Patent: Anti-Freeze Lubricant Delivery System for Robotic Joints

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ABSTRACT

A system and method for delivering temperature-resistant lubricant to robotic joint assemblies operating in sub-zero environments. The invention comprises a network of thermally-insulated microchannels, smart-sensing lubricant reservoirs, and precision dispensing mechanisms that maintain optimal joint lubrication in temperatures ranging from -40 C to +50 C. The system incorporates adaptive viscosity control and predictive maintenance capabilities.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage and freezer environments face significant challenges related to joint lubrication and mechanical wear. Traditional lubricant delivery systems fail at low temperatures due to increased viscosity and potential freezing of lubricating compounds.

[0002] Existing solutions have proven inadequate for maintaining consistent lubrication in extreme cold conditions, leading to premature wear, increased maintenance requirements, and potential system failures.

SUMMARY OF THE INVENTION

[0003] The present invention provides a novel solution for delivering temperature-adaptive lubricants to robotic joint assemblies operating in extreme cold environments. Key components include:

a) Thermally-regulated lubricant reservoirs with integrated heating elements

b) Network of insulated microchannels with smart flow control

c) Temperature-responsive viscosity modification system

d) Predictive maintenance sensors and feedback mechanisms

e) Adaptive dispensing algorithms based on operational conditions

DETAILED DESCRIPTION

Thermal Regulation System

[0004] The primary lubricant reservoir incorporates a proprietary heating element array that maintains lubricant temperature between -5 C and +10 C, regardless of ambient conditions. The heating elements are powered by the robot's main power system and controlled by a dedicated microprocessor.

Microchannel Network

[0005] A network of thermally-insulated microchannels, constructed from aerospace-grade composite materials, delivers lubricant to critical joint assemblies. Channel diameter ranges from 0.5mm to 2.0mm, optimized for specific joint requirements.

Smart Sensing System

[0006] The invention incorporates multiple sensor types:

- Temperature sensors (accuracy 0.1 C)
- Pressure sensors (0-100 psi range)
- Viscosity monitors
- Flow rate sensors
- Wear detection sensors

Control Architecture

[0007] The system employs a hierarchical control architecture:

Primary control unit (PCU)

Local joint controllers (LJCs)

Sensor integration modules (SIMs)

Predictive maintenance algorithm (PMA)

CLAIMS

A system for delivering temperature-resistant lubricant to robotic joints comprising:

a) A thermally-regulated primary lubricant reservoir

b) A network of insulated delivery channels

c) Multiple smart sensing elements

d) An adaptive control system

The system of claim 1, wherein the lubricant reservoir maintains temperature between -5 C and +10 C in ambient conditions ranging from -40 C to +50 C.

The system of claim 1, wherein the delivery channels comprise composite materials with thermal conductivity below 0.1 W/mK.

[Claims 4-20 omitted for brevity]

DRAWINGS

[Reference is made to the accompanying drawings:

Fig. 1: System Overview

Fig. 2: Reservoir Design

Fig. 3: Microchannel Network

Fig. 4: Control Architecture

Fig. 5: Sensor Layout]

TECHNICAL FIELD

[0008] This invention relates to the field of robotics, specifically addressing lubrication systems for autonomous mobile robots operating in extreme temperature environments. The invention has particular application in cold storage facilities, pharmaceutical manufacturing, and industrial freezer environments.

INDUSTRIAL APPLICABILITY

[0009] The invention provides significant advantages for autonomous mobile robots operating in cold environments, including:

- Extended joint lifetime
- Reduced maintenance requirements
- Improved operational reliability
- Enhanced performance in extreme conditions

- Lower total cost of ownership

CERTIFICATION

I hereby certify that I am authorized to execute this patent application on behalf of Polar Dynamics Robotics, Inc.

/s/ Marcus Chen

Marcus Chen

Chief Technology Officer

Polar Dynamics Robotics, Inc.

Date: March 15, 2021

LEGAL REPRESENTATION

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