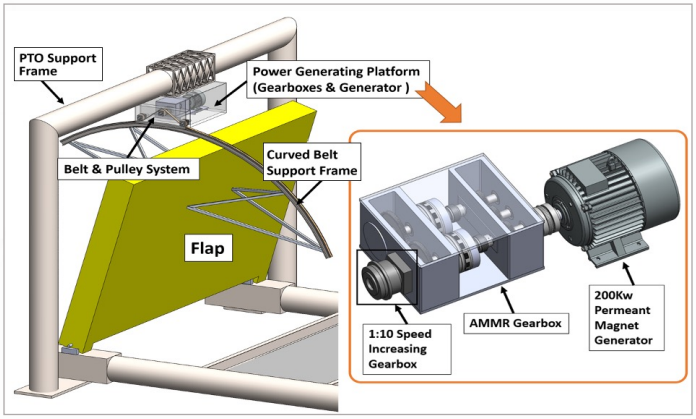
Power Take-off for Ocean Wave Energy Harvester

VTIP 21-095: "Control Co-designed Power Take-off and Motion Magnification Mechanism for Ocean Wave Energy Conversion"

THE CHALLENGE

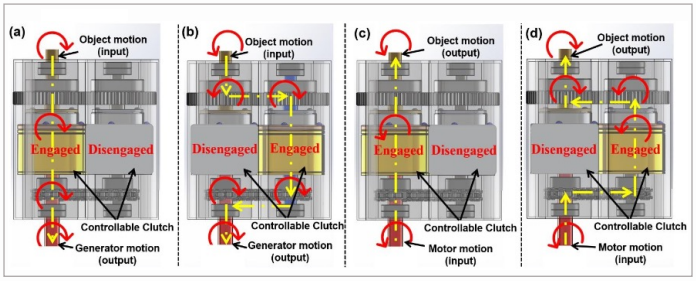
As global demand for energy rises, the ocean holds large, untapped potential as a source for renewable energy. The power takeoff mechanism is at the heart of wave energy converter (WEC) and is the mechanism by which the captured energy is transformed into usable electricity. The power takeoff is widely recognized as the most important challenge in WEC for generating power from a dynamic, low-velocity, and high-density resource while withstanding large loads in corrosive marine environments.



The active controllable power take-off can be realized in oscillating surge wave energy converter with a belt or rack pinion driven motion mechanism. It can also be integrated with point absorber buoy or other type of wave energy converters.

OUR SOLUTION

Researchers at Virginia Tech and Stevens Institute of Technology have developed an active controllable power take-off for ocean wave energy conversion. Within the system, which can be applied to several types of wave energy designs, two controllable clutches can actively control engagement and disengagement, allowing the generator to be driven in unidirectional rotation and to act as a motor to drive the WEC in two directions to synchronize the WEC motion with the wave excitation. A innovation motion magnification by using the wave energy capture structure itself also allow efficient power transmission. Our invention will significantly increase the efficiency, reliability, and power output of wave energy converters, reduce the peak-to-average power ratio and thus substantially reduce the levelized cost of electricity (LCOE, in $/KWH). This invention has been verified in dry lab and wave tank tests.



The four modes of a gear-chain based active controllable power take-off. A and B show the drive mode, during which the bidirectional motion of WEC object input drive the generator in a unidirectional rotation (output). C and D show the control mode, where the unidirectional motor motion is the input while driving the WEC object into bidirectional motion to synchronize with the wave excitation and thus maximize the wave power extraction.

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