UNIVERSITY OF CENTRAL FLORIDA

Buoy Array for Ocean Wave Power Generation

PI: Zhihua Qu **Co-PI**: Kuo-Chi Lin
Students: Shiyuan Jin (Ph.D), Steven Helkin (M.S.), Carlos Velez (B.S.), Karan Kutty (MS)

Description: The objective of this project is to develop a novel design that can extract ocean wave energy for commercial consumption. The design detailed herein is unique in that it is a wave point energy harvester that is small in size and contains all of the mechanical components directly within the buoy. As such, the buoy would simply need to be moored to the ocean floor and have cables to transport power to the shore, making it ideal for use in a multiple-unit wave farm. The project focuses mainly on the mechanical system within the buoy as well as methods to control the electrical load on the system. Different mechanical systems have been developed and tested on a motion platform to simulate a vertical wave motion—these systems have been analyzed and compared in order to provide an ever-increasingly effective design. Mathematical simulations have been developed to help optimize design parameters for use in subsequent prototype designs that will be able to be implemented in a wave pool or saltwater environment.

Budget: $150,000

Universities: UCF

Progress Summary

A Wave Energy Conversion (WEC) simulation model (see Fig. 1) was developed. The proposed model will be used to stabilize the variable frequency and voltage output and to satisfy the grid requirements of constant voltage, frequency, and power. It will also be used for future preparation once the buoy power system is deployed in an ocean environment.

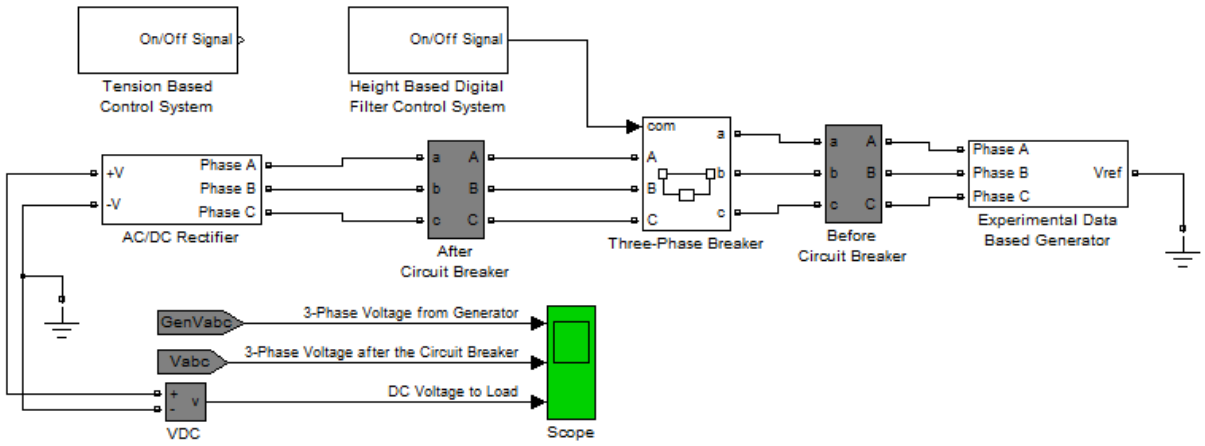

Fig. 1 Schematic for Wave Energy Conversion (WEC) system

The first alternative prototype (see Fig. 2) was built with the following characteristics:

- A cable is used instead of a chain to improve reliability
- A two-shaft system is used that allows motion on both upstroke and down-stroke without need of additional pulleys to be mounted to the floor
- A large size aluminum flywheel is used to increase the inertia of the rotating system
- A 4:1 gear set increases the RPM and power output

The second alternative prototype (see Fig. 3) was built with the following characteristics:

- Replaces the pulley and cable system with a rack-and-pinion to drive the shaft
- Also uses a two-shaft power drive system with ratchets on each to generate consistent power in both upward and downward motions

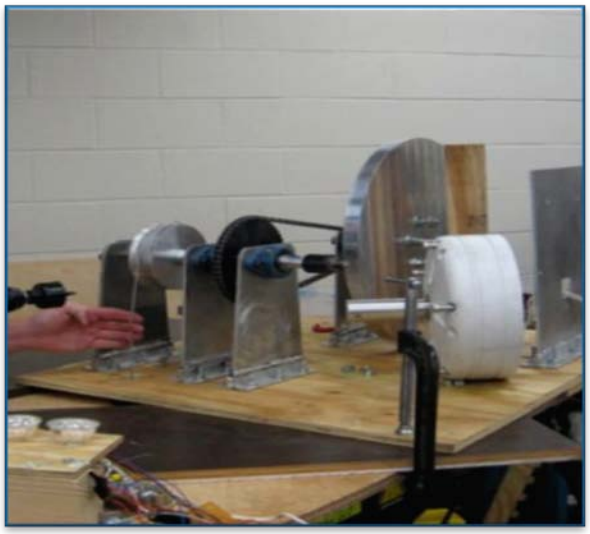

Fig. 2 Alternative prototype 1

Due to the lack of information regarding several important generator parameters provided by the manufacturer, a performance analysis was carried out.

- Developed a function to relate voltage produced by the generator with the moment applied to the shaft
- Determined a relation between the RPM of the shaft, the load acting on the generator, and the back-torque developed

An updated mathematical model was designed to simulate buoy motion on an ocean wave.

- Can be used to estimate power output for given conditions
- Allows for different design parameters to be varied to optimize design
- Will be used to prepare for next-generation, optimized design

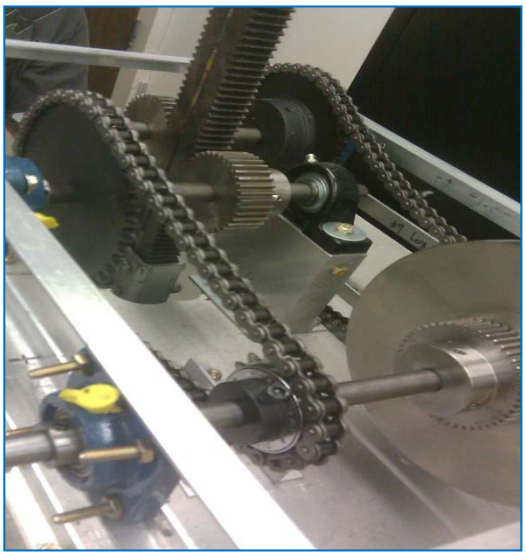

Fig. 3 Alternative prototype 2