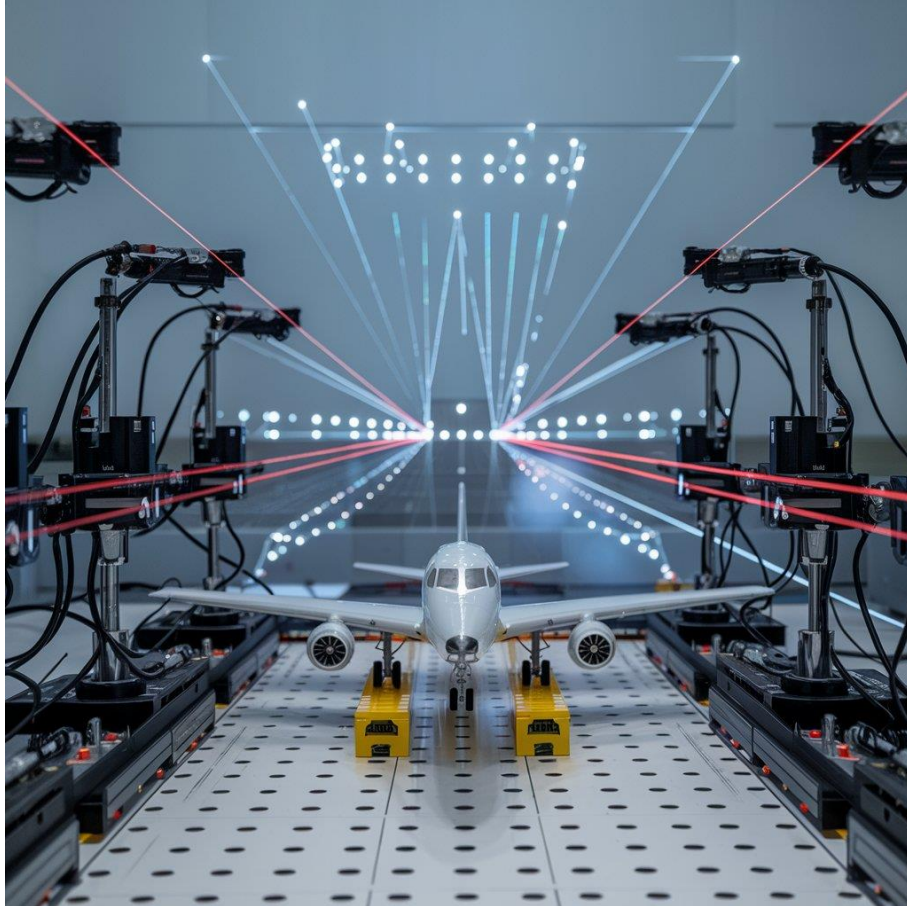


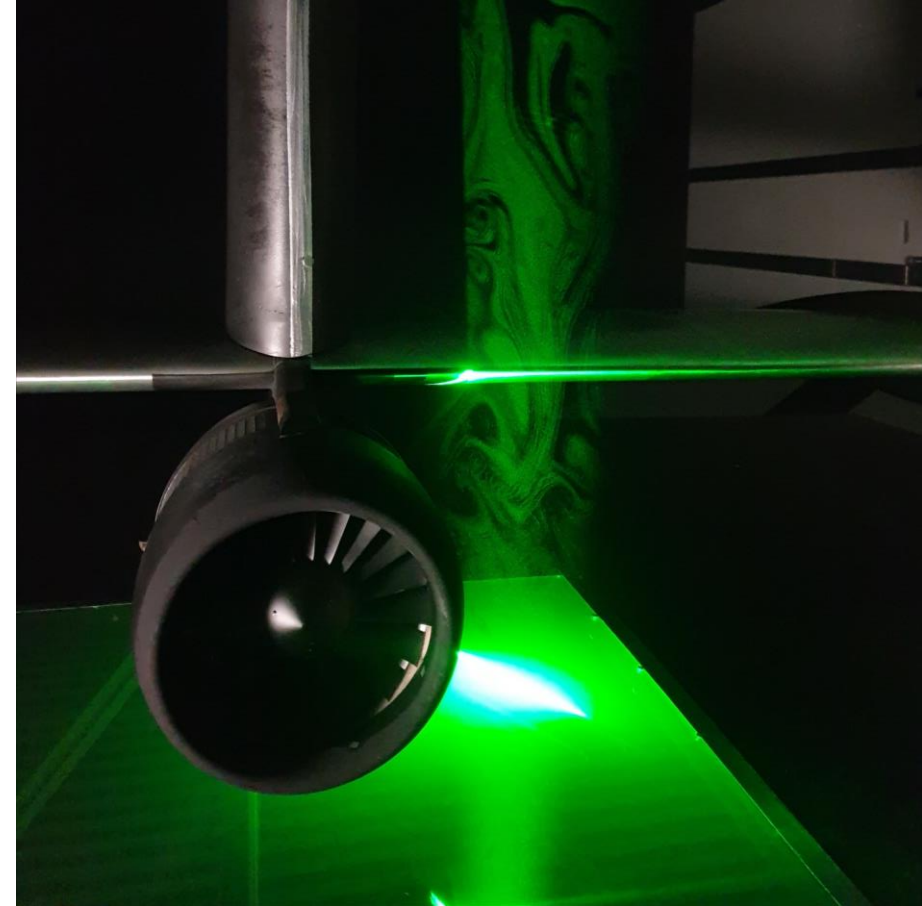
NWTF Optical Measurements Subgroup

Dr Mark Quinn – University of Manchester
Dr David Roberts – Aircraft Research Association

GenAI?



