

MBARI Wave Energy Converter Description

This document outlines the basic configuration of the MBARI wave-energy converter. This system is intended to generate small amounts of electrical power to be used for oceanographic instrumentation. The project goal is to develop a system that generates 300-500 Watts of power averaged across all sea states expected during a year in Monterey Bay. To date one month deployments have yielded averages of about 300 Watts using a purely resistive loading scheme. During high sea states the system generates ample power but the low sea states with long period waves the systems performance is insufficient.

System Description

The wave-energy converter consists of a nearly cylindrical surface buoy connected to a submerged plate 30m below the surface by an electro-hydraulic power take-off system.

Surface Buoy

The surface buoy is very nearly a cylinder and has the following characteristics:

- Diameter: 2.5m
- Water-plane area = 4.9 m^2
- Mass (with power take-off system attached) = 1520kg
- Displacement (with PTO system and plate attached) = 2.29 m^3
- Added-mass and damping of buoy computed by WAMIT is shown in the attached graphs. The WAMIT output files are also available.

Submerged Plate

- Geometry shown in attached drawing
- Mass = 972kg
- Area = 13.7 m^2
- Added mass estimate = 10140 kg
- Drag coefficient estimate = 1.9

Power Take-off System

The power take-off system is an electro-hydraulic system and also includes a pneumatic spring element. The damping element is controllable via computer at a rate of 10Hz and the spring element is set to a fixed value for the deployment. The hydraulic component includes a pressure relief valve that limits the total force the system can exert

- Total Stroke: 2m
- Spring coefficient. 4450N/m
- Max damping force: Approx 20000N as the pressure relief valve is currently set.
- Force/Speed relationship is shown in the attached graphs. Any loading can be applied and updated at a 10Hz rate as long as the maximum

voltage of the system is kept below 550 Volts. Currently the hydraulic relief valve limits the peak currents to 20 Amps.

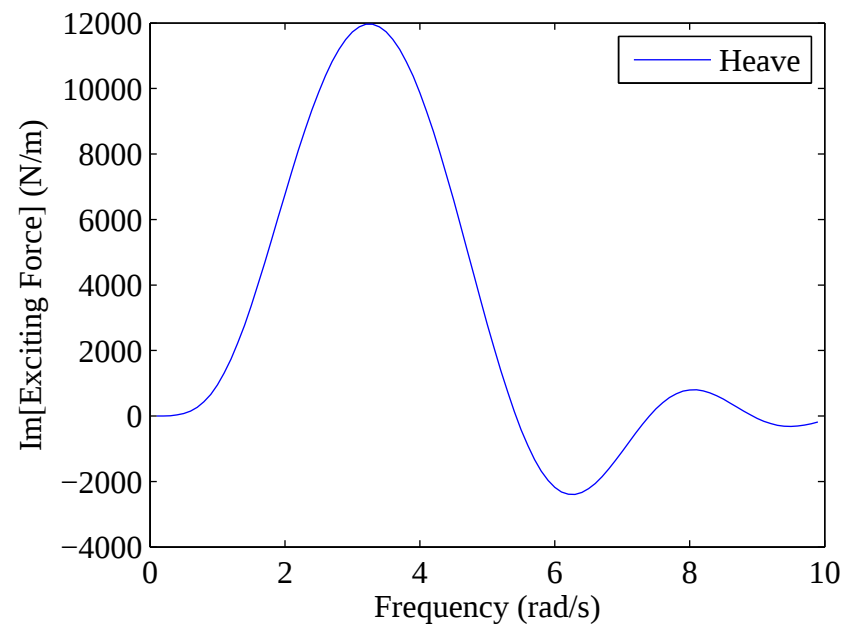
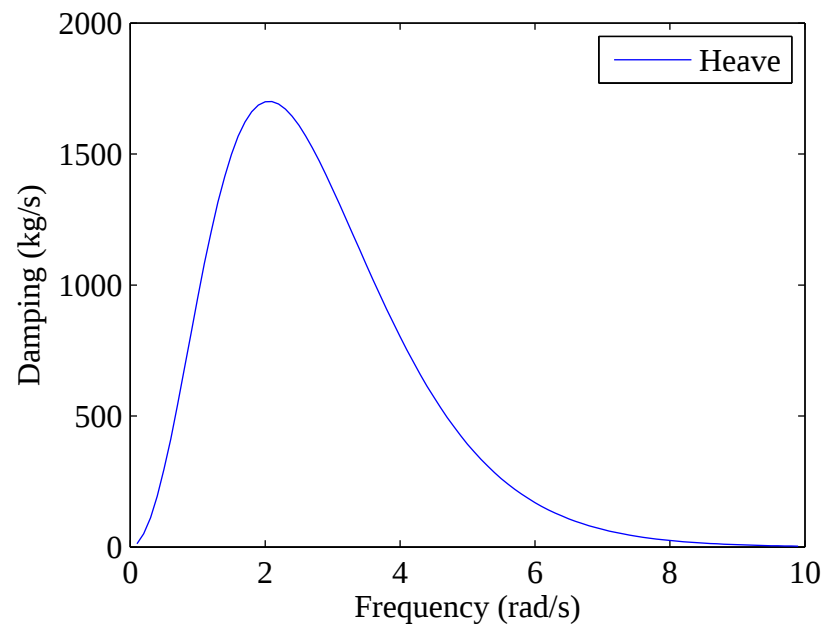
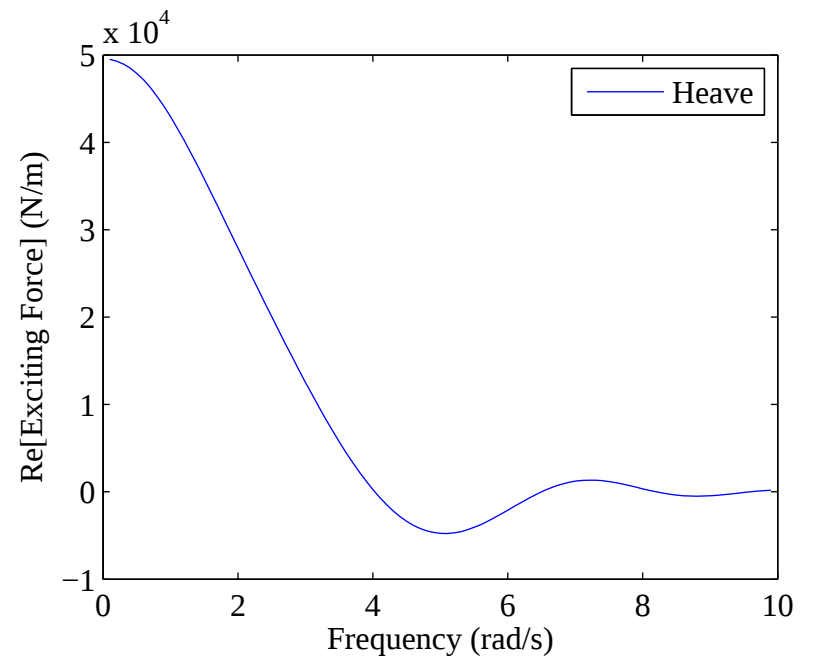
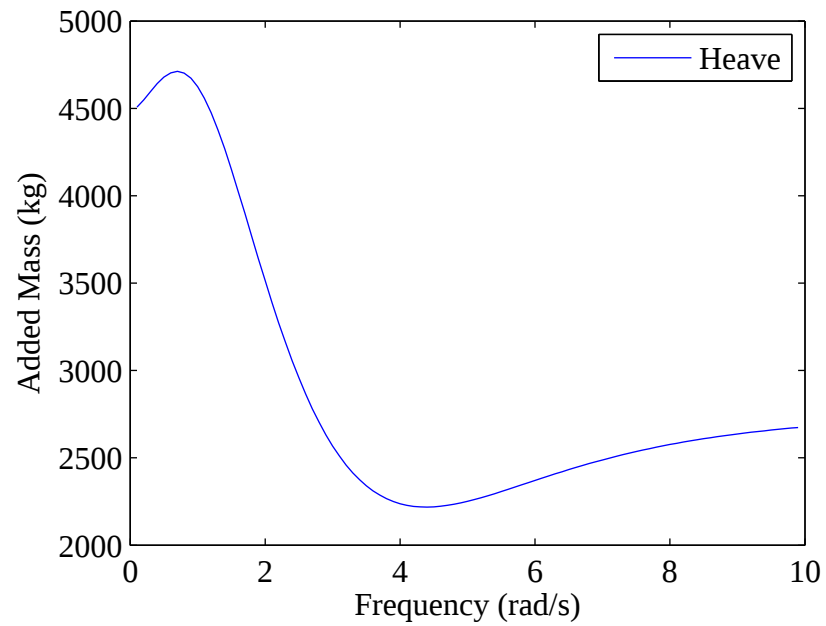
Instrumentation and Control System

