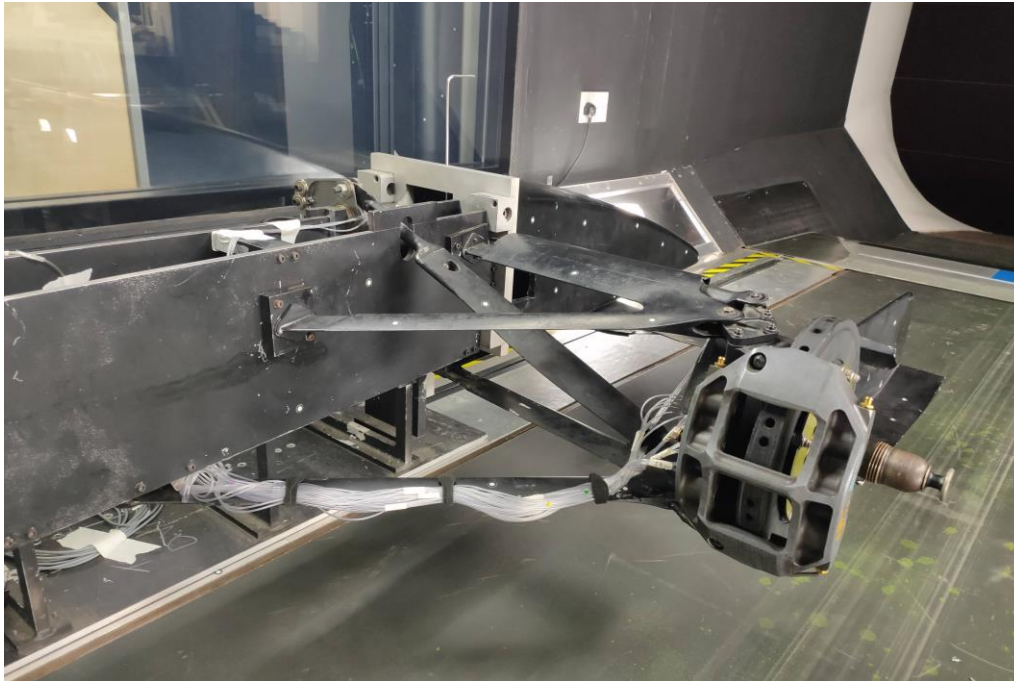


ProCap



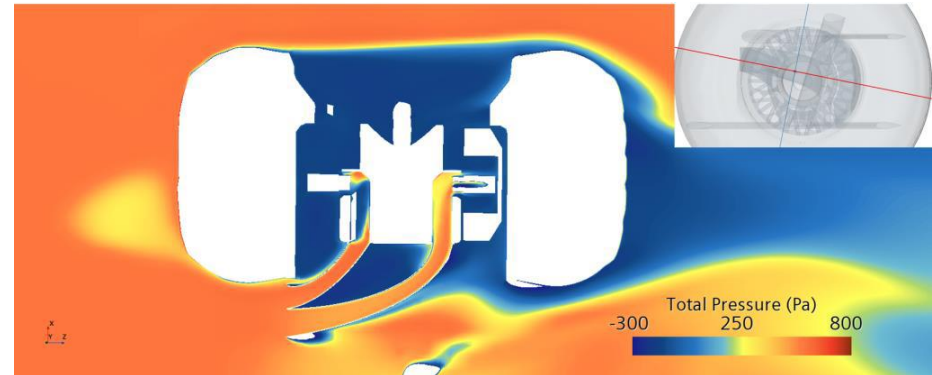
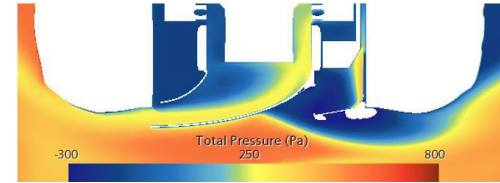
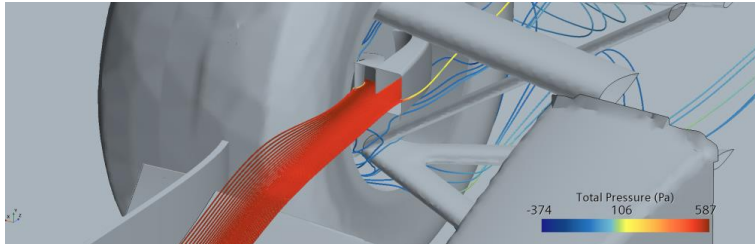
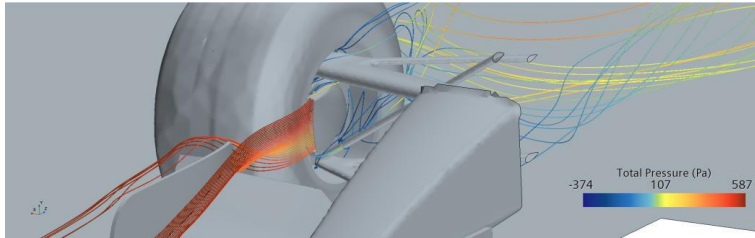
Full-scale F1 legacy setup