**“Optical aerodynamic
measurements using lasers”**



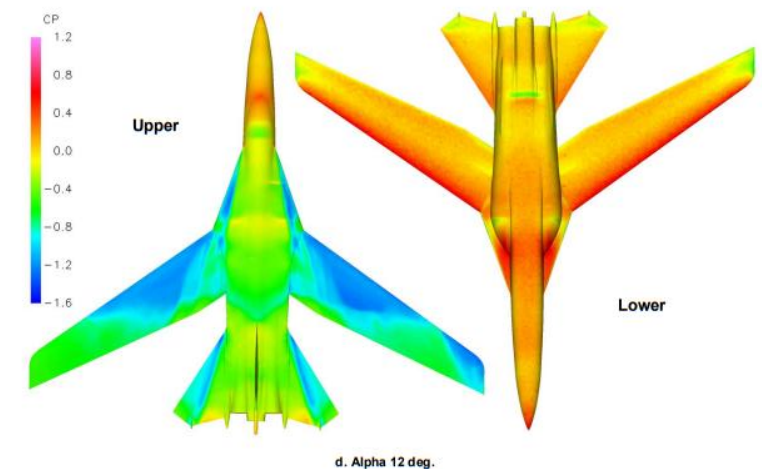
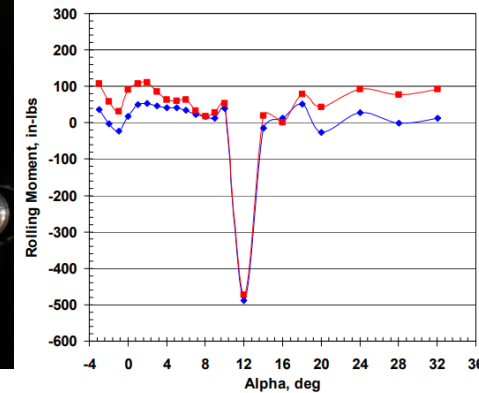
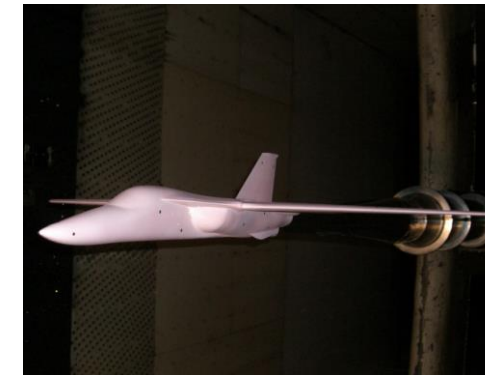
**UoM, ARA, RUAG, RR – CS2
TRUFlow project**

What?