The following relevant instrumentation on the buoy is currently monitored and logged at 10Hz. The power take-off control system has access to all of this data and can adjust the loading according. Currently the resistive loading scheme sets the loading based solely on piston velocity computed from the piston position.

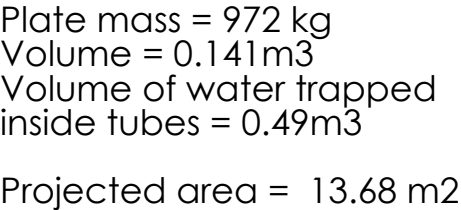
- Piston Position
- Force between buoy and PTO system
- Pressure sensor monitors sea pressure at top of the PTO
- GPS aided IMU on buoy measures buoy motions in 6DOF.
- Generator voltage
- Generator current

Sea conditions

The next deployment will take place in May in Monterey bay. We have good estimates of the expected sea spectra This is not a season of storms but is a time of afternoon wind waves. Throughout a month deployment a wide range of sea conditions will be experienced, we will need to settle on a few representative cases for this analysis.



REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
	INITIAL RELEASE		



Aluminum plates added
to increase area

BILL OF MATERIALS									
NEXT ASSY Description	NEXT ASSY Number	UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:				APPROVALS	DATE		
		1 PLACE DIM ±1/16	2 PLACE DIM ±.02	3 PLACE DIM ±.005	ANGLES ±1°	DRAWN	2/5/2013		
THIRD ANGLE PROJECTION		1. DIMENSIONS ARE IN INCHES				ENGINEER	Francois Cazenave		
		2. DIMENSION LIMITS HELD AFTER PLATING.				CHECKED			
		3. REMOVE BURRS AND SHARP EDGES .015 MAX.				PROJECT NO.			
		4. MACHINED FILLET RADII .0150-.030.				PROJECT			
		5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITHIN .005				Power Buoy			
		6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH, MAX .012 INCHES FOR SINGLE SURFACE.				WEIGHT lbs			
		Material:		Material					
						Monterey Bay Aquarium Research Institute MBARI 7700 Sandholdt RD. Moss Landing, CA 95039 PH: (831) 775-1700 			
						Submerged Plate			
						SIZE B	DWG. NO.		REV.
						SCALE	1:200	CAD FILE:	SHEET 1 OF 1

System Force and Efficiency

