VANDERBILT UNIVERSITY

CTTC Center for Technology Transfer & Commercialization

Monopropellant/Hypergolic Powered Proportional Actuator

Summary

This proportional actuator developed at Vanderbilt University is a superior source of controllable power for mobile robots. It utilizes monopropellant or hypergolic bipropellant fuel sources in a controlled manner for more efficient and effective untethered mobile robots performing human mechanical tasks over a prolonged period of time.

Addressed Need

- Electrochemical batteries, typically used to power electric motors in mobile robots, are limited by insufficient mass specific energy density to perform human scale work for a long time. For example the Honda P-3 Humanoid robot only operates for 15-25 minutes depending on its work load.
- Electric motors are energetically expensive and require a bulky speed reducing gearbox, adding weight.
- Hydraulic actuators require pumps that are too heavy for human scale robots
- Internal combustion engines cannot be force or motion controlled over bandwidths of human-scale robots. They must be used to drive more complex, low energy-density systems.
- Monopropellants have been used as fuel sources but never with proportional force or motion control of robotic actuators.

Technology Description

The invention uses a monopropellant powered actuator to increase the energetic performance of the system to ten times that of the state-of-the-art battery/servomotor combination. The system uses monopropellant or hypergolic liquids (H_2O_2 or HAN based fuels) to power any fluid-powered actuator. The increase in energetic performance of the system leads to extended run time and efficiency, increasing the usefulness of machines such as self-powered robots. Although a variety of configurations are possible, the system commonly consists of a blow down fuel tank that delivers fuel to a catalyst producing a gaseous product. Proportional valves control the gas flow to the actuator, actuating the piston and powering the system in a highly controlled manner.

Commercial Applications

- Powering untethered mobile robotic actuators
- Creating controllable forces on actuators with centralized or distributed monopropellant actuator systems
- Any self-powered application with a high energy and power density control actuator

Unique Properties and Competitive Advantages

- No pre-mixing, pre-compression or ignition
- Flow control occurs within the liquid state reducing energy loss
- Direct chemical to mechanical energy with 10x more energy and power densities than a battery
- In the application of untethered mobile robots it provides extended run time when performing human mechanical tasks, making the robot more efficient and effective
- Potential to be increased further with modification of the monopropellant fuel

Intellectual Property Status

- US Patent 6,935,109 issued Aug 30, 2005.
- For more information, demonstration videos, and related publications visit: http://research.vuse.vanderbilt.edu/cim/research_monopropellant.html
- For inventor bios click the names below

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