- How to turn TRL3 into TRL6 for measurement capability
 - A turnkey solution that can be used quickly and reliably
 - Collaboration between partners is likely to be the best method!
- Initial meeting in October 2024 at City
- Discussion at Imperial in Jan 2025 focused around:
 - “what industry needs”
 - “what academics are working on”

Industry needs

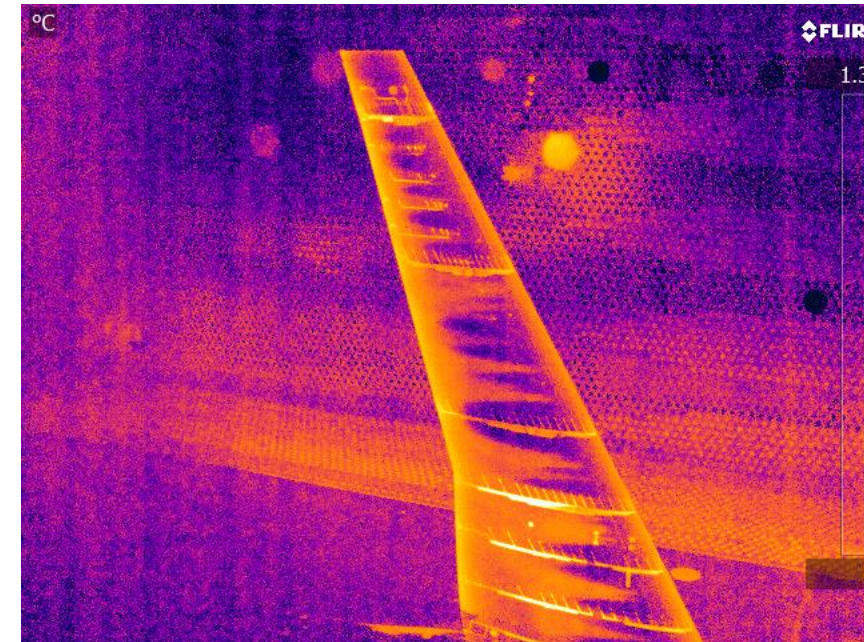
- CFD validation (although what exactly this means is unclear still)
- Full-surface pressure measurements
- High-incidence vortex flows
- Shock-vortex interactions
- Acoustic propagation from jets
- Capability to measure hinge moments
- Rapid and flexible flow visualisation



AEDC 16T Modified F111 PSP test

Industry needs

- Boundary layer characterisation
- Field-based data on- and off-surface
- Dynamic loads on unbalanced parts (stores/panels)
- Streamlined data processing pipeline
- A clearer understanding of uncertainty analysis of field measurements
- Miniature optical measurements (fit inside models)
 - Micro balances for stores?