Brake cooling intake – Experimental flow analysis



Full-scale F1 legacy setup

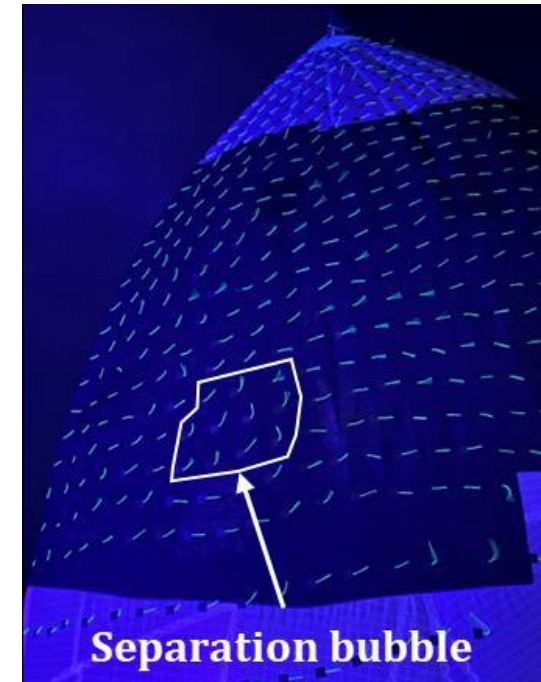
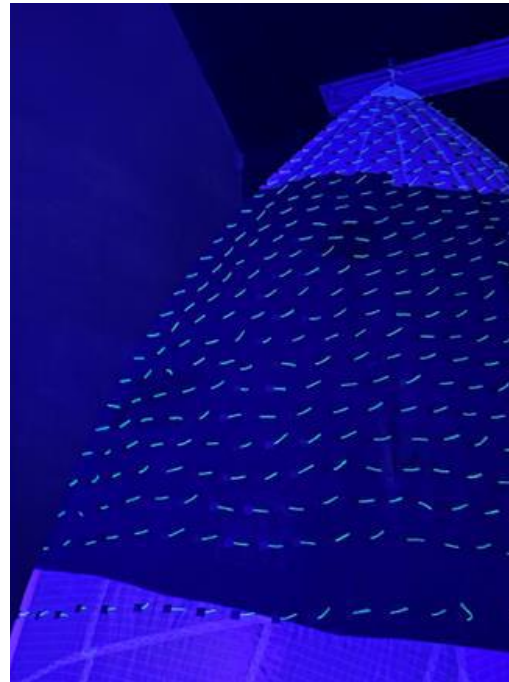
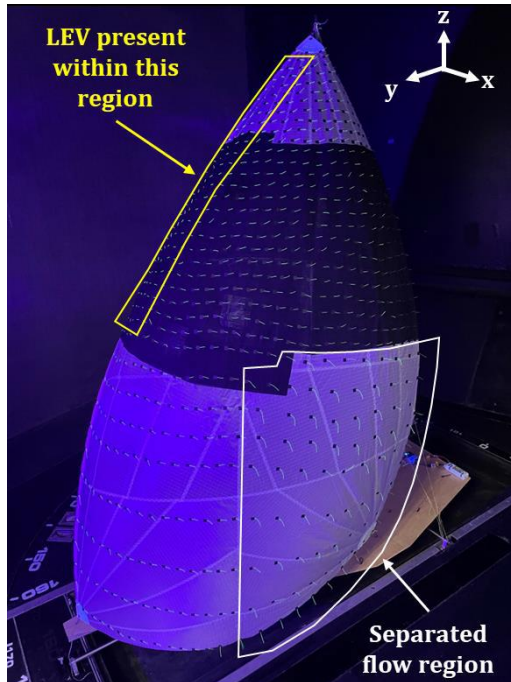
Brake cooling intake – Experimental-supported CFD design



For the Sea

Experimental Methods for Flexible Downwind Sails (MSc)

Classical tufts analysis

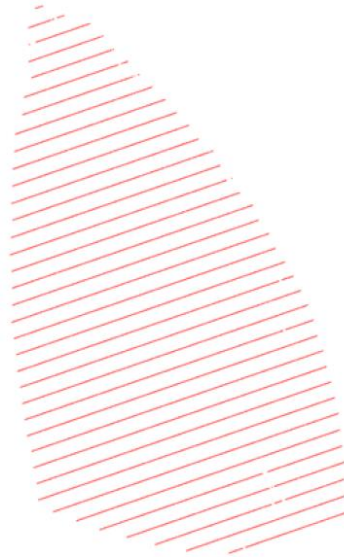


Experimental Methods for Flexible Downwind Sails (MSc)

