Hydrokinetic Wave-Powered Generator

Karis Petersen, Brian Gastineau, Justin Freeman, Hunter Kearney

Overview

The hydrokinetic wave power generator is a proof of concept R&D project with the goal of efficiently generating electrical energy from the kinetic energy stored in waves. As such, the project is focused on creating prototypes, testing, and iterating to come up with the most effective design possible. Once the prototype, consisting of a rotational motion generator and electrical system, is completed, it can be shown to customers as a proof of concept and developed further based on their requirements.

Product Specifications

The mechanical assembly rises with the waves, pulling a rope attached to the conversion mechanism. The rope is wound around a spool which imposes a torque onto a shaft. This energy would be stored in torsional springs. The torsional springs would be allowed to input the energy into the conical continuously variable gearing mechanism, which uses springs, cones and levers to regulate the gearing based upon the rpm of the system. From here the energy is output through the shaft to the electrical generator.

All electrical components connect to a central charge controller with ports for a battery, input power, and a load. A 12V, 10Ah battery was used to store power. The input power was connected to a 200W, 24V generator and regulated with a DC-DC converter to protect the charge controller from surges. The load was connected to a DC output port, to provide charging for emergency devices.

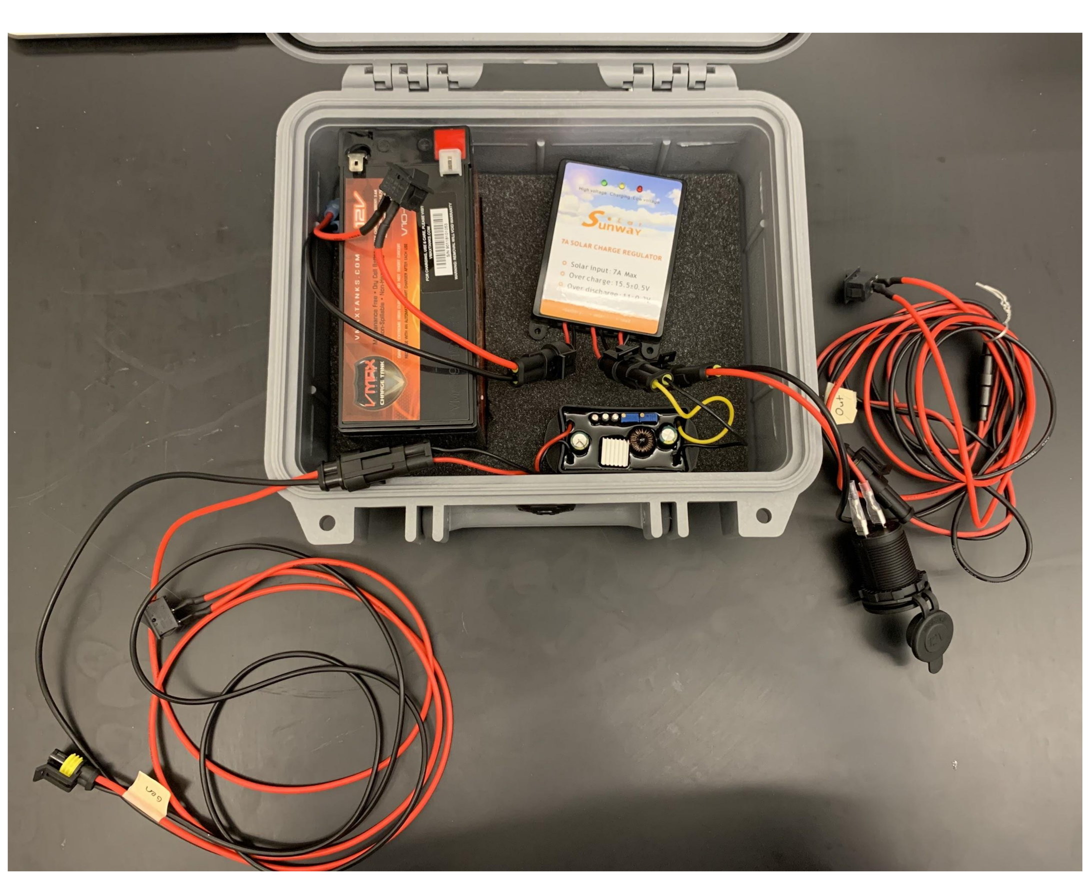
Functional Requirements

Mechanical Requirements

- M1: Assembly must have a buoyant force greater than all other forces acting on it
- M2: Assembly must be structurally sound so it survives its operating environment
- M3: Assembly must be waterproof
- M4: Assembly must be transportable
- M5: Must convert low frequency/high force waves into electric power
- M6: Sufficient RPM for generator to be above 17.5V

