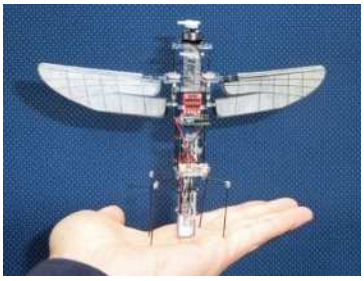
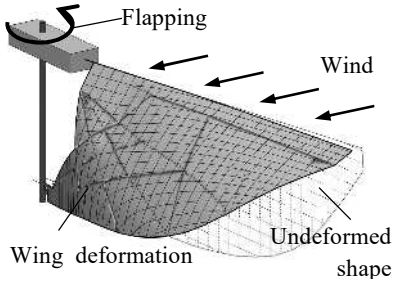
Name	Job Title	Area of Expertise
NAGAI Hiroto	Associate Professor	Aeroelasticity, Aeronautics, Vibration

1. Main Research Topics: We primarily study the design and analysis of large-scale or flexible structures that experience fluid-structure interaction (FSI) across various engineering fields.

① **Development of Small-Sized Flapping Drones**

Birds and insects achieve excellent flight performance through flapping flight, despite their small size. Inspired by this natural mechanism, we are developing compact, bio-inspired flapping drones equipped with flexible wing structures. These drones are designed and analyzed using a multiphysics approach that integrates fluid dynamics, structural mechanics, mechanical design, dynamics, and control engineering. Unlike conventional rotary-wing drones, flapping drones offer improved safety and quieter operation, making them suitable for use in natural environments and human-centered spaces.





② **Fluid-Structural Interaction (FSI) Analysis of Large-Scale Structures**

Large-scale structures such as high-rise buildings, long-span bridges, and large wind turbines tend to become relatively flexible as their size increases, and thus are susceptible to fluid-induced vibrations such as vortex-induced vibration and flutter. In our laboratory, we analyze such vibration phenomena using fluid-structural interaction (FSI) techniques that couple computational fluid dynamics (CFD) with the finite element method (FEM). Our main research topics include:

- Vibration analysis of large-scale structures subjected to both forced excitations (e.g., earthquakes and ocean waves) and flow-induced vibrations (e.g., vortex shedding)
- Simulation and prediction of aeroelastic responses in large-scale wind turbine blades
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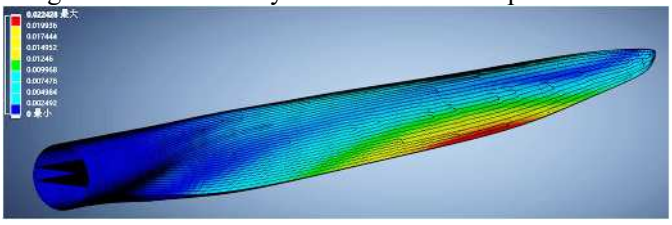
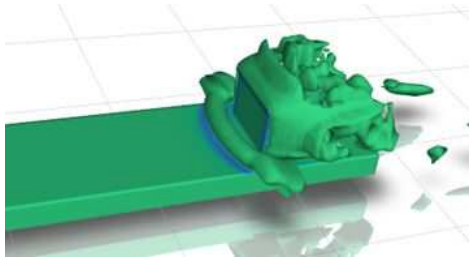
③ **Aerodynamic Analysis of Ships**

Wind-assisted propulsion technologies such as rigid sails and rotor sails have recently attracted attention in the maritime industry as a means of achieving carbon neutrality. We are conducting research on how ship motions and structural vibrations affect the aerodynamic performance of these wind-assisted propulsion devices. Additionally, we are investigating the influence of ship superstructure geometry on the airflow around ships, aiming to optimize aerodynamic design for fuel efficiency and environmental performance.



Deformation of large-scale wind turbine



Airflow around a ship superstructure

2. Keywords

Fluid-Structure Interaction (FSI), Structural Vibration, Aeroelasticity, Multidisciplinary Design Optimization (MDO), Bio-inspired Engineering, Flapping Drone Technology

3. Remarks and Websites

In our laboratory, we address fluid-structure interaction design and analysis across a wide range of engineering fields, including aircraft, ships, buildings, and wing turbines. We actively pursue interdisciplinary collaboration and practical applications across different research domains. If you are interested in our research, please feel free to contact us.

researchmap: https://researchmap.jp/nagai-hiroto

Laboratory: http://www.st.nagasaki-u.ac.jp/laboratories/nagai/