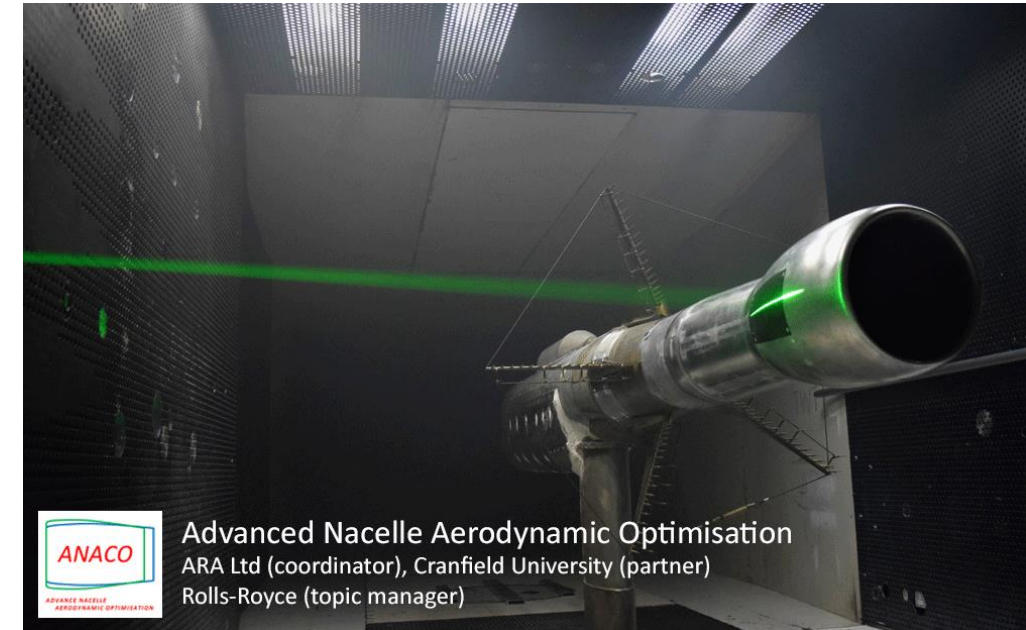


ARA - Turbulent transition using IRT

Current issues for commercial testing



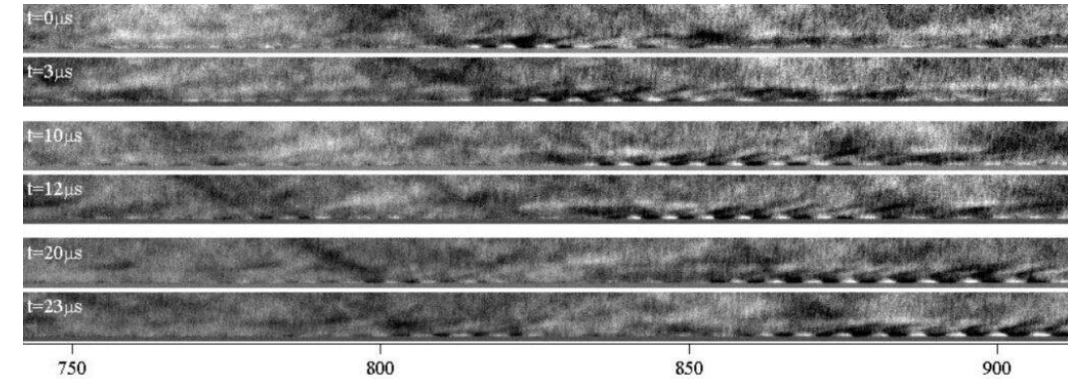
- Currently get either of the below from customers:
 - Test me this matrix of things please
 - Measure me this specific thing ... that you can't currently do... that I won't pay for you to develop
- Only options for funding of development are CS2/ATI-like projects