Real-time geometry by LIDAR



Campaign 1

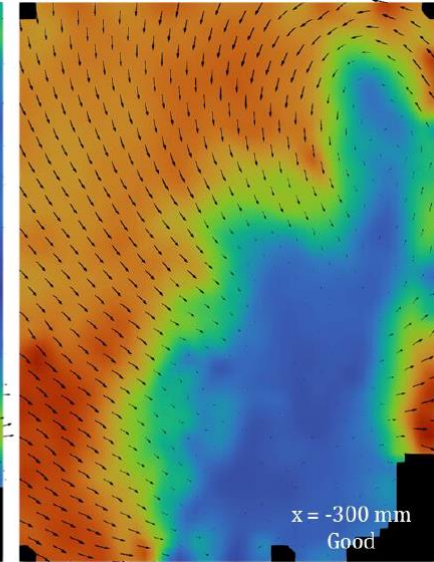
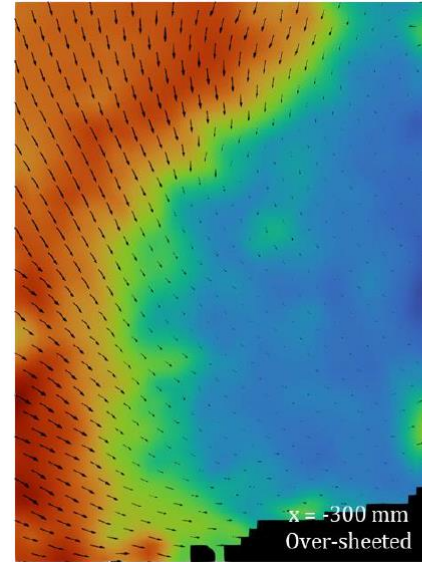
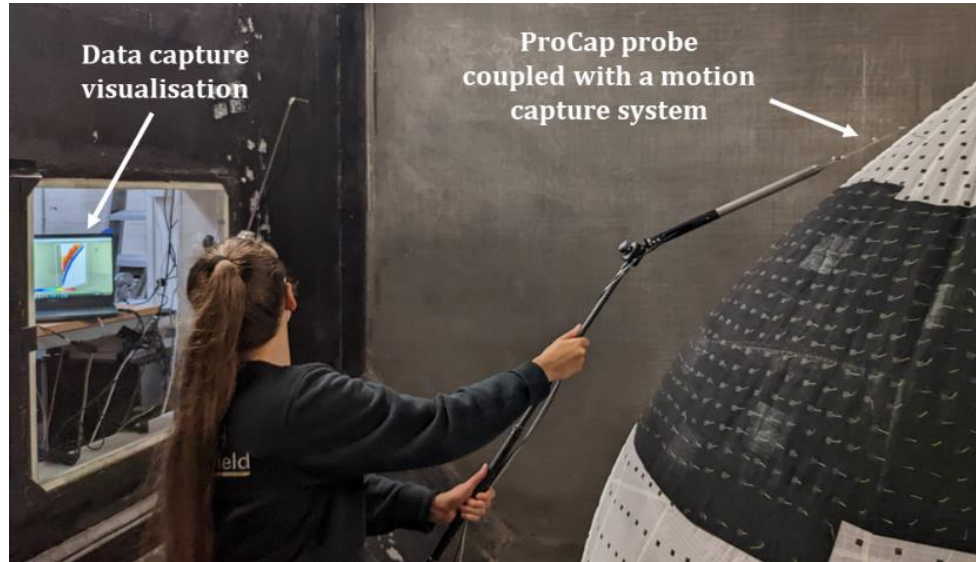


Campaign 2



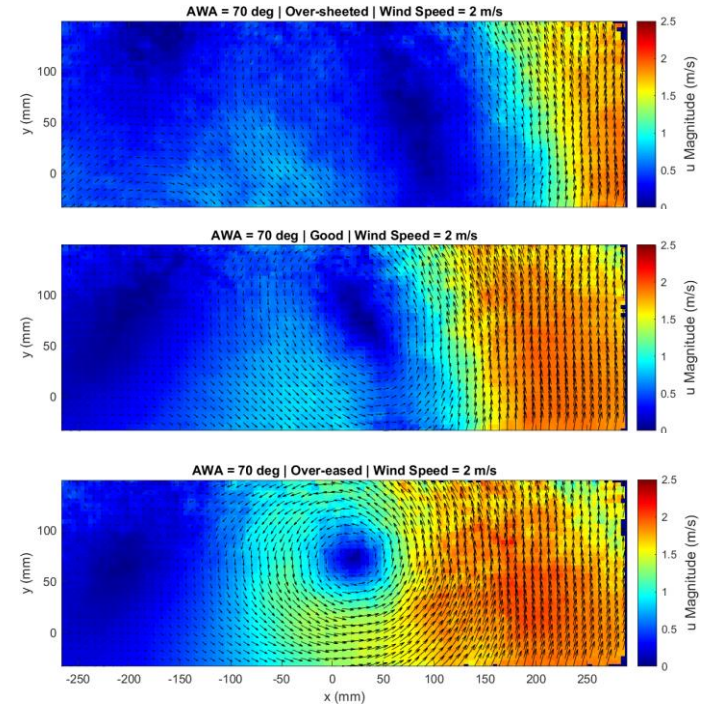
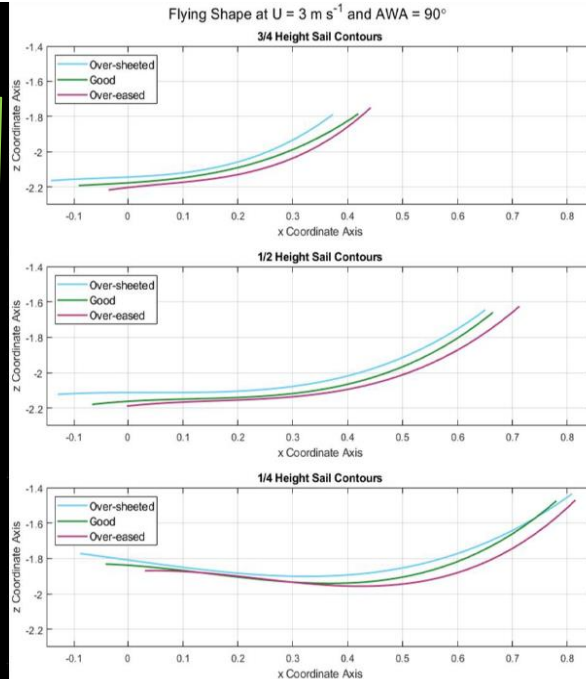
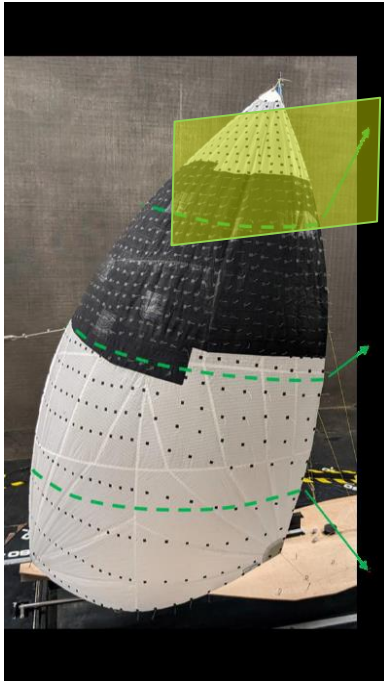
Experimental Methods for Flexible Downwind Sails (MSc)

