

Innovative Climate Change Emissions Reduction: Flettner Vortex Scrubber with Active Seakeeping

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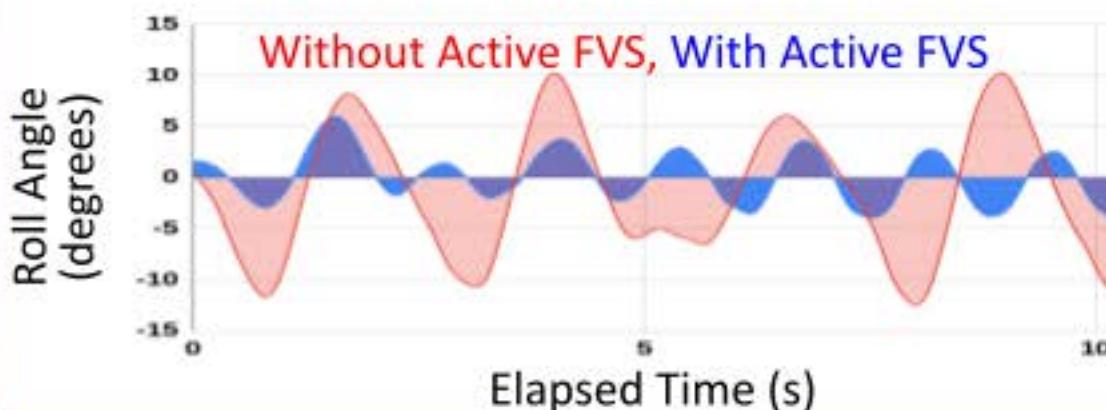
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Problem: 90% of goods move by cargo ships, a root cause of climate change and respiratory health issues. We need mitigation technology that will be implemented rapidly, with compelling business cases for ship owners and operators.

Engineering Goal: Expand both vessel efficiency and capability through creative use of valuable cargo space. Design novel active seakeeping control for the Flettner Vortex Scrubber (FVS), creating hybrid wind and fossil fuel powered vessel, cleaning exhaust and providing an expanded vessel operating envelope.



Data Analysis & Results: Result Sample, Forced Vibration Ocean Wave Simulation. Active FVS effectively reduced maximum rolling angle by 65.6% (total n = 120 waves)



Project Design:

- Design iterations performed in CAD and computational fluid dynamics.
- Custom Scale Test Mule designed and built: Vessel model with mass distribution, buoyancy, and hull shape approximating a neopanamax cargo ship.
- Custom Wave Pool designed and built, simulating open ocean, and used it for tuning and testing novel active seakeeping algorithm and control systems.
- Tested functional prototype in both a Forced Vibration Ocean Wave Simulation, and also a Free Vibration Simulation.

Interpretation & Conclusions: Statistical analyses show that the Active FVS is a significantly effective seakeeping system. This investment pays for itself in less than a year through fuel savings and increased cargo space. The Active FVS allows a neopanamax ship to transport an additional containers worth \$185,000 on a trip from Shanghai to New York, while improving IMO emissions compliance. Scaling globally means annual reductions of:

- 93 million metric tonnes of climate-changing CO₂,
- 1900 kilotonnes of nitrogen oxides,
- 160 kilotonnes of asthma-causing particulate matter.
- A climate change impact equivalent to taking 7.5 million cars off the road.