CAD Modeling, Simulation and Prototyping of a Wave Energy Generation System for USVs

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Unmanned surface vehicles (USVs) are defined as ocean surface craft that remove the operator from the platform. USVs are able to autonomously navigate the ocean for extended periods of time. USVs have the ability to perform a myriad of scientific, commercial, and military missions. However, current USVs do not have enough energy to travel at a fast enough rate or to take measurements from sensors at a frequent enough interval. As a result, a unique approach to energy generation for USVs is proposed such that the USV can harness wave power while in motion by using the relative displacement between a stable center hull and low displacement pontoons. The solution was simulated and optimized on Delftship, then it was modeled on Autodesk Fusion 360. The parts then underwent a stress simulation on Autodesk Fusion to ensure they were able to withstand the ocean's forces. Next, a prototype was 3D printed and tested in a wave tank. It was determined that a single pontoon per side is ideal, as it results in a significantly larger vertical displacement (p value of less than 0.0001) and and significantly smaller horizontal displacement (p value of 0.0003). It was also determined that a flat hulled pontoon has a significantly greater vertical displacement than an angled hull (p value of 0.0002). Finally, it was determined that the prototyped pontoon generates an upwards force of 0.378 Newtons, but only has to overcome 0.235 Newtons of resistance to move.

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