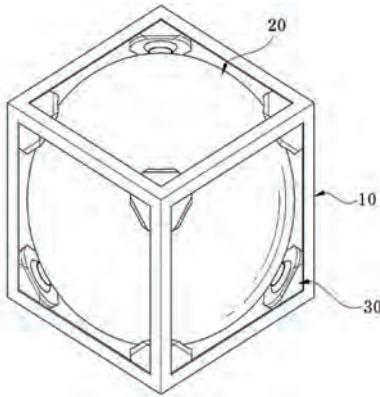


09

Three Dimensional Rigid Ball driving System

Rigid ball driving system for controlling attitude of satellite



Inventor

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Team

Satellite Control Team

Status of right

- US : 9751644
- JP : 6023326

Title

- THREE-DIMENSIONAL RIGID BALL DRIVING SYSTEM
- THREE-DIMENSIONAL RIGID BALL DRIVING SYSTEM

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Outline of Technology

A three dimensional rigid ball actuation system is a new concept of next generation actuator that can be replaced with the conventional general actuator used for attitude control and momentum storage, and is capable of accurately controlling the orientation in a three-axis direction by rotating a spherical fly wheel in a desired direction.

■ Problems of conventional art

- A conventional actuator operates in a manner of generating a single axis control torque, and requires at least three actuators to control an attitude of a satellite in a three-axis (X, Y and Z) direction.
- Since a plurality of actuators are used for the purpose of three-axis attitude control, there are problems with an increase in costs, volume and weight, and ensuring technical/economic competitiveness of a satellite shall be taken into account.

Technical features and advantages

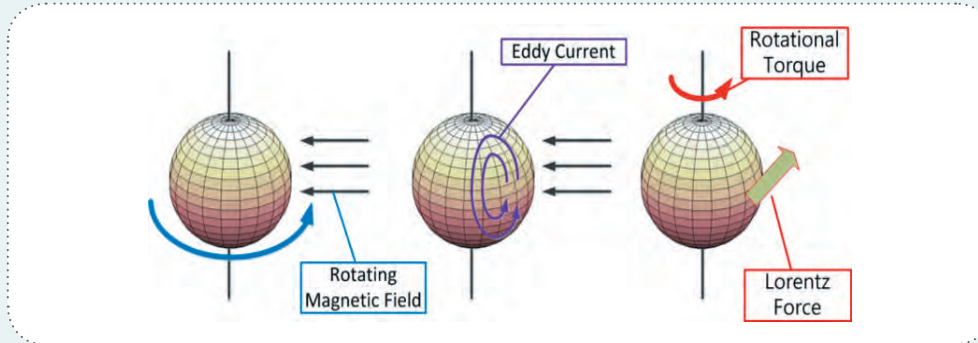
Distinctiveness

- A single actuator enables three-axis control of a satellite, and thus lightweight, small in size and a reduction in cost can be implemented.

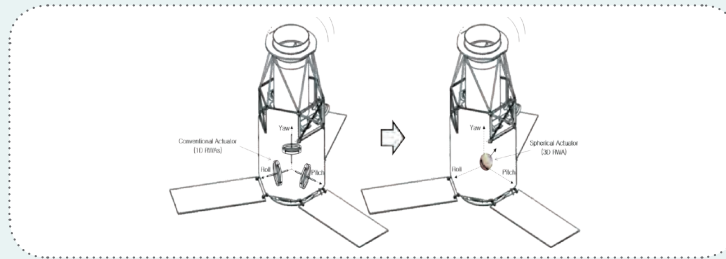
Technical features and advantages

Technical effects

- A torque generated by Lorentz's force between a rotating magnetic field and an induced current is used for a spherical (3D) fly wheel.

