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Development of a ocean-current turbine for the Kuroshio Current

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Ocean currents are a promising source of sustainable energy because the flow of water provides regular and predictable energy. Japan is in a suitable location for harnessing the power of ocean currents because the Kuroshio ocean current runs steadily near the Japanese seaside. The current flow is approximately 500 m deep and 100 km wide with a flow speed of 1-1.5 m/s. In order to harness the kinetic energy of marine currents, we propose a novel ocean-current turbine [1]. The turbines are moored to the seabed and function like kites in the water flow. To operate such turbines in the middle layer of a marine current, it is necessary to cancel the resulting rotor torque. Therefore, our turbine is designed with a float at its top and a counterweight at its bottom. Owing to buoyancy and gravitational force, the turbine body maintains its attitude stably by canceling the rotor torque. In other words, buoyancy and gravity act together as a righting moment. Another advantage of working far from the sea surface is the lack of influence from waves and wind, especially in a typhoon. As a first step, we constructed a prototype turbine and conducted towing experiments in order to confirm the float and counterweight configuration. The turbine has a 2-m-diameter three-blade rotor and a 1 kW electric generator. The turbine was attached with a strut to small fishing boat and towed to simulate an ocean current. The measured power of the load reached a maximum of 400 W at the towing speed of 1 m/s. The result is in good agreement with the theoretical estimate. In addition, stable body attitude and output power were observed. The experimental results demonstrated that our ocean-current turbine has a high hydrostatic stability and achieves stable power generation. In this presentation, we report on the novel ocean-current turbine and show the experimental verification.

[1] K. Shirasawa, K. Tokunaga, H. Iwashita and T. Shintake, "Experimental verification of a floating ocean-current turbine with a single rotor for use in Kuroshio currents," *Renewable Energy*, vol. 91, pp. 189-195, 2016.

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