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1. Main Research Topics

① Multi-objective Optimization of Turbomachinery

Turbomachinery plays a vital role in transporting fluids such as air and water. Additionally, when harnessing renewable energy sources like wind and tidal currents, the efficient design of turbomachinery is essential. Although turbomachinery can be designed using computer-based numerical simulations, the challenge lies in the fact that it requires the combination of many design variables—making it difficult to identify the optimal shape. To address this, a system that combines a genetic algorithm-based shape optimization method with an artificial-neural-networks has been developed, enabling the efficient and automated search for optimal designs. This system allows the computer to automatically modify shapes and search for the best design. It has been applied to various turbomachinery design goals, including improving efficiency, reducing noise, and expanding operational ranges. Through the development of high-performance turbomachinery, it will be contributed to energy conservation in the industrial sector.

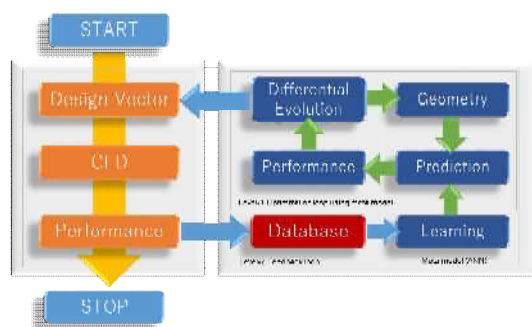


Fig.1 Multi-objective Optimization System

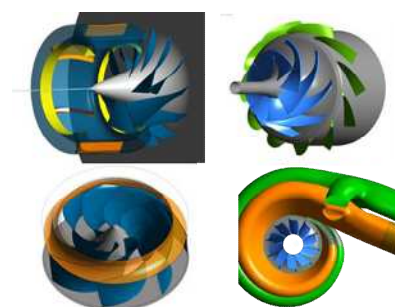


Fig.2 Applications to Turbomachinery Design

② Development of an Energy Harvesting Smart Buoy

Effective utilization of marine resources requires a sampling system capable of long-term, fixed-point observation over wide ocean areas. To address this need, it has been developed a smart buoy equipped with a tidal current turbine for independent power supply. The turbine was optimally designed to achieve high efficiency across a wide range of current velocities, corresponding to the roughly 6-hour tidal cycle.

The developed smart buoy is capable of measuring seawater temperature, tidal current velocity, salinity, chlorophyll concentration, and the FSI value which is an indicator of red tide. Leveraging the high-power generation capacity of the tidal turbine, the buoy can support multiple high-power-consuming sensors. This smart buoy is intended for various applications, including the efficient utilization of marine resources, remote monitoring of offshore aquaculture, and red tide sensing.

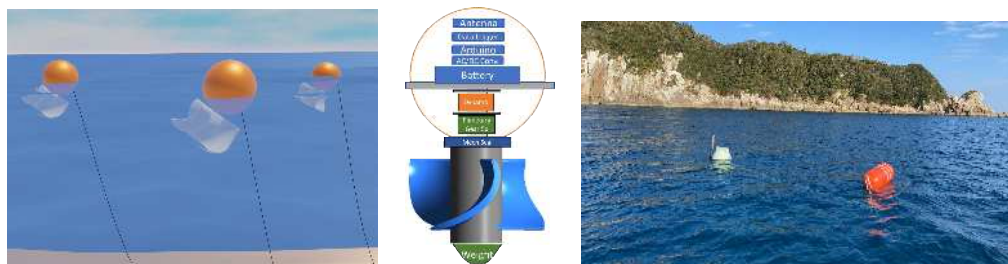


Fig. 3 Development and Demonstration Testing of a Smart Buoy

2. Keywords

Turbomachinery, Multi-objective optimization, Tidal turbine, Smart buoy

1. Remarks and Websites

AI based optimization system enables efficient design of turbomachinery, contributing to energy conservation and the development of renewable energy sources. In addition, the smart buoy equipped with a tidal current turbine is expected to provide fundamental data for future marine development.

researchmap: https://researchmap.jp/dai_sakaguchi

Laboratory: https://www.mech.nagasaki-u.ac.jp/lab/sakaguchi_lab/html/home.html