

## Working at the Wind Tunnel Facility at Centrale Nantes

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### The FLOATEOLE Project



**Figure 1:** FLOATGEN, the prototype at SEM-REV test site in Le Croisic (France)<sup>4</sup>.

- Goal: Characterise the interaction between swell and the far wake of floating wind turbines (FWT)
- Two components: experimental modelling (PhD), and field campaign measuring on site (Post-Doc)
- Funding provided by: Région Pays de la Loire (via WEAMEC), Centrale Nantes, ADEME (PhD position)

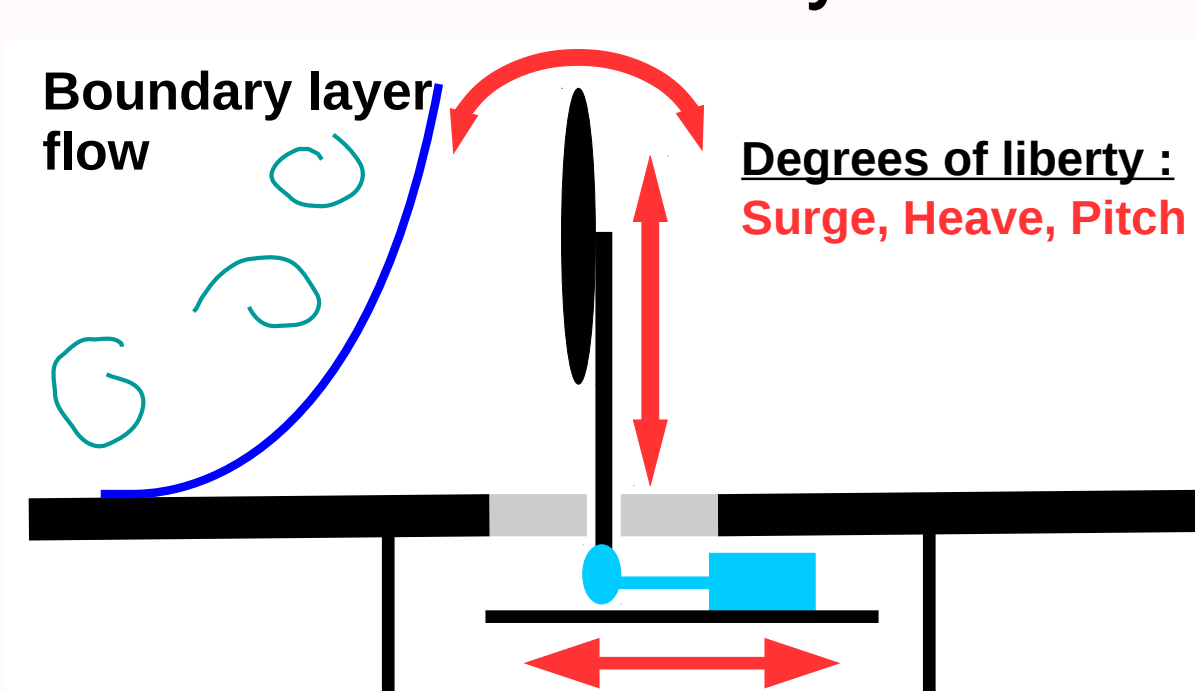
- Partners: LHEEA, CNRS, Ideol, D-ICE Engineering
- Time frame: November 2017 to November 2021
- Experimental modelling in wind tunnel at Centrale Nantes
- Field campaign will measure wake effects of FLOATGEN

