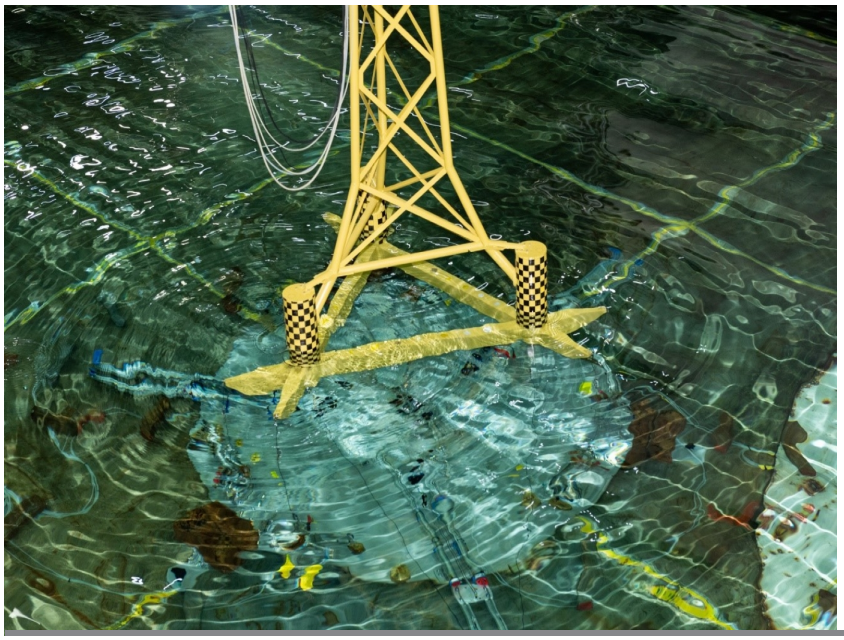


National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Tension Element Vibration Damping

A Fundamentally New Approach to Structural Vibration Control

NASA engineers have developed a new approach to mitigating unwanted structural vibrations. NASA's method is fundamentally different from conventional passive and active vibration damping methods widely used today. Tension Element Vibration Damping uses “disruptive modal coupling” between two structures, each with their own vibrational behavior, to proactively provide vibration damping for one or both of the structures. This novel vibration damping method reacts to, and uses the vibrational tensile/compressive displacement itself to disrupt the vibration. Resistance to the displacement force is provided by either hydraulic, pneumatic, or magnetic means to suit the target application and the size/displacement of the vibration. Compared to conventional vibration passive and active damping methods, Tension Element Vibration Damping systems are simple in design, lightweight, highly effective, and adaptable to a range of applications with different structure sizes and types of vibration.

BENEFITS

- Fundamentally new: approach to vibration damping is innovative
- Spatially efficient: simple and lightweight design
- Dynamically responsive: to changes in vibration amplitude and frequency
- Broadly adaptable: to low frequency vibration down to less than 1Hz
- Entirely reactive: system requires no energy input or external loads
- Effective for one or two structures: duality offers vibration control for either one or multiple connected structure

APPLICATIONS

The technology has several potential applications:

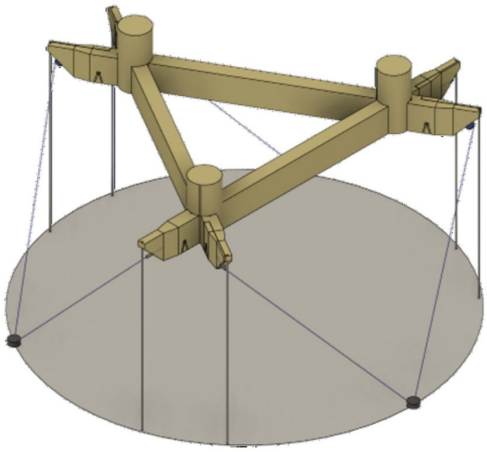
- Vibration damping in tall, slender structures: Wind turbine blades and towers, drilling rigs, space rocket launch structures, towers, industrial stacks, floating platforms and structures
- Vibration control of small-scale, high-aspect-ratio structures: scientific equipment and instrumentation

THE TECHNOLOGY

NASA's Tension Element Vibration Damping technology presents a novel method of managing the dynamic behavior of structures by capturing the vibrational displacement of the structure via a connecting link and using this motion to drive a resistive element. The resistive element then provides a force feedback that manages the dynamic behavior of the total system or structure. The damping force feedback can be a tensile or compressive force, or both. Purely tensile force has advantages for packaging and connection alignment flexibility while combined tensile/compression forces have the advantage of providing damping over a complete vibratory cycle.

This innovation can be readily applied to existing structures and incorporated into any given design as the connecting element is easily affixed to displacing points within the structure and the resistive element to be located in available space or a convenient location. The resistive element can be supplied by any one of either hydraulic, pneumatic or magnetic forces. As such the innovation can provide a wide range of damping forces, a linear damping function and/or an extended dynamic range of attenuation, providing broad flexibility in configuration size and functional applicability.

NASA-built prototypes have been shown to be highly effective on a 170-foot long wind turbine blade in test beds at the University of Maine.



Schematic of the NASA Tension Element Vibration Damping technology

Oil rig structure that could benefit from this NASA vibration damping technology.

PUBLICATIONS

Patent No: 11,078,984; 11,041,539; 11,441,311; 11,111,980

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

MFS-33814-1, MFS-33815-1, MFS-33825-1, MFS-34190-1, MFS-33815-2, MFS-TOPS-125

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