The Development and Application of Harvesting Kinetic Energy from Marine Fish

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Part of marine ecology revolves around tracking marine life in the ocean. However, the lifespan and functions of a traditional tracker are limited by its power and range. In this work, an energy harvester to convert the kinetic energy from marine fish into useable electrical energy is incorporated into a marine fish tag for collecting, analyzing, and transmitting data. For the energy harvester, the optimal piezoelectric material is determined for harvesting the vibration energy induced by the surrounding water flow while marine fish is swimming. A bluff body and a tail fin are respectively designed at the front and rear ends of the piezoelectric material to enhance the amplitude of the vibration so as to increase the power generation. Numerical simulations based on the finite element method are conducted to optimize the geometry of the bluff body and the tail fin. In the experiments, a giant custom-designed Venturi tube in a re-circulating flume system is designed to achieve a sufficiently high flow rate associated with the average swim speed of migratory fish. Not only the power generation but also the spectral response of the energy harvester under different flow rates are measured in the re-circulating flume experiments. The spectral responses at different flow rates can be potential for sensing the oceanic currents. Besides, a live fish experiment is also conducted to verify the energy harvesting capabilities of the proposed self-powered marine fish tags in practical circumstances. This work would present a promising future with the potential to facilitate a better understanding in Oceanography.

Awards Won:
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