PATENT SPECIFICATION

Polar-Optimized Motor Controller Design

Patent Application No. 16/789,432

Filing Date: March 15, 2022

ABSTRACT

A system and method for controlling electric motors in extreme low-temperature environments, comprising a thermally-optimized motor controller with integrated temperature compensation algorithms and cold-resistant semiconductor components. The controller maintains precise positional control and torque management while operating in ambient temperatures as low as -40 C through the implementation of proprietary thermal management techniques and adaptive control algorithms.

BACKGROUND

[0001] Autonomous mobile robots operating in cold storage and industrial freezer environments face significant challenges related to motor control and positioning accuracy. Traditional motor controllers exhibit degraded performance and increased failure rates when exposed to extreme low temperatures, primarily due to changes in semiconductor characteristics and mechanical stress on components.

[0002] Existing solutions typically rely on heating elements or thermal enclosures, resulting in increased power consumption and reduced operational efficiency. There remains a need for motor control systems specifically designed to maintain optimal performance in cold environments without requiring external thermal management.

DETAILED DESCRIPTION

[0003] The present invention provides a motor controller architecture specifically designed for operation in extreme cold environments, comprising:

a) A primary control unit featuring:

- Cold-hardened semiconductor components rated for operation at -40 C
- Temperature-compensated oscillator circuits maintaining timing accuracy
- Proprietary thermal gradient management system

- Adaptive gain control algorithms

b) Sensor integration system including:

- Hall effect position sensors with temperature compensation
- Current monitoring circuits with automatic calibration
- Thermal feedback loop integration
- Real-time performance optimization algorithms

[0004] The controller implements a novel approach to motor commutation timing, automatically adjusting switching parameters based on measured temperature gradients and motor load conditions. This adaptive control system maintains optimal torque production and positioning accuracy across the entire operating temperature range.

CLAIMS

A motor control system comprising:

a) A primary control unit configured to operate in ambient temperatures between -40 C and +50 C;

b) Temperature compensation circuits for maintaining timing accuracy;

c) Adaptive control algorithms for optimizing motor performance based on environmental conditions;

d) Integrated thermal management system for component protection.

The motor control system of claim 1, wherein the temperature compensation circuits include:

a) Cold-hardened oscillator components;

b) Automatic gain adjustment mechanisms;

c) Real-time thermal feedback processing;

d) Dynamic parameter optimization routines.

A method for controlling electric motors in cold environments, comprising:

a) Monitoring ambient and component temperatures;

b) Adjusting control parameters based on thermal conditions;

c) Implementing adaptive commutation timing;

d) Maintaining positioning accuracy through thermal compensation.

DRAWINGS

[0005] Figure 1: Block diagram of the cold-optimized motor controller architecture

[0006] Figure 2: Thermal management system schematic

[0007] Figure 3: Control algorithm flow diagram

[0008] Figure 4: Performance characteristics across temperature range

INVENTORS

Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

100 Innovation Drive

Cambridge, MA 02142

Marcus Chen

Chief Technology Officer

Polar Dynamics Robotics, Inc.

100 Innovation Drive

Cambridge, MA 02142

ASSIGNMENT

The inventors hereby assign all right, title, and interest in this patent application to:

Polar Dynamics Robotics, Inc.

A Delaware Corporation

100 Innovation Drive

Cambridge, MA 02142

DECLARATION

I hereby declare that I am the original inventor of the subject matter which is claimed and for which a patent is sought; that I have reviewed and understand the contents of the above-identified specification, including the claims; and that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true.

Executed on: March 15, 2022

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Dr. James Barrett

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Marcus Chen

LEGAL REPRESENTATION

Patent prosecution handled by:

Morrison & Thompson LLP

Patent & Intellectual Property Group

200 State Street, Suite 3000

Boston, MA 02109

Attorney Docket No.: PDR-2022-03-15-001