Flow analysis by 5-hole probe (velocity mapping)



Experimental Methods for Flexible Downwind Sails (MSc)

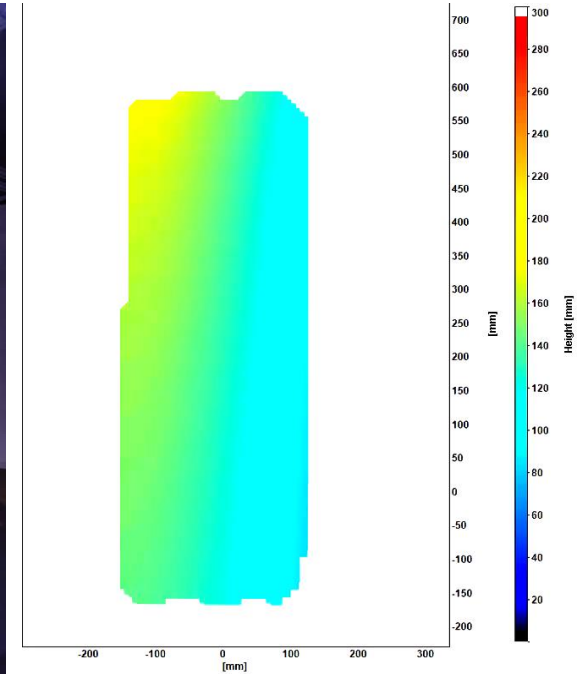
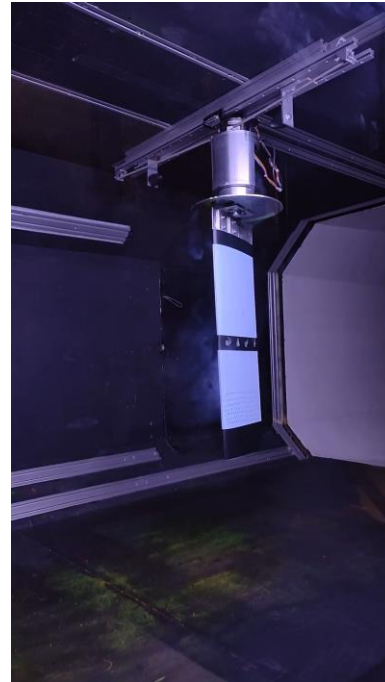
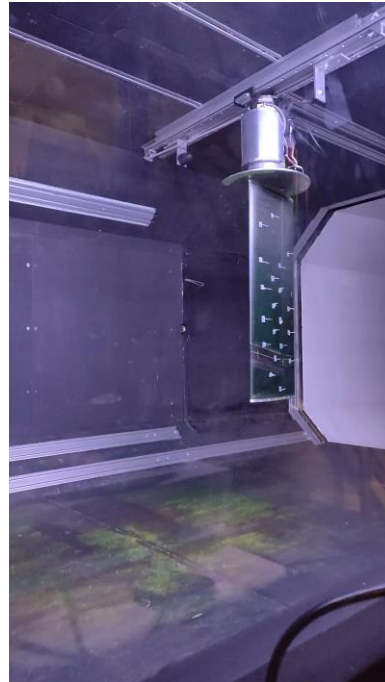
Flow analysis by PIV (velocity mapping)



For the Air

H2020 'Homer' Consortium

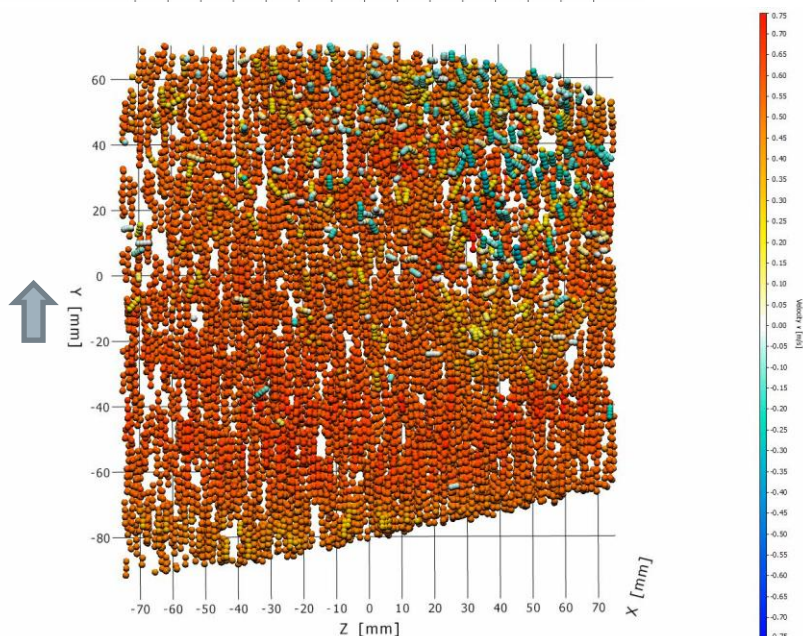
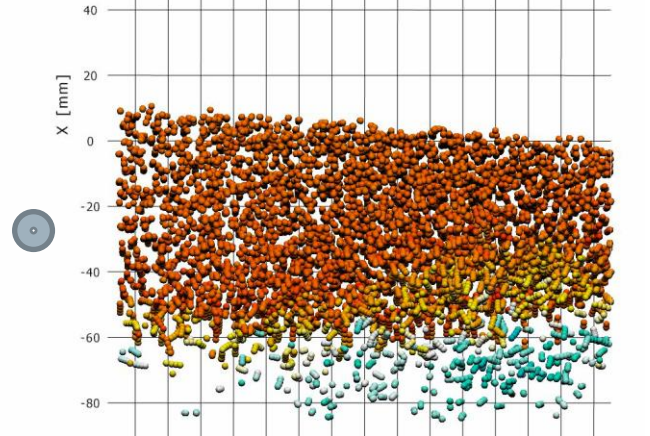
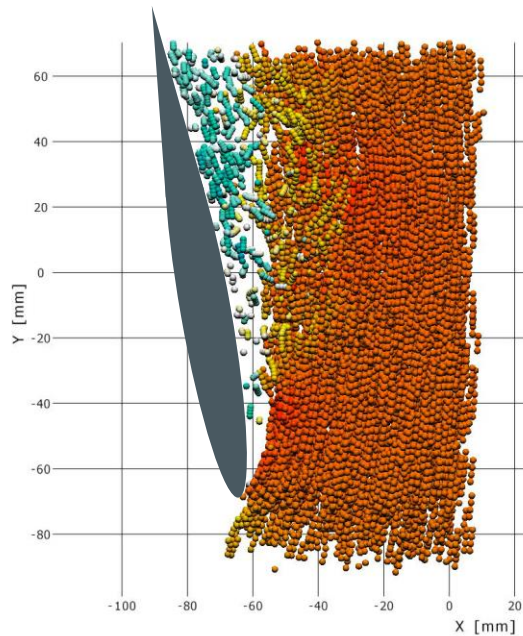
Rigid and flexible wings – Digital image correlation (DIC) method



