Spray Facility (ADAS)

Gary Page
Loughborough University

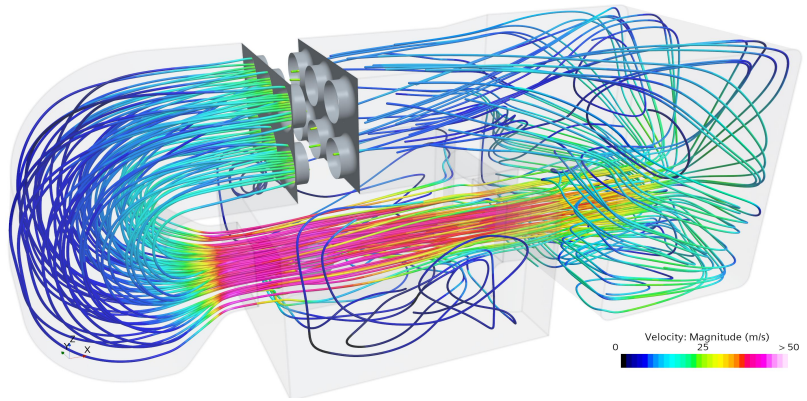
Multiphase Wind Tunnel (ADAS spray facility)

Gary Page

Department of Aeronautical and Automotive Engineering

Loughborough University

G.J.Page@lboro.ac.uk



2 April 2025

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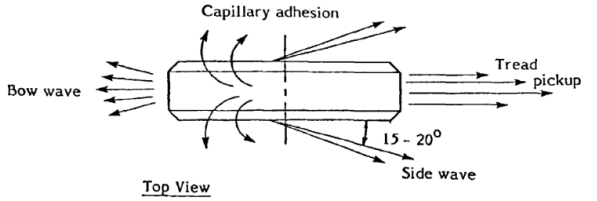
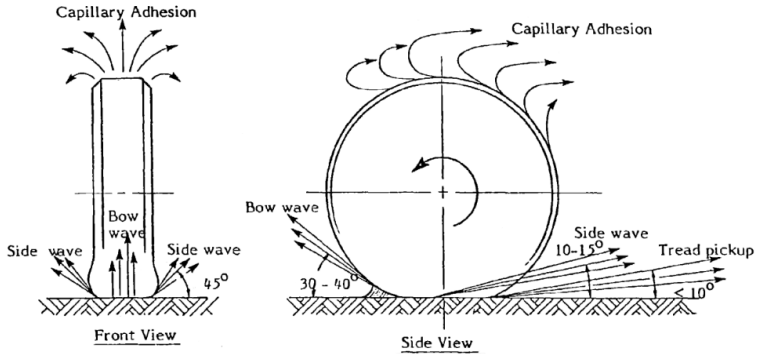
Why a New Multiphase Wind Tunnel?

- Modern cars depend upon sensors
  - Radar, Lidar, optical cameras, ultrasonic
- Degrade in poor weather, particularly rain
  - May not see a vehicle, cyclist or pedestrian
  - May 'hallucinate' another vehicle (especially lidar in high rainfall intensity)
- Previous work at Loughborough and elsewhere assume a given spray distribution
  - Little knowledge of the actual mechanisms for source generation and spray characterisation
  - Can then be used as boundary conditions for simulations





'The Influence of Automotive Aerodynamics on Spray Transport and the Implications for ADAS Sensor Operability,' PhD thesis, Conor Crickmore, 2024.
https://doi.org/10.26174/thesis.lboro.26861788.v1

Overall Design Parameters

- Single full size wheel and tyre 235/55 R16 with correct load
- *Sub-scale quarter car (single wheel) and full car (four wheels)*
- *Isolated Formula 1 model wheel (60% scale)*
- Running on a belt 2m long and 0.7m wide
- Air and belt speed up to 30 m/s (67 mph, motorway speed)
- Up to 2mm film of water ahead of wheel (target 15 litres/second)
- Measure near field source droplet and flow field
- Measure far field droplet and flow field
- Real ADAS sensors in operation
- Total budget ~£1.2M