### PhD Thesis Targets

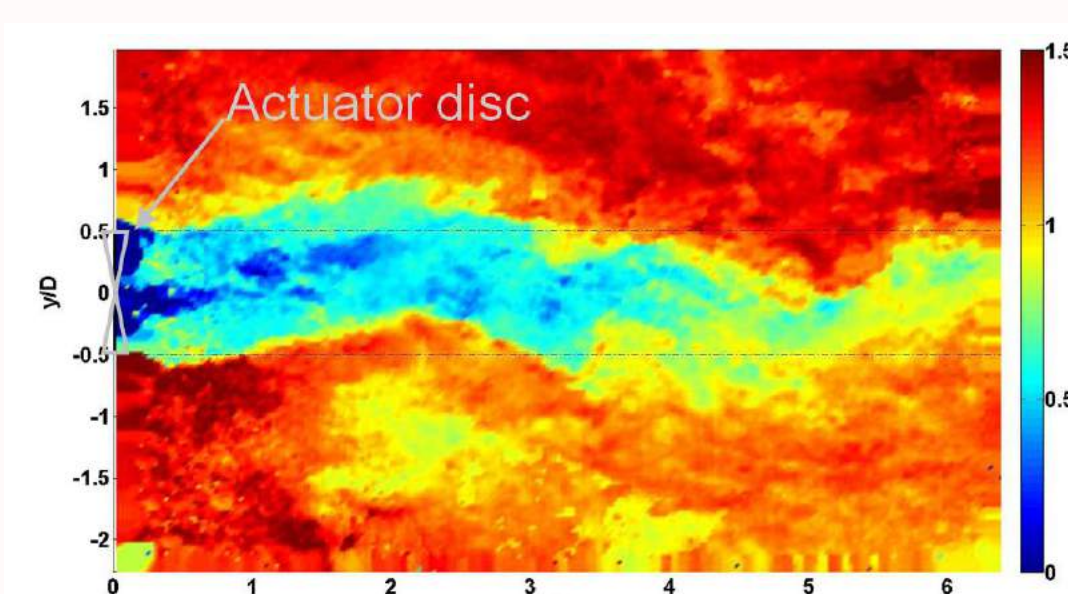
- Will it be possible to find a "signature" of the swell's frequency in the wake?
- What characterizes the interaction between two wind turbines?
- Will the wake be shortened or prolonged?

### Our Road Map

- Design of the motion system at Centrale Nantes using numerical motion data provided by Ideol ✓
- Construction of the motion system by the technical team at Centrale Nantes's towing tank facility ☹
- Modelling a off-shore boundary layer in the wind tunnel at Centrale Nantes ☹
- **Future work:**
  - Measure wake of the moving model in the wind tunnel
  - Long-term measurements of FLOATGEN's wake at SEM-REV using LIDAR.
  - Put forward suggestions on how to model the dynamic wake numerically.