H2020 'Homer' Consortium

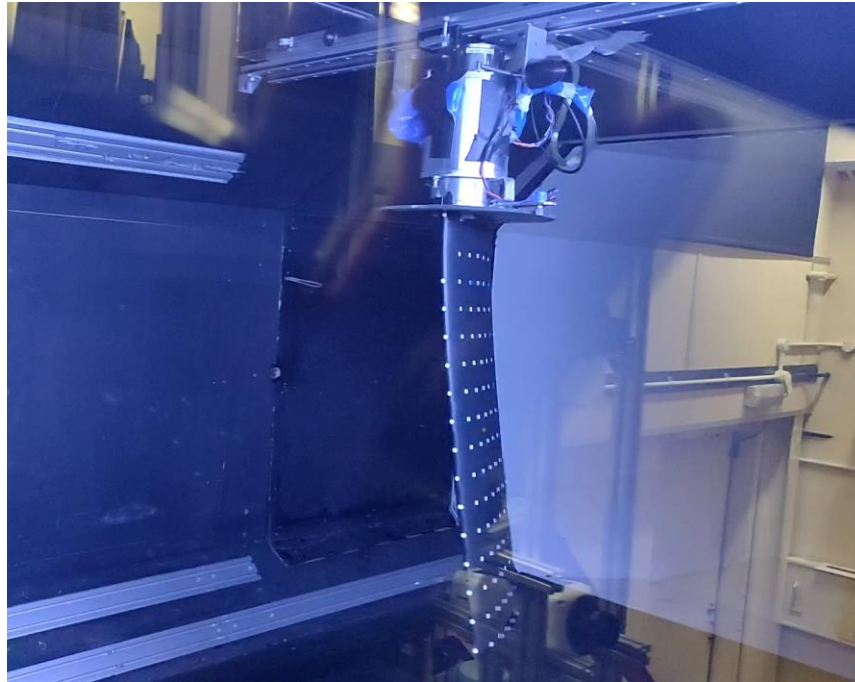
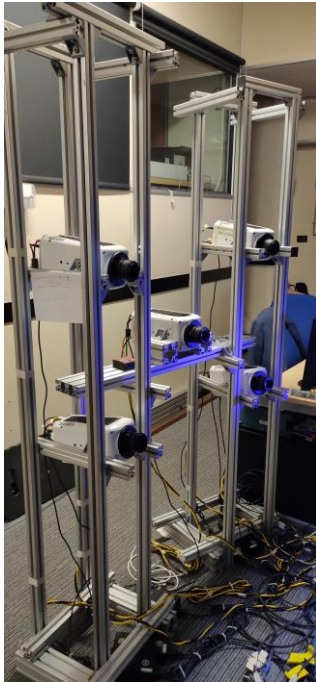
Independent PTV validation project