Overview

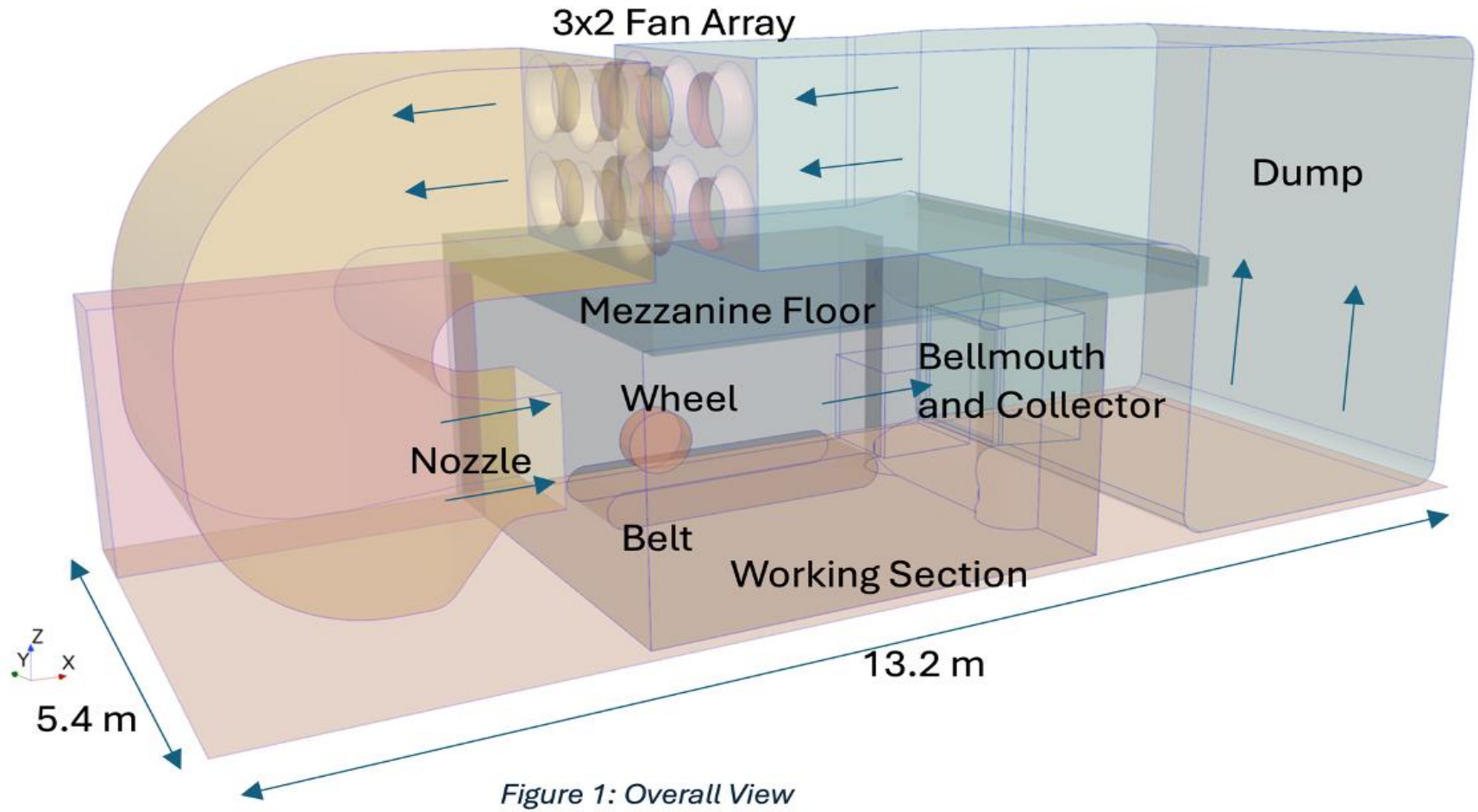