**ARA, Cranfield, RR – CS2 ANACO
Nacelle Optimisation**

Academic needs

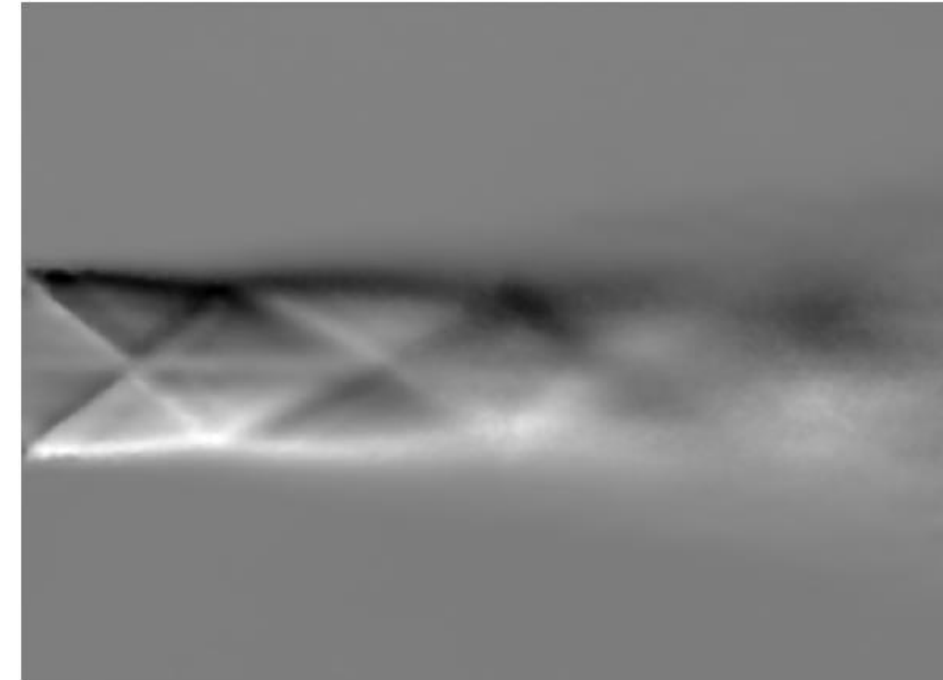
- Everything, everywhere, quickly, cheaply
- Hypersonic example:
 - Incredibly fast response for BL investigations ($>100\text{kHz}$)
 - Many sensors needed to detect transition onset (spatial resolution)
 - Other sensors compromised by temperature changes
 - Short flow durations



Laurence et al. (2016), "Experimental study of second-mode instability growth and breakdown in a hypersonic boundary layer using high-speed schlieren visualization" JFM

Academia developments

- Focused laser differential interferometry
 - Velocity and density gradient measurements
- High-speed (MHz) schlieren imaging
- Event-based imaging
- Distributed PIV systems using cheap components
- Focused schlieren measurements
- Custom PSP applications (cheaper/faster/less temp sensitive etc.)
- Application of post-processing methods (modal decomposition, temporal super resolution etc.)
- Surrey Sensors



**UoM, QQ – Jet screech
measurements using BOS**

Main challenges

- “We want to measure flow property X ...

- *faster*

- *cheaper*

- *in more detail*

- *in a tighter space*

- *onboard*

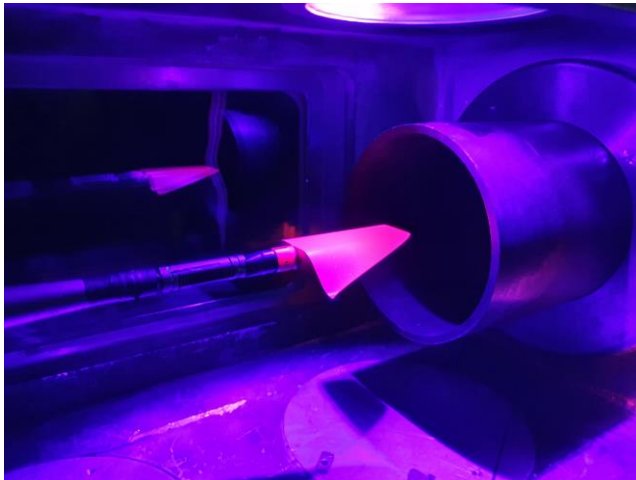
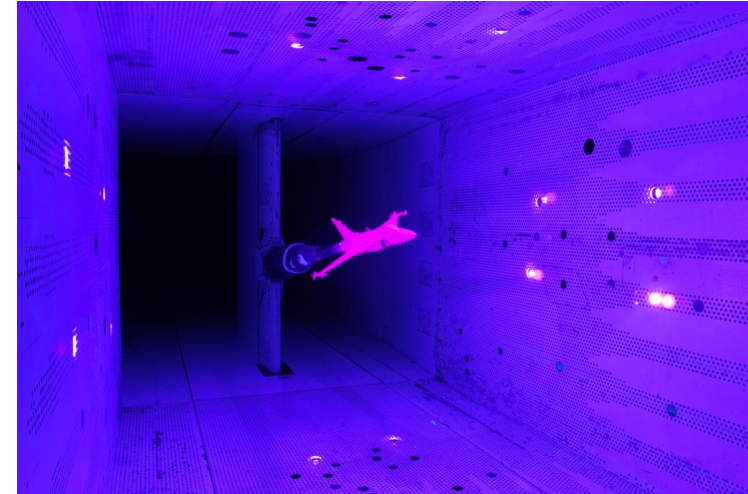
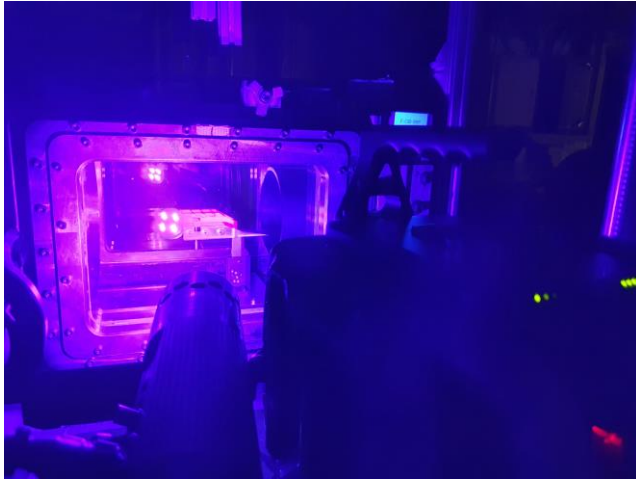
- *reliably”*

