Design Optimization of a Wave Energy Converter

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Goal: use MDO to minimize energy cost and power variation of the RM3 WEC

MDO	WEC	RM3
Multidisciplinary · **D**esign · **O**ptimization	**W**ave · **E**nergy · **C**onverter	**R**eference · Model · **3**
• Procedure to optimize engineering systems with cross-discipline coupling	• Renewable energy for utility grids and distributed offshore projects • Costs more than solar and wind, but perhaps more consistent power	• Reference WEC design by NREL and Sandia [10] • Comprised of two-body point absorber

Research Highlights

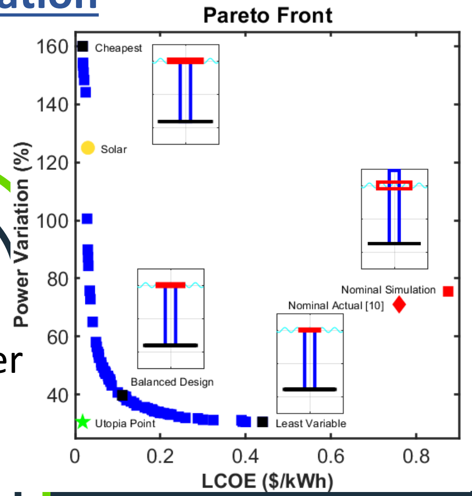
• Achieved **40 x lower energy cost** and 2 x less variable power

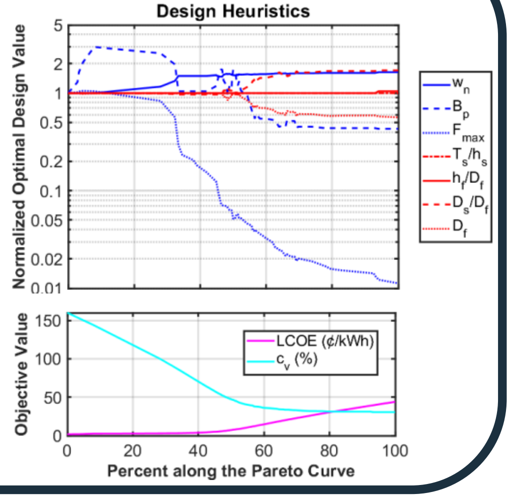
• Optimal tradeoff curve with three representative designs

• High **sensitivity** to sea states and economic parameters

• Potential to **share hardware** designs across applications

Optimization Results





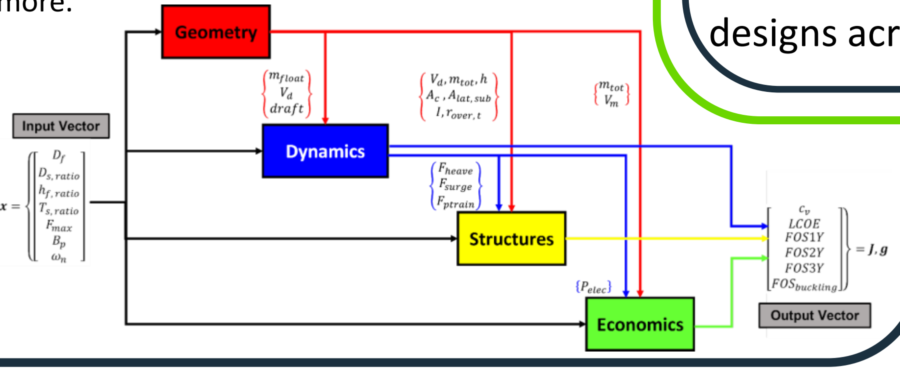
Simulation and Optimization Formulation

7 geometric and controller design variables are optimized while enforcing 14 constraints to prevent structural failure, instability, and more.

Two metrics to minimize:

$$LCOE = \frac{cost}{energy}$$

$$c_v = \frac{std.\ dev.\ power}{mean\ power}$$



Discussion

A tradeoff between energy cost (LCOE) and power variation (c_v) suggests a possibility of a **single hardware design** across applications, with application-specific controls software.

Three representative designs are highlighted: a min-LCOE design for cost-sensitive operations like utility power, a min-variation design for cost-insensitive installations like small offshore systems, and a balanced design for intermediate applications like island microgrids.

Future Work

1. Improve simulation fidelity
2. Consider application-specific objectives
3. Extend to other WEC architectures

References

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