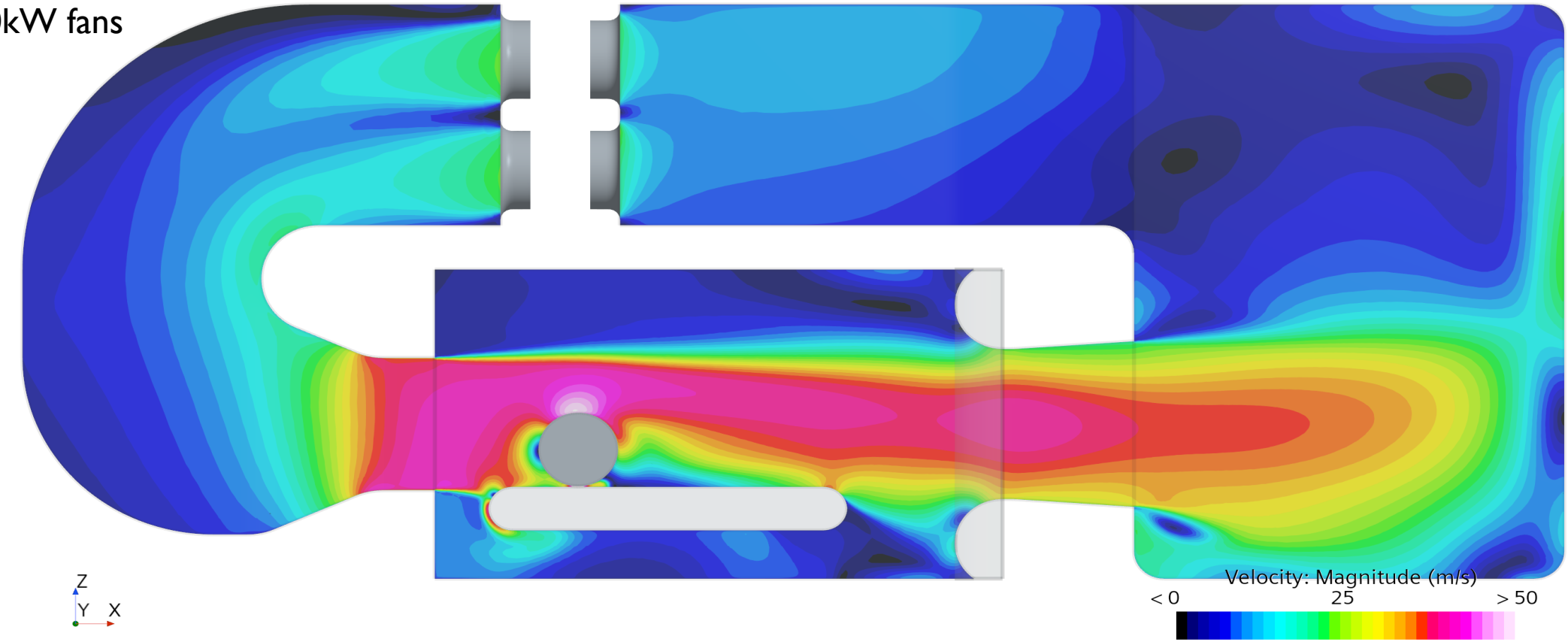