**Figure 2:** Sketch of the intended set-up of the motion system at the wind tunnel facility.

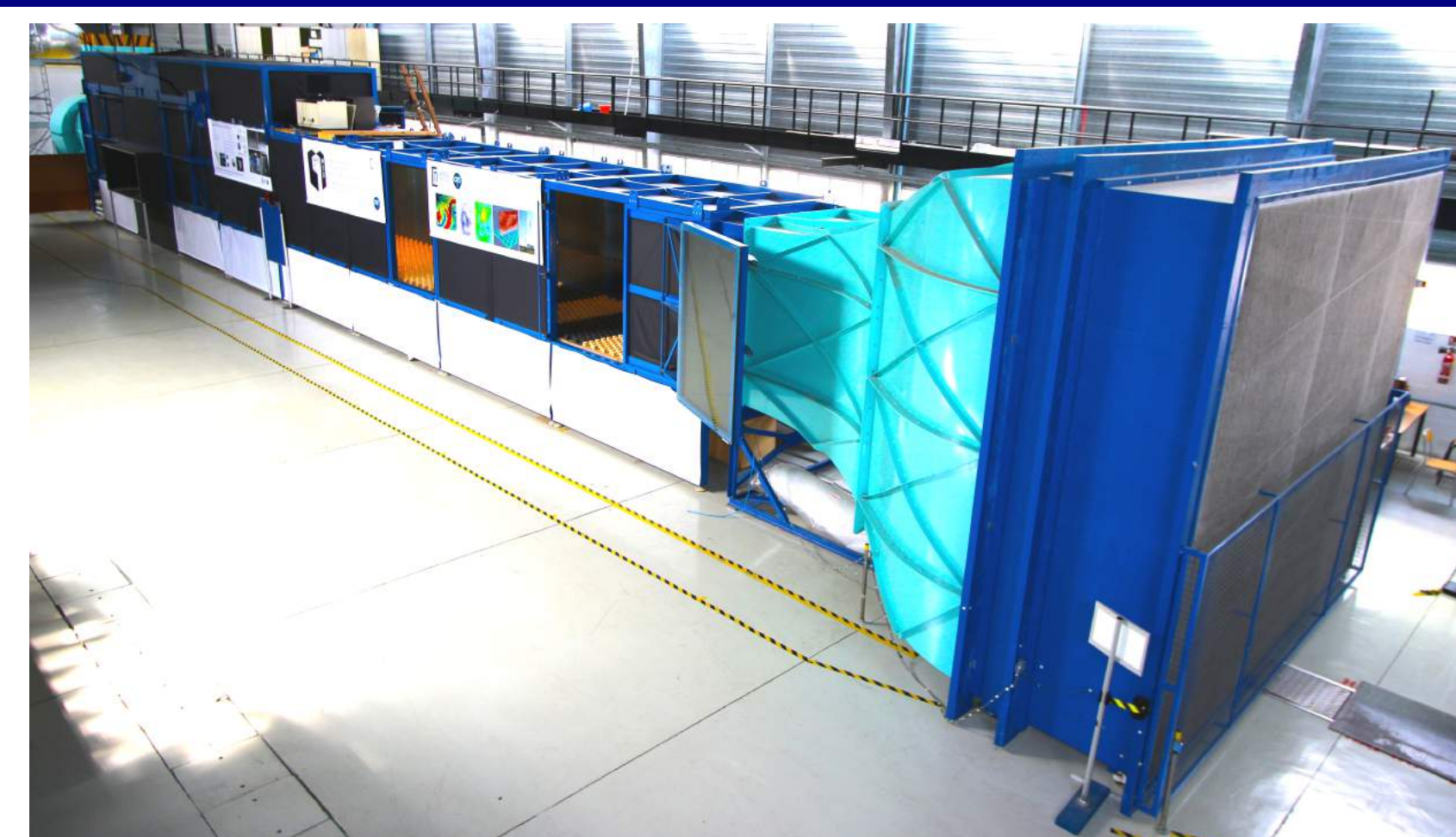


**Figure 3:** Example results plot from a differential campaign.

### Facility and Equipment

The atmospheric boundary layer wind tunnel:

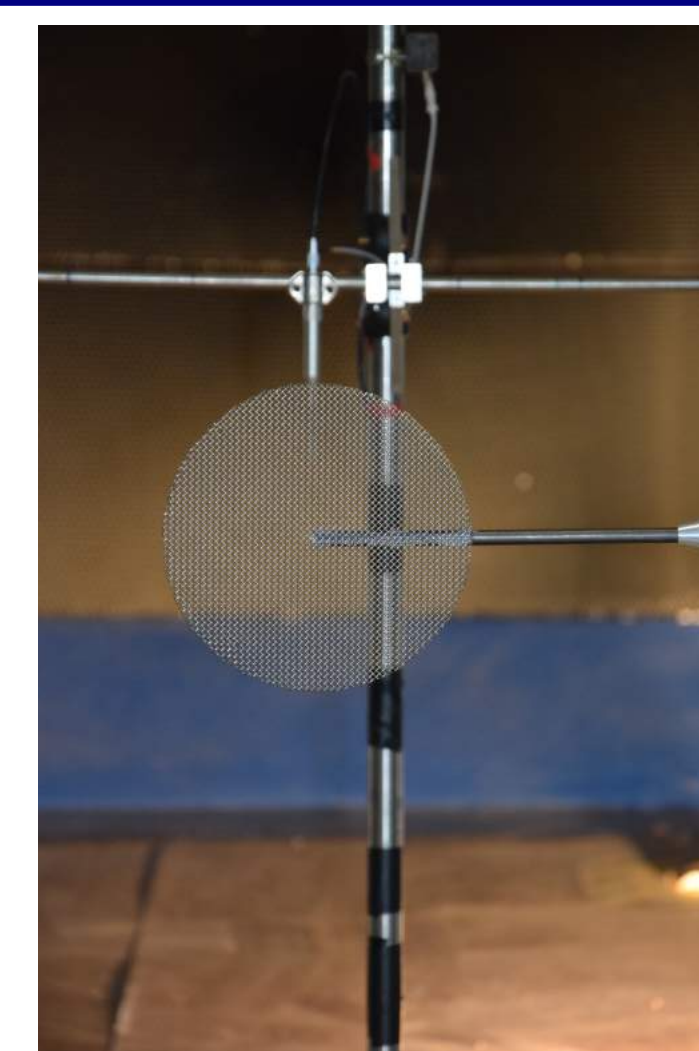
- 24 m length
- 2 m × 2 m cross-section
- Flow velocity up to 10 ms<sup>-1</sup>
- automated traverse system



