



Permanent Magnet AC Machine Direct-Drive Resonant System

This new flapping wing/fin resonant system provides a highly efficient, well-balanced, and easily manufacturable actuator for rotary reciprocating motion in aerial, underwater, and haptic applications.

Flapping Wing Micro-Aerial Vehicles (FWMAV) employ complex, inefficient systems for operation. Currently, three general systems have been utilized: piezoelectric cantilever mechanisms, motor driven linkages, and motor gear direct drives. Piezoelectric systems require high voltage to operate and are limited underwater due to their lack of at scale power circuits. Motor driven linkages are used at a larger scale. The motor is running continuously at high efficiency, but it operates at a fixed rate and requires additional actuation to generate control forces/torque for flight. Motor direct drive systems generally use two motors running discontinuously, which leads to suboptimal efficiency. The aforementioned systems require precise fabrication and assembly and suffer from various degrees of structural fatigue due to vibration. Some fail in the matter of minutes.

Researchers at Purdue University have developed a flapping wing/fin resonant system, which cuts the cost of manufacturing and operates at high efficiency. This technology contains a highly magnetically permeable core and elastic properties to induce increased torque and reduced energy loss, maintaining a well-balanced system. The simplicity of the design makes the system easy to manufacture and energy efficient. In addition to the resonant system's use aerially in flapping wing micro-air vehicles and underwater in flapping fin autonomous underwater vehicles, the actuator can be optimized for any application that needs rotary reciprocating motion or as a vibration haptic device.

Advantages:

- Actuator has high efficiency
- Core has high magnetic permeability
- Well-balanced

Technology ID

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Category

Aerospace &
Defense/Autonomous Systems
(UAVs & AVs)
Robotics &
Automation/Automation &
Control

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View online



-Simple design, easy to manufacture

-Energy efficient

Potential Applications:

-Flapping wing micro-air vehicles

-Flapping fin autonomous underwater vehicles

-Haptic feedback device

TRL: 4

Intellectual Property:

Provisional-Patent, 2017-05-26, United States

Utility Patent, 2018-05-29, United States

Keywords: Flapping Wing Micro-Aerial Vehicles, FWMAV, flapping wing resonant system, flapping fin autonomous underwater vehicles, AUV, rotary reciprocating motion, vibration haptic device, high efficiency actuator, high magnetic permeability core, piezoelectric cantilever mechanisms, Actuators, Magnetics, Mechanical Engineering, Metals, Robotics, UAV, Vibration