Figure 1: Overall View

CFD Velocity Magnitude

Nozzle Velocity 39 m/s
Reported fan pressure drop 800-850 Pa
6 x 10kW fans



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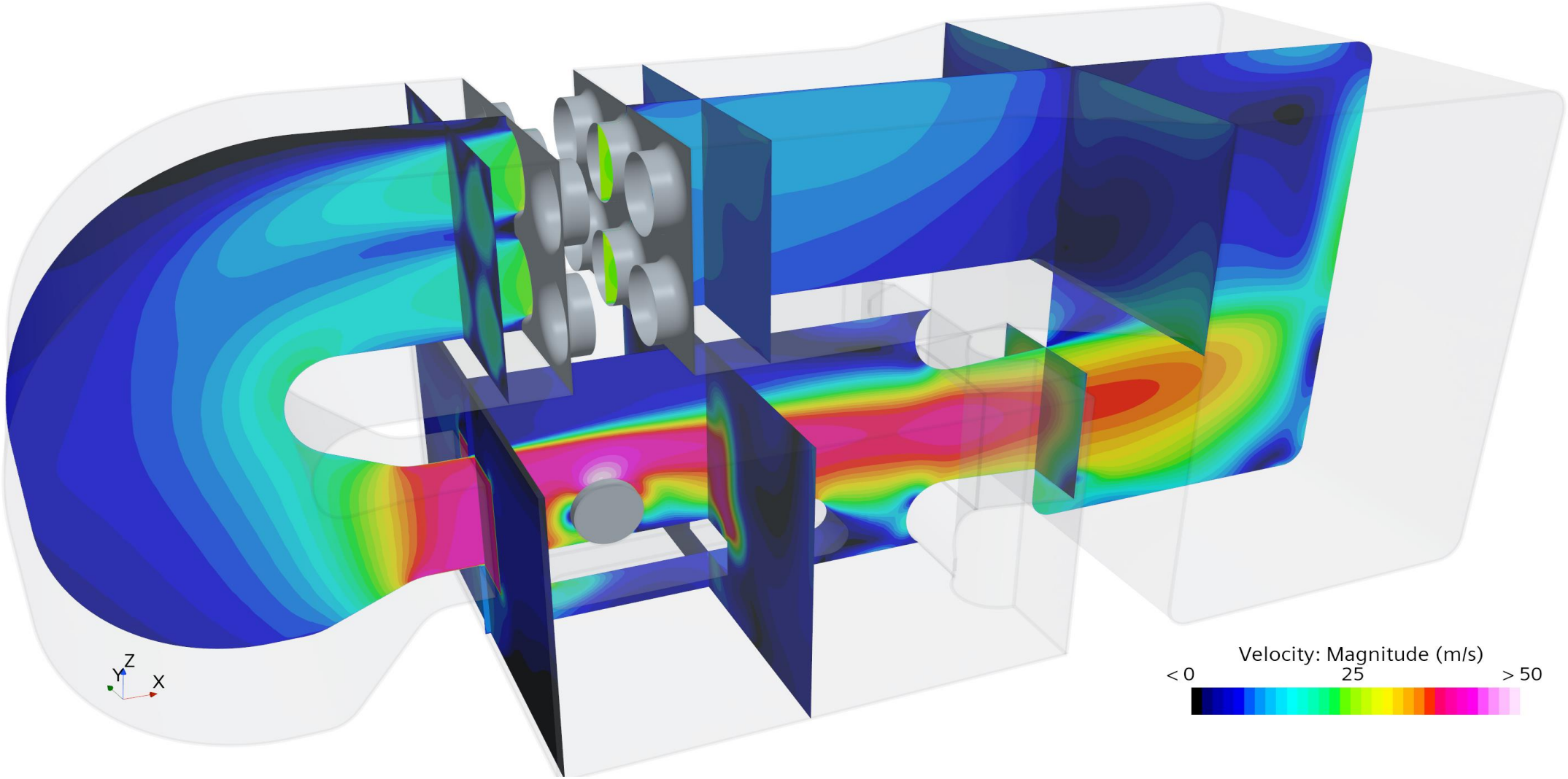
CFD Velocity Magnitude