- NACA0012, 12deg
- Water-medium



H2020 'Homer' Consortium

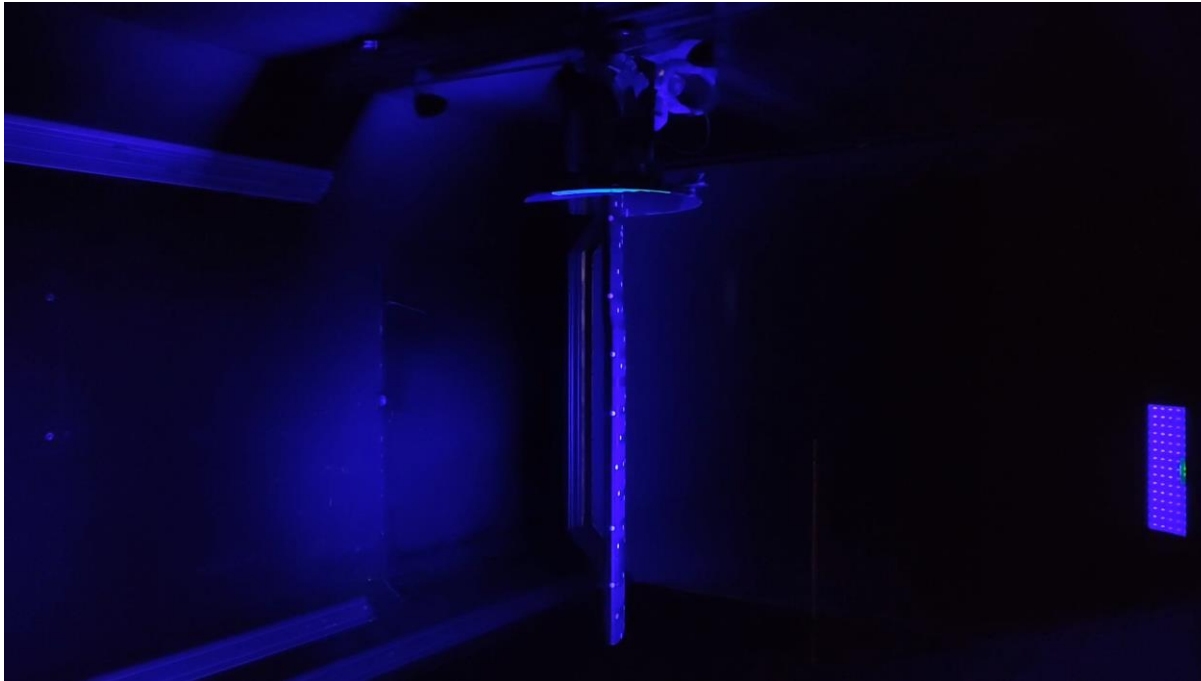
Rigid and flexible wings – PTV method



- Attempt to track both flow and body motion with a non-intrusive technique (PTV).
- Added in-house tracking solutions in heave and pitch motions for validation purposes.

H2020 'Homer' Consortium

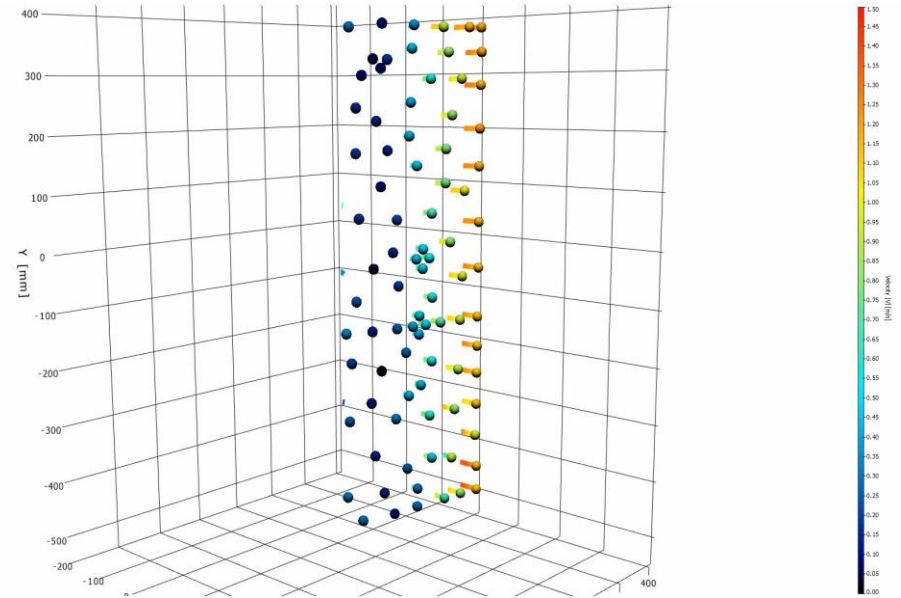
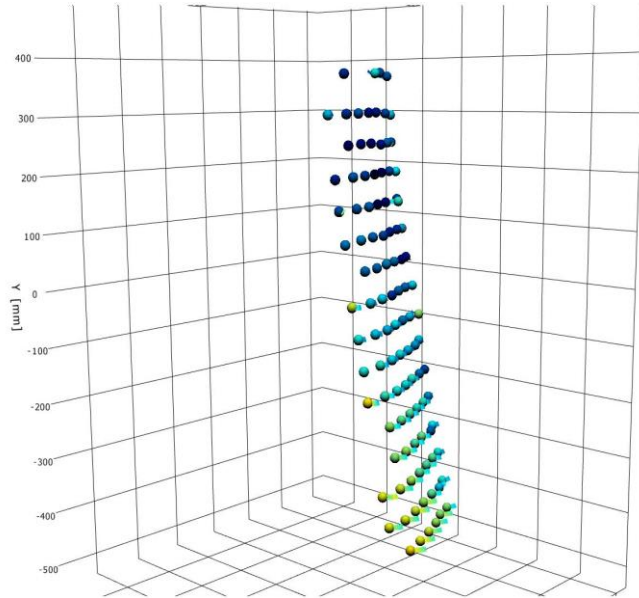
Rigid wing under self-sustained symmetrical LCO



- Finite wing under limit cycle oscillation (LCO).
- Passive self-sustained motion for $9 < U < 14\text{m/s}$