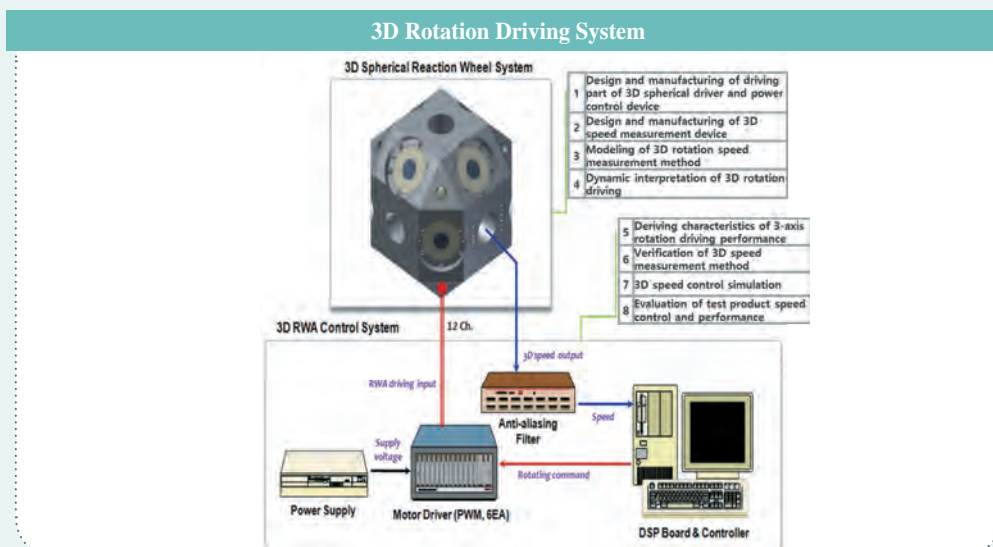


- The spherical fly wheel can rotate in a three dimensional direction, and a torque in a three-axis direction is generated.



Technical detail

- Analysis of driving characteristics through design and manufacturing of a one-dimensional spherical actuator model and performance test

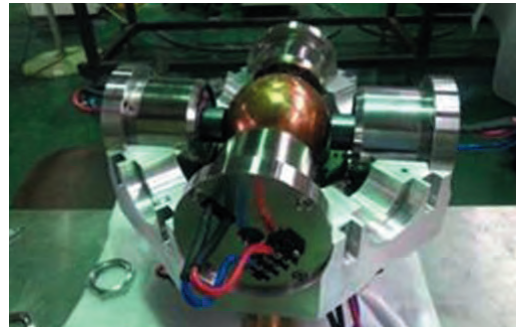
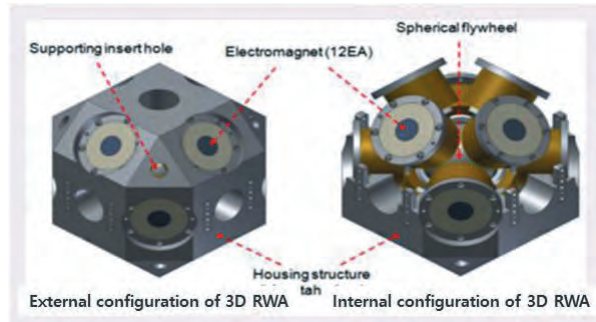


Three Dimensional Rigid Ball driving System

Technical detail

- Design of 3D spherical actuator and interpretation of speed control (S/W), and development of 3D spherical actuator test products (H/W)

Internal/External Configuration



Application example

Segway (conceptual diagram)



Market and future prospect

For the next 10 years from 2013 to 2022, the U.S., Russia, Europe (France and Italy), Japan, China, India, and Israel are capable of operating low earth orbit and geostationary orbit launch vehicle, and launch vehicles that have been operated and under development by the countries are 46. The launch vehicle market size is estimated to produce 739 vehicles, and to reach a sales of fifty-eight billion, four hundred million, nine hundred twenty thousand USD for the next 10 years.

Identification	2003~2012	2013~2022	Increase/decrease
Number of launching satellite	809 satellites	1,151 satellites	+42%
Total weight of launched satellites	1,824 tons	2,397 tons	+31%
Satellite market	142 billion UDS	1,81 billion UDS	+27%
Launching service market	45 billion USD	55 billion UDS	+23%
Sum of satellite + launching service markets	187 billion USD	2,36 billion UDS	+26%

Estimate of demand for launching a satellite for the next 10 years

Applications

- CNG is employed to substitute the conventional actuator for controlling an attitude of a satellite.
- This technology has been drawing an increasing amount of attention as the next generation attitude control actuator covering the field of space and underwater robotics, vessels, flight, precision motors as well as small satellites.