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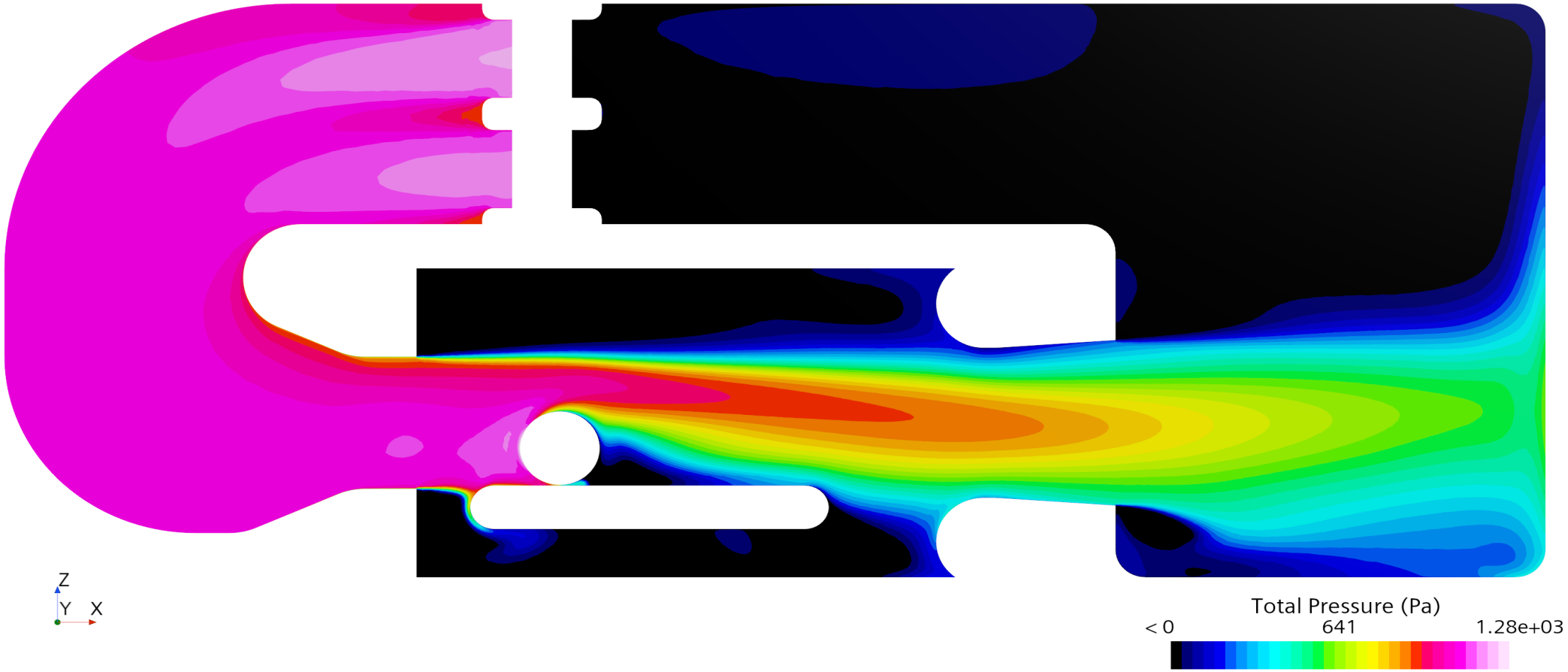
CFD Total Pressure