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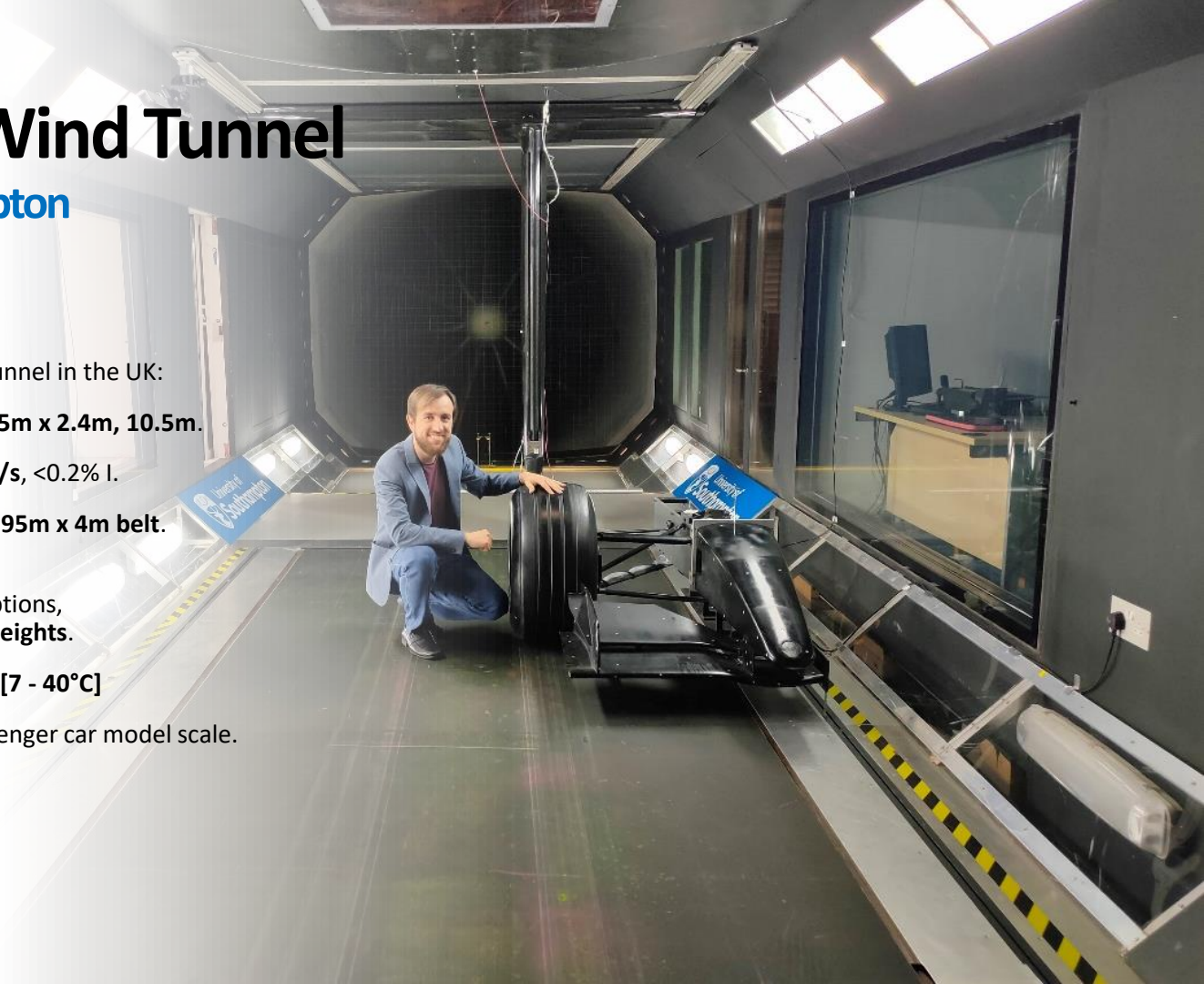
Body motion by PTV

