COMPACT SERIES ELASTIC ACTUATOR INTEGRATION

Tech ID: 33610 / UC Case 2024-098-0

PATENT STATUS

Patent Pending

BRIEF DESCRIPTION

While robots have proven effective in enhancing the precision and time efficiency of MRI-guided interventions across various medical applications, safety remains a formidable challenge for robots operating within MRI environments. As the robots assume full control of medical procedures, the reliability of their operation becomes paramount. Precise control over robot forces is particularly crucial to ensure safe interaction within the MRI environment. Furthermore, the confined space in the MRI bore complicates the safe operation of human-robot interaction, presenting challenges to maneuverability. However, there exists a notable scarcity of force-controlled robot actuators specifically tailored for MRI applications.

To overcome these challenges, UC Berkeley researchers have developed a novel MRI-compatible rotary series elastic actuator module utilizing velocity-sourced ultrasonic motors for force-controlled robots operating within MRI scanners. Unlike previous MRI-compatible SEA designs, the module incorporates a transmission force sensing series elastic actuator structure, while remaining compact in size. The actuator is cylindrical in shape with a length shorter than its diameter and integrates seamlessly with a disk-shaped motor. A precision torque controller enhances the robustness of the invention's torque control even in the presence of varying external impedance; the torque control performance has been experimentally validated in both 3 Tesla MRI and non-MRI environments, achieving a settling time of 0.1 seconds and a steady-state error within 2% of its maximum output torque. It exhibits consistent performance across low and high external impedance scenarios, compared to conventional controllers for velocity-sourced SEAs that struggle with steady-state performance under low external impedance conditions.

SUGGESTED USES

» Robotic, MRI-guided medical interventions

» MRI-guided brain stimulation

ADVANTAGES

» Compact, cylindrical design (length shorter than diameter) compatible with commercial ultrasonic motors

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OTHER INFORMATION

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» Medical
» Position sensors
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RELATED CASES

» Transmission force-sensing series elastic actuator structure

» High-precision torque control, robust through varying impedance

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Printable Repulsive-Force Electrostatic Actuator Methods and Device
- Multilayer Pouch Robot And Manufacturing Method
- Locomotion Device and Methods and Related Software

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