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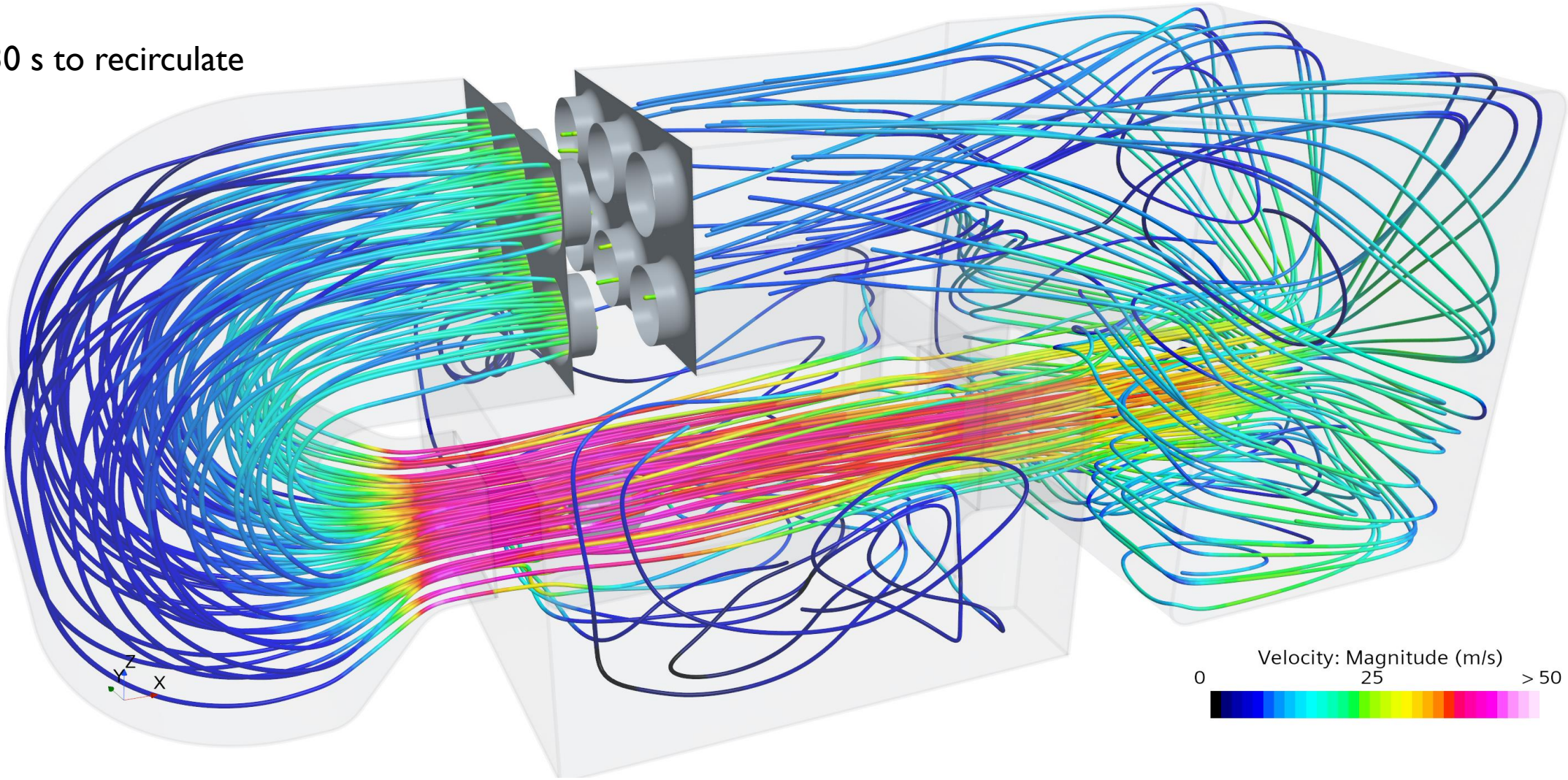
CFD Streamlines from Fans

