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Efficiency Enhancements in Hydrokinetic Energy Harvesting Achieved Using a Compliant Membrane Hydrofoil VARGHESE MATHAI, GALI ALON TZEZANA, KENNETH BREUER, School of Engineering, Brown University — Hydrokinetic energy harvesting using an oscillating hydrofoil has recently received increased attention as an alternative to conventional rotary turbines. One of the challenges in the development of commercially viable flapping foil technology is to attain cycle efficiencies comparable to those of rotary turbines. Here we experimentally study the energy harvesting performance of a compliant membrane hydrofoil undergoing heaving and pitching oscillations in a uniform flow. Membrane foils with different properties: elastic modulus, thickness and prestretch were fabricated and tested in a water flume facility. The Reynolds number based on the chord length and free stream velocity was $\mathrm{Re} = 5 \times 10^4$, and the reduced frequency $f^* \in [0.1, 0.2]$. When compared to a rigid symmetric hydrofoil, the membrane foil is able to dynamically adapt its shape and camber during each oscillation cycle, yielding up to 50% higher lift forces and 30% improvement in cycle efficiency. The flow structure and wake patterns obtained from Particle Image Velocimetry (2-D PIV) measurements will also be discussed.

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