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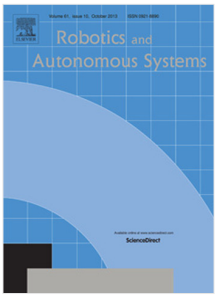

Integrated design, modeling and analysis of a novel spherical motion generator driven by electromagnetic principle

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Integrated Design, Modeling and Analysis of a Novel Spherical Motion Generator Driven by Electromagnetic Principle

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Abstract

Spherical motion generators are increasingly needed for constructing robots, manipulators and pointing devices. This paper presents a novel design of spherical motion generator built on the basis of a spherical parallel manipulator. The new motion generator integrates the electromagnetic actuator with the coaxial 3-RRR spherical parallel manipulator, thus leads to a more compact and light-weight structure with the advantages of no backlash, high stiffness and low inertia. In this paper, the inverse kinematics and dynamics of the spherical parallel manipulator are described. The analytical torque model of this spherical motion generator is developed and compared with the numerical finite element method by Ansoft Maxwell. The models allow for comprehensive design analysis and parameter optimization. It is shown that the proposed SMG has better performance with larger workspace and output torques than the existing permanent magnet spherical motors with comparable dimensions. Upon the developed model, a motion control method is developed for tracking trajectory to demonstrate the application of the analytical model.

Keywords: Spherical motion generator, Permanent magnet spherical motor, Spherical parallel manipulator, Torque model, Trajectory tracking control;

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