

Chair: Physics of Fluids group

Optimising and understanding the generation of homogeneous isotropic turbulence (HIT)

Description

Our brand-new Dodecahedron setup has been created to generate strong, turbulent flows. More specifically, we wish to create homogeneous isotropic turbulence (HIT), which is the most studied (and most idealised) form of turbulent flow. The Dodecahedron has 20 engines to stir the flow, which can be individually programmed. This leaves us with the question: how can we program the dodecahedron to give us the best form of HIT?



Figure 1: Dodecahedron with a volume of ≈ 210 L.

Assignment

We will use the Dodecahedron (shown in Figure 1) to generate high turbulent flow conditions. The Dodecahedral chamber has 20 engines with impellers attached to the corners to make the flow turbulent. The engines can be programmed individually, used to create a custom sequence of engine rotations, thereby creating a certain (turbulent) flow.

In this assignment, you have the freedom to create a wide range of programmes for the Dodecahedron. While running the programmes, we measure the flows properties. The results from these measurements will then be used to quantify how ‘good’ the turbulent flow is. Based on how well different programmes perform, this process can then be iterated to optimise the turbulent flow. This optimisation process also offers a possibility to use machine learning while iterating, though this is not a required aspect.

Bachelor assignment

Skills learned:

- Laser Doppler anemometry to measure the local flow velocity
- Doing experimental work on a large setup
- Basic turbulence theory to characterize the flow

Master assignment

Skills learned:

- Laser Doppler anemometry to measure the local flow velocity
- Performing particle tracking velocimetry using high-speed imaging, lasers, and image analysis to measure the local flow velocity
- Doing experimental work on a large setup
- Turbulence theory to characterize the isotropy and homogeneity of the flow. And look at more advanced properties including structure functions

If you are interested, feel free to send us an email; we will gladly explain you the project in more detail.

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