

Using Hybrid Simulation to Measure the Flicker Output of a Grid-Connected Wave Energy Converter

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Flicker

- Change in visible light
- Caused by variations in voltage
- Defined by several standards:
 - IEC TS-62000-30
 - IEC TS-61000-4-15
 - IEEE 1547
 - IEEE 1453
 - UL 1741



Measuring Flicker

- Five stages:
 - Voltage scaling
 - Low frequency demodulation
 - Incandescent lamb eye-brain filter
 - Squaring & sliding filter brain short-term storage effect
 - Statistical Processing



Hybrid Simulation

- Computer-based numerical model
- Connected physical system
- Feedback between physical system and numerical model
- Commonly used in seismicresistant civil engineering



Why apply Hybrid Simulation to WECs?

- WEC hydrodynamics often require full-scale prototypes for complete dynamics
- Ocean conditions are harsh making prototyping costly
- Grid integration of WECs rarely occurs, often costly and difficult for WEC companies
- For power quality specifically:
 - Flicker studies are mainly simulations
 - Experimental data is rare and power output is proprietary data

WESRF's Hybrid Simulation WEC





Wave Speed and Position





Initial OWC WEC Hybrid Simulation





Questions?