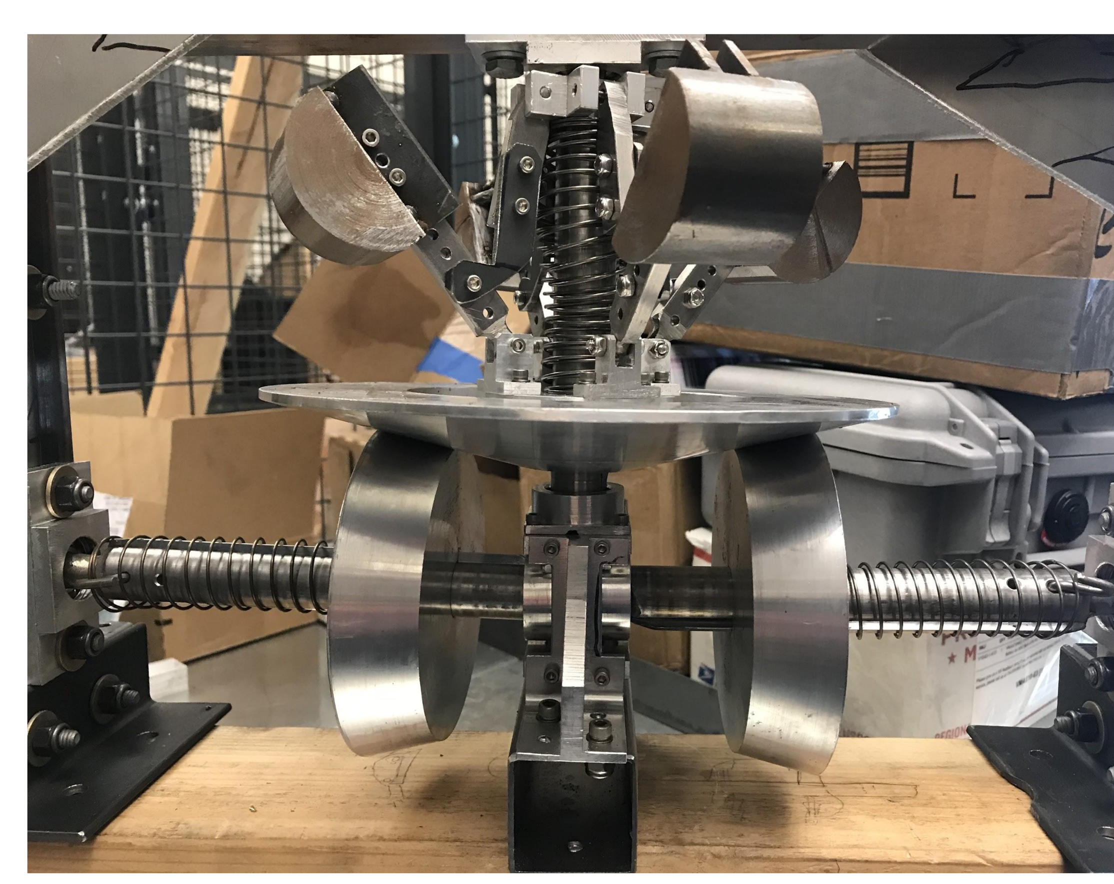
Electrical Requirements

- E1: Generator can produce required voltage at reasonable torque and RPM values
- E2: Generator can produce required current to charge battery
- E3: Generator is small enough to fit on the buoy
- E4: Generator is light
- E5: Generator has V/RPM ratio above the minimum
- E6: Electrical system contains overcurrent and overvoltage protection
- E7: Electrical components do not require external power (i.e. no active filtering, op amps, etc.)
- E8: Electrical components are waterproof or encased in watertight container
- E9: Safety factor for electrical components current and voltage ratings
- E10: Minimum voltage safety rating
- E11: Minimum current safety rating
- E12: Battery charger must output steady voltage



