Hydrokinetic renewable energy harvesting using oscillating hydrofoils

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Abstract:

Renewable energy is energy that is harvested from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. Compared to conventional energy (fossil fuels), renewable energy is clean in consumption. In this talk, we will focus on the tidal energy harvesting, which is essentially extracting hydrokinetic energy from moving fluids (rivers or tides) by using oscillating hydrofoils.

Experiments were conducted in a water flume with hydrofoils operating in different configurations and energy harvesting efficiency is evaluated to find the optimal conditions. I will first talk about the prescribed system, in which the hydrofoil motion is predefined by the experimentalist. In such a system, we explored the energy harvesting performance of a single hydrofoil in a confined channel and the interaction of two hydrofoil operating in a tandem configuration (in line). Then I will move to the passive system, which is achieved by using a force-feedback cyber-physical system to realize a spring-mass-damper system. In such a
system, we optimized the energy harvesting performance and aeroelastic instability of a single foil under various elastic mountings. In addition, Particle Image Velocimetry (PIV) measurements of the flow fields were used to help understand the energy harvesting performance of the hydrofoil.