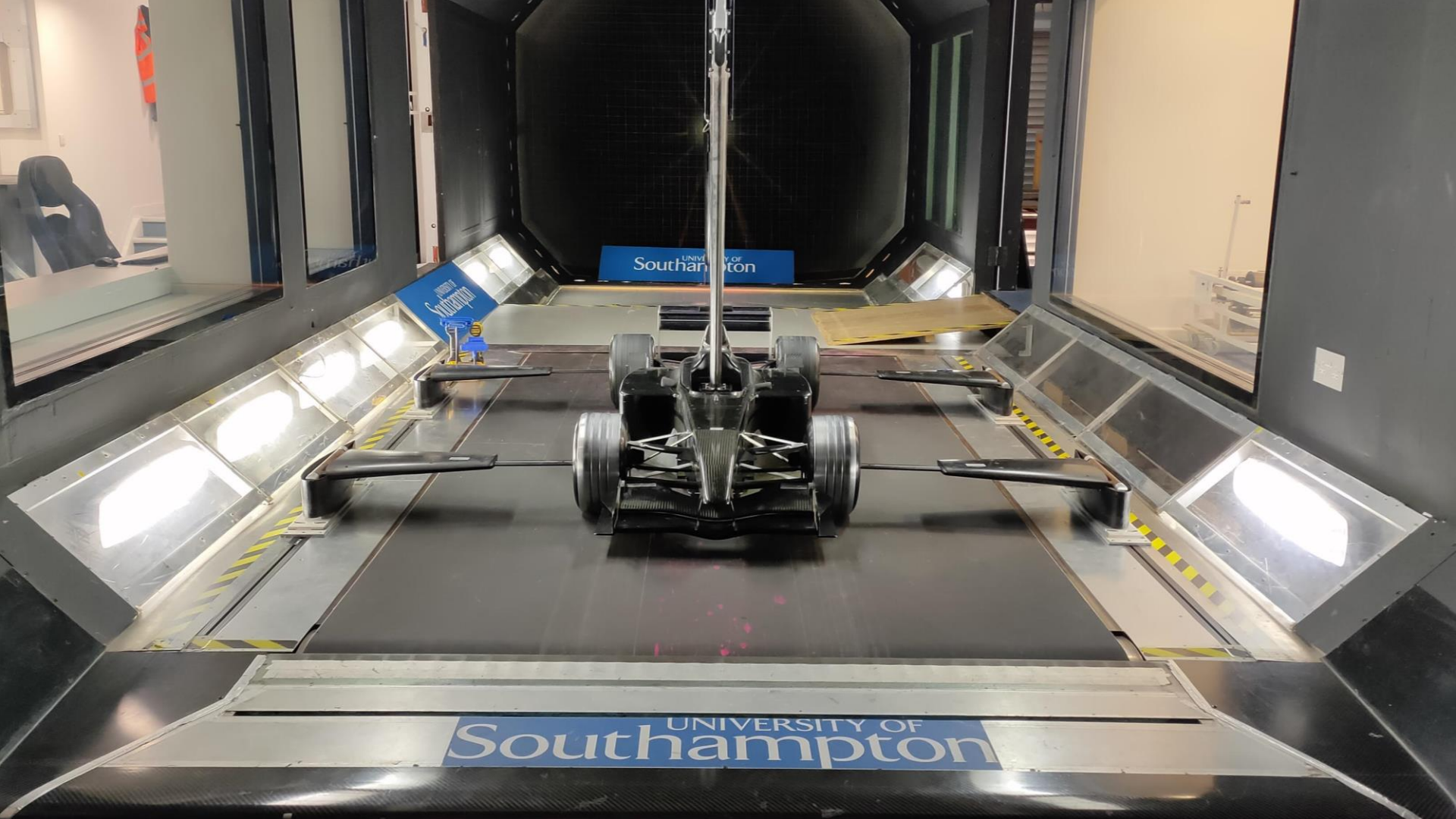


R.J. Mitchell Wind Tunnel

University of Southampton
UK

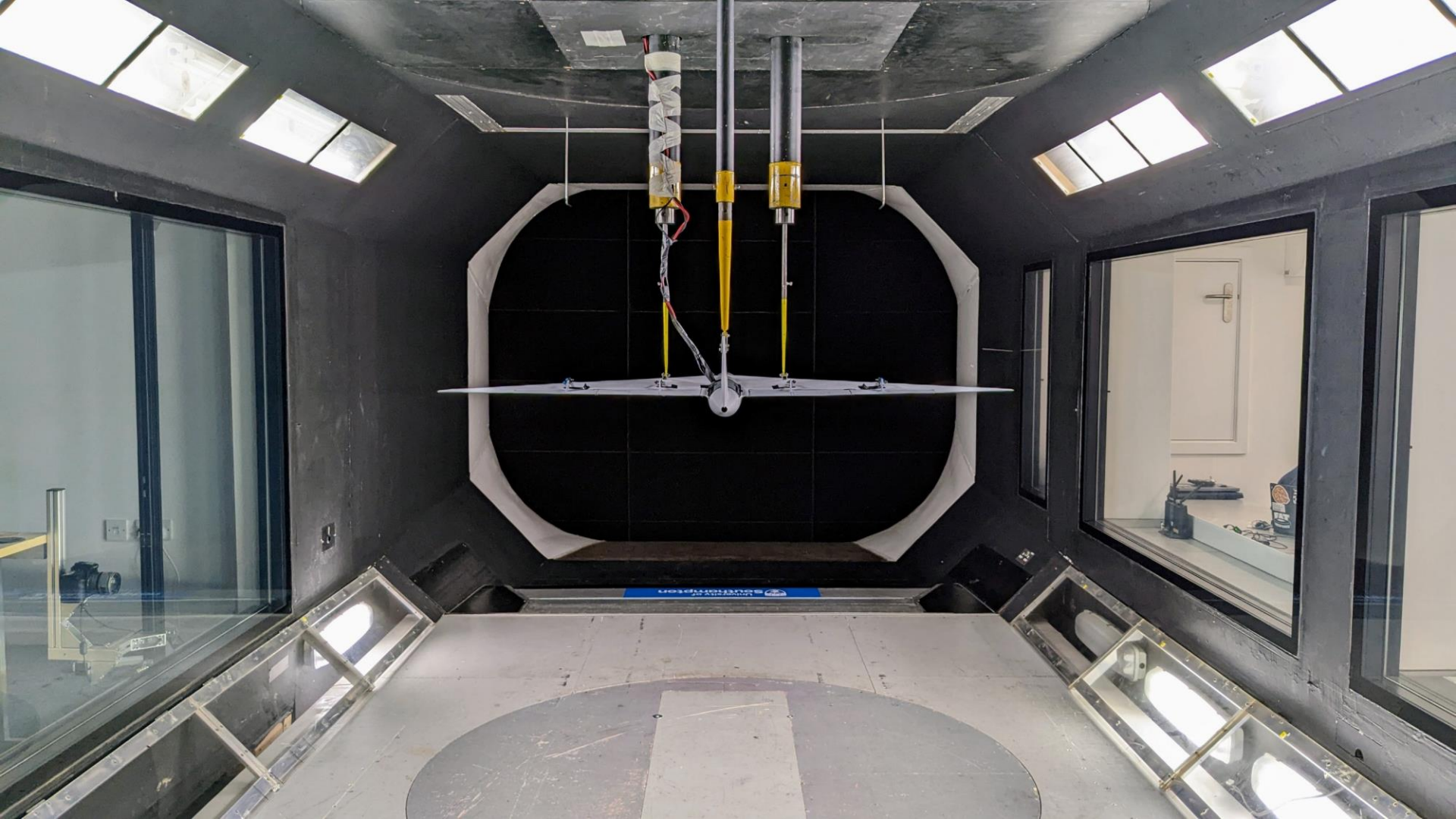
- Largest university-owned wind tunnel in the UK:
 - 11x8[ft] working section: **3.5m x 2.4m, 10.5m.**
 - Wind speed from **4 to 40 m/s**, <0.2% I.
 - Moving ground available: **1.95m x 4m belt.**
- In-model or overhead balance options, **automated yaw angle** and **ride heights.**
- Temperature-controlled system: **[7 - 40°C]**
- Suitable for **up to 50%** race/passenger car model scale.
- Available for commercial use
(approx. **2900 £/day** - excl. VAT)





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Optimising performance. RJ Mitchell Wind Tunnel



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R.J. Mitchell Wind Tunnel

Thank You!