30 s to recirculate



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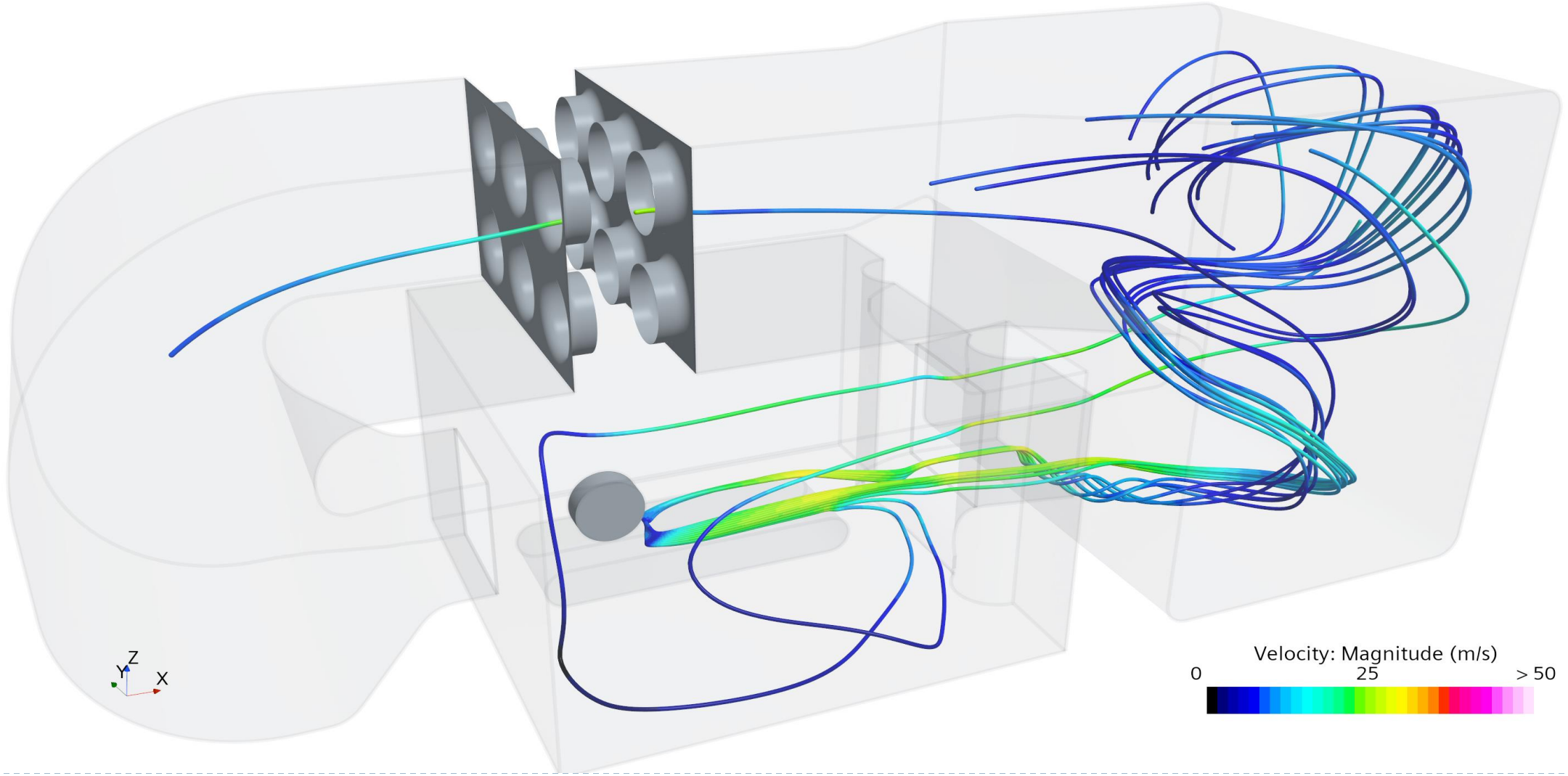
CFD Streamlines from Contact Patch



Status

- Preliminary design hand calculations and CFD consistent
- Need to refine further and look at water extraction
- Delayed by Facilities Management
  - room strip-out and refurbishment yet to start
- Building proof of concept belt and water system in separate lab
- Final belt will be built and constructed in separate lab and moved when building released (September 2025?)
- New highly experienced Research Fellow about to start
- Plan to take measurements in Summer 2027