Electromagnetic actuator with variable compliance

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Invention

The proposed device aims to fill a gap in the field of **electromagnetic and mechanical actuators**; creating a simple and compact actuator capable of simultaneously producing an **active force/torque and a passive reaction with variable compliance**. Solutions currently in use are based on separate and complex devices, difficult to integrate in small volumes.

The presence of a single actuator able to operate in an active and passive way can bring considerable advantages in the design of robotic, biomedical and industrial systems in terms of reducing complexity and increasing the performance and functionality of the systems in which they will be used.

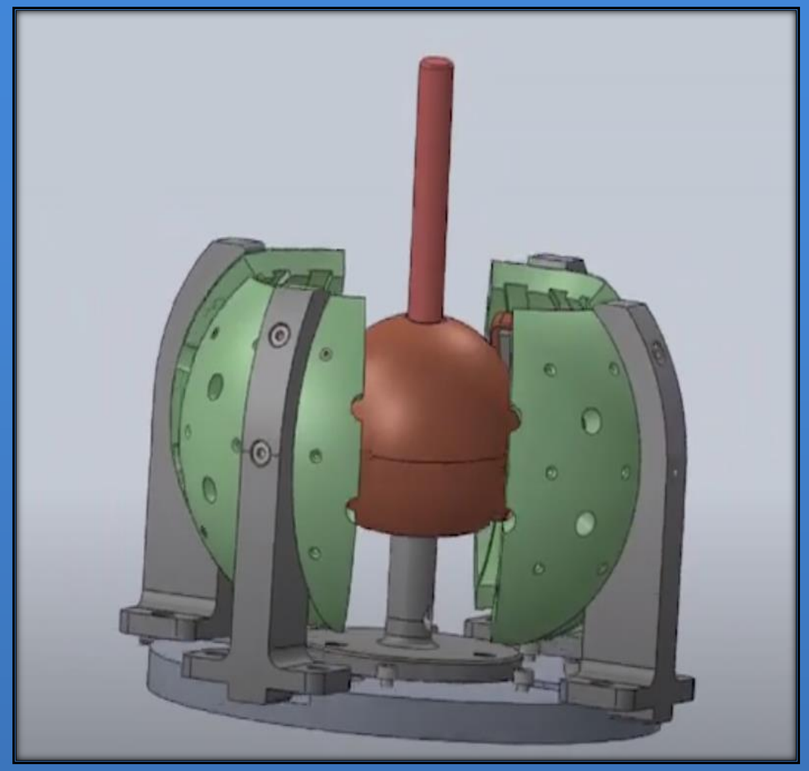
The system is designed to provide an active electromagnetic torque and a passive internal reaction pair. The active electromagnetic torque is produced by the interaction between the magnetic field generated by a system of electric windings on the stator and the currents induced on an aluminium foil placed on the rotor.

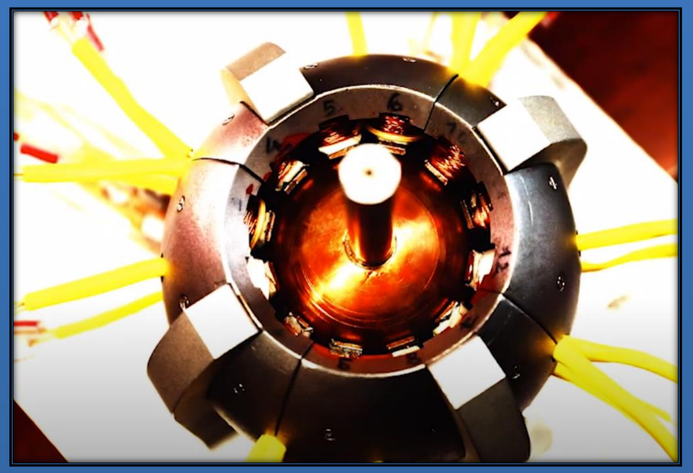
The **passive reaction torque**, instead, is obtained thanks to a magnetoreological fluid (MRF) contained in the gap between stator and rotor. This fluid is composed of micro-particles of iron dispersed in a base of oil or water. In resting conditions, it behaves like a common low-viscosity lubricating fluid. If the fluid is excited by an external magnetic field, instead, it changes its rheological properties to become semi-solid.

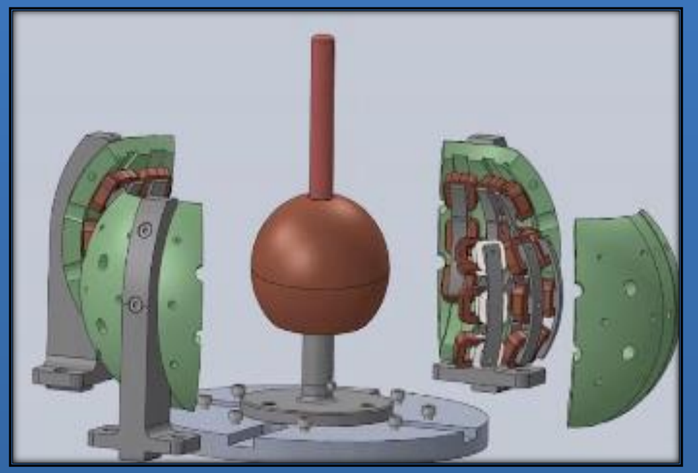
By properly controlling the magnetic field of excitation of the MRF it is possible to modulate the passive reaction torque obtaining a device with variable compliance.

The system works with **3 degrees of freedom (Dof)** being able to move in the plane z-x and z-y with an angle width of about ± (60° - 70°) and being able to rotate of 360 around the z axis.

Drawings & pictures







Industrial applications

The electromagnetic variable-compliance actuator developed can be used in **robotics**, in particular in industrial robotics, as a spherical "joint" for connections between mobile parts; in the **biomedical field** the intended use is in the design of special prostheses or haptic interfaces.

The device may be able to simulate human body joints or to recreate a force feedback capable of reproducing a constrained movement, to be used for example in remote surgical activities, or in personnel training (for example health professionals) via virtual devices.

In addition, the device can be used for the **realization of Joystick** in which the reaction force can be made to vary according to different parameters (for example in the cloche of flight simulators or video games) or in **wind generators as a start/braking system** controlled according to wind speed and rotation system stress.

Possible developments

A **prototype** that is currently in the testing phase has been realized thanks to a partnership with a company in the sector that has taken care of the actual construction of the various components of the device and their assembly.

It is planned to develop further prototypes, even on a different scale, to conduct experimental tests and analysis of the results to increase the TRL current and futures prototypes .

As a result of this phase, new specifications will be available for use in the construction of a new refined laboratory prototype, on which experimental measurements will be carried out both to validate general performance and assess the capability of the device to be used for the intended applications.

You can watch a **video of the technology** to the following **LINK.**

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