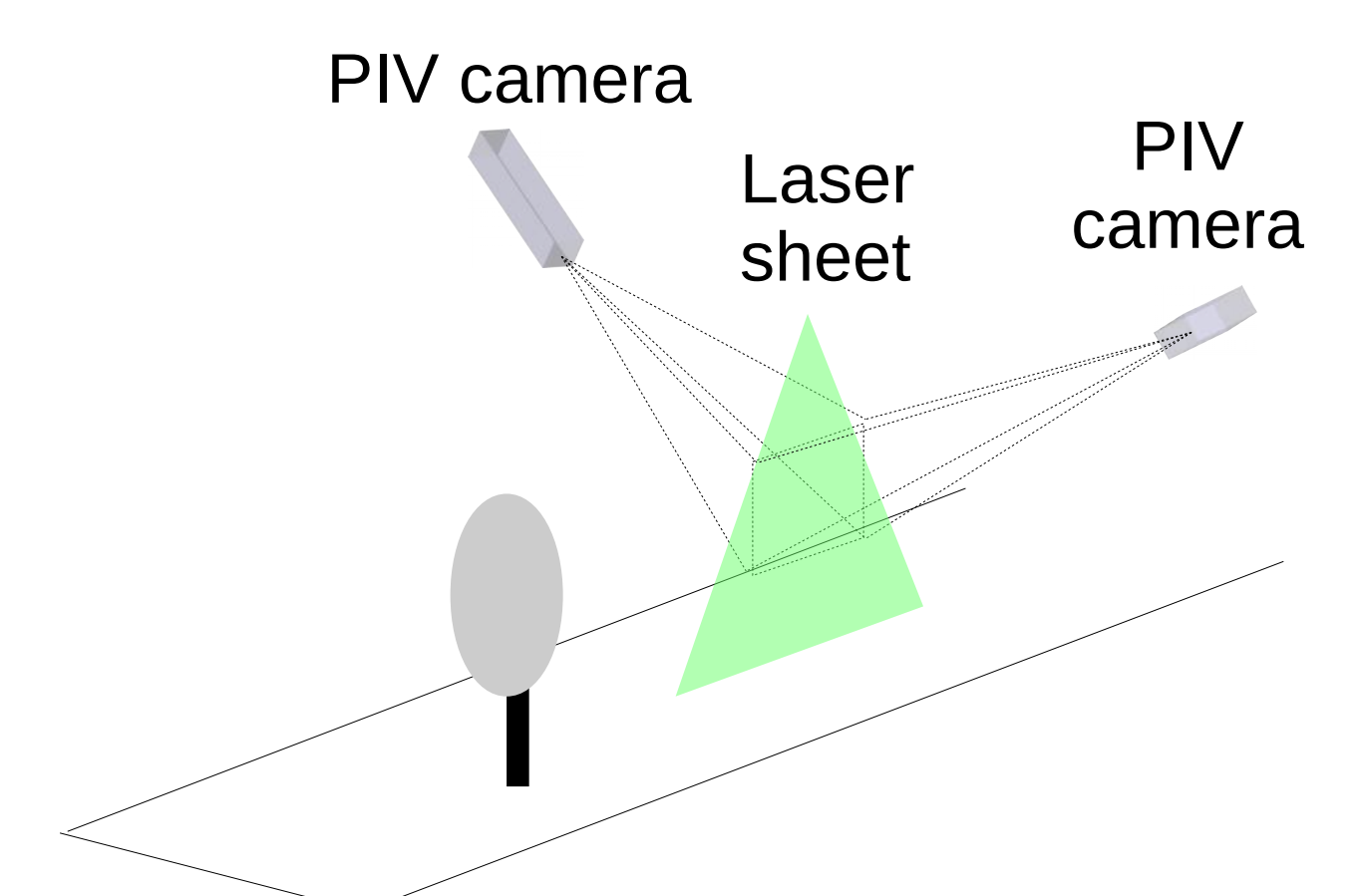
**Figure 4:** The atmospheric boundary layer wind tunnel at Centrale Nantes<sup>5</sup>.

The wind tunnel facility at Ecole Centrale Nantes offers a wide range of measurement instrumentation:

- Pressure and Force Measurements
- High-frequency, 3-D pitot probe (Cobra)
- Hot-Wire Anemometry
- Laser-Doppler Velocitmetry (LDV)
- Particle Image Velocitmetry (PIV)



**Figure 5:** Preliminary test set-up in the wind tunnel using an actuator disc and a Cobra probe<sup>5</sup>.



**Figure 6:** Sketch of an idealized PIV system using an actuator disc and a Cobra set-up.

**Future instrumentation:**

- LIDAR
  - For atmospheric scanning
  - Wind speed measurements
  - 4 km range

### Acronyms and Bibliography

1. LHEEA: Laboratoire de recherche en Hydrodynamique, Énergétique et Environnement Atmosphérique (Research Laboratory in Hydrodynamics, Energy and Atmospheric Environment)
2. EMO: Énergies Marines et Océan (Marine and Ocean Energies)
3. DAUC: Dynamique de l'Atmosphère Urbaine et Côtière (Dynamics of Urban and Coastal Atmosphere)
4. <https://sem-rev.ec-nantes.fr/eolienne-flottante-floatgen/> (visited on 18/02/2019 at 17:19)
5. Stock photograph from DAUC, LHEEA, Ecole Centrale Nantes collection