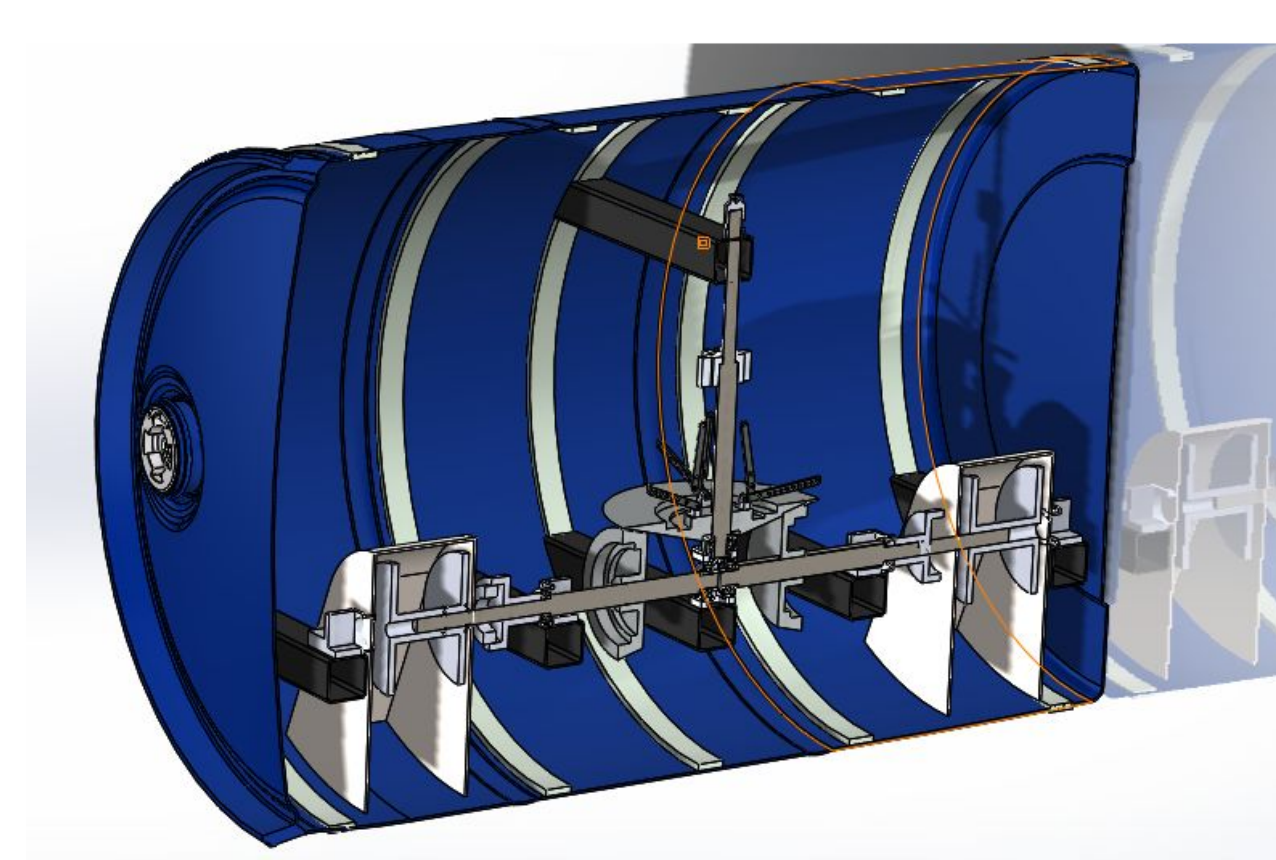
Design Process & Standards

The team began by designing the linear-to-rotational motion converter to meet the functional requirements and standards MIL-STD-810H and MIL-B-16115F. Then, the electrical system was designed to meet the functional requirements, power expected to be produced from the mechanical system, and standards NFPA-70-NEC and 1184-2006 - IEEE Guide for Batteries for Uninterruptible Power Supply Systems. Once the above prototype was completed, it was to undergo the testing below.



Testing and Data

The Hydrokinetic Wave Powered Generator was to be tested for waterproofing, overvoltage and overcurrent protection, buoyancy, and overall efficiency. Since the group was limited by the lack of ocean in Arizona, the variables had to all be tested separately. The waterproofing test consisted of dunking the assembly under 1 meter of water for 30 minutes. The overvoltage and overcurrent protection test consisted of applying 21V and 6A of electricity. The buoyancy test consisted of simply placing the assembly in a body of water and observing how it floats. Adjustments would be made if necessary. Lastly, the overall efficiency test consisted of fixing the assembly onto the cart. Two team members pull on the ropes attached the spool simulating the damper plate force. This will spin the internal components. Then, the output voltage, output current, rotational speed, and input force would be measured. This allows for the work to be calculated which leads to the derivation of the overall efficiency of the system.



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