- **Solutions are normally very test or task specific**

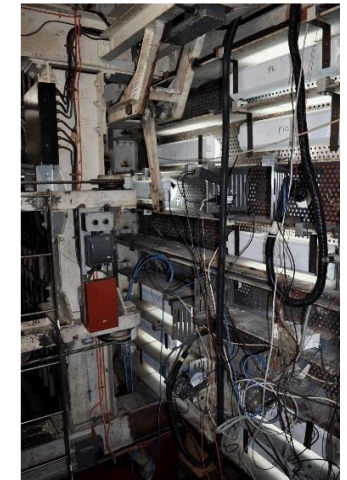
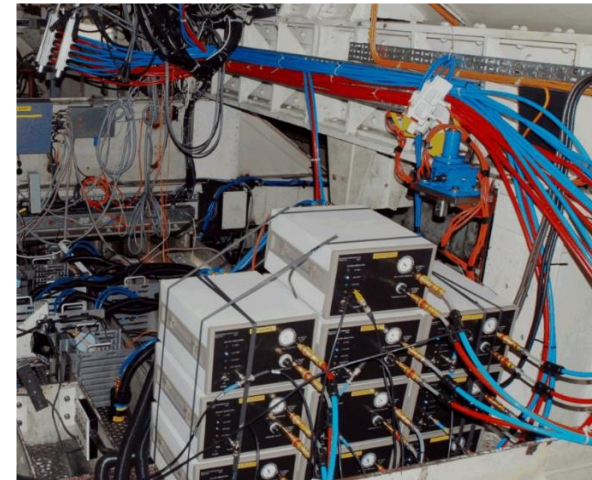
Reliability is key!

**What is reliable in an academic
lab may not be reliable in an
industrial facility**

Differences in scale



UoM PSP System



ARA PSP System

Next Steps



- Capability audit – followed by white paper
- Future meetings including other potential partners
 - Motorsport, rotorcraft, military
 - Build a community that collaborates and shares best practice
- Series of training workshops around the UK supported by NWTF
- Development of a **challenge by industry stakeholders for UK academia to support** (with ATI)
 - Measurement of vortices, cavity flows, PSP for dynamic loads, reduction in energy costs, model manufacture for measurement, efficient processing chains
 - Generate a method at one university and test it at another as a pseudo-industrial shakedown

For example, RR are implementing a test at the Mitchell Tunnel but are struggling to measure **X**. Cranfield and Imperial develop an approach and support the test.