

IceNav Environmental Mapping Protocol

Polar Dynamics Robotics, Inc.

Protocol Version 2.4

Effective Date: January 15, 2024

1. Purpose and Scope

1. This Environmental Mapping Protocol ("Protocol") establishes the standard operating procedures and technical specifications for environmental data collection, processing, and utilization within the IceNav(TM) Autonomous Navigation System developed by Polar Dynamics Robotics, Inc. ("Company").

2. This Protocol governs all environmental mapping activities conducted by Company's autonomous mobile robots ("AMRs") operating in temperature-controlled environments ranging from -40 C to +25 C.

2. Definitions

1. "Environmental Data" means any spatial, thermal, or physical data collected by AMR sensors during operation, including but not limited to:

- a) Temperature gradient measurements
- b) Humidity levels
- c) Surface friction coefficients
- d) Ice formation indicators
- e) Thermal radiation patterns
- f) Atmospheric pressure variations

2. "Mapping Session" refers to any continuous period during which an AMR collects Environmental Data for navigation purposes.

3. "IceNav(TM) Core" means the proprietary artificial intelligence system that processes Environmental Data to generate navigation parameters.

3. Data Collection Specifications

1. Sensor Configuration Requirements:

- a) Minimum of three (3) thermal imaging sensors with 0.1 C resolution
- b) Surface texture analysis sensors with 1mm precision
- c) Atmospheric condition sensors sampling at 10Hz
- d) LiDAR systems with cold-environment certification

2. Calibration Standards:

- a) Primary sensor calibration required every 168 operating hours
- b) Secondary calibration checks performed at startup when ambient temperature varies >5 C from previous operation
- c) Automated drift compensation for temperature-induced sensor variations

4. Processing Protocols

1. Raw Data Processing:

- a) Initial filtering using Company's proprietary ColdFilter(TM) algorithm
- b) Minimum sampling rate of 100 data points per square meter
- c) Real-time thermal anomaly detection
- d) Surface condition classification using machine learning model version 4.2 or higher

2. Map Generation:

- a) Resolution requirements: 2cm for critical areas, 5cm for general navigation
- b) Update frequency: Dynamic based on environment stability metrics
- c) Thermal overlay integration with physical mapping
- d) Confidence scoring for each mapped region

5. Data Security and Storage

1. All Environmental Data shall be:

- a) Encrypted using AES-256 during collection and transmission
- b) Stored in Company's secure cloud infrastructure
- c) Backed up according to Company's Data Retention Policy
- d) Accessible only to authorized personnel with appropriate clearance

2. Retention Requirements:

- a) Raw sensor data: 30 days

- b) Processed environmental maps: 1 year
- c) Critical navigation parameters: 3 years

6. Quality Assurance

1. Validation Requirements:

- a) Automated consistency checks between consecutive mapping sessions
- b) Manual verification of mapping accuracy quarterly
- c) Statistical analysis of navigation performance metrics
- d) Regular comparison with control environment measurements

2. Error Handling:

- a) Automatic detection of sensor malfunctions
- b) Failsafe protocols for data corruption
- c) Recovery procedures for interrupted mapping sessions

7. Proprietary Rights

1. All Environmental Data collected pursuant to this Protocol, including derived maps and navigation parameters, shall remain the exclusive property of Company.
2. Any improvements or modifications to the mapping algorithms resulting from Environmental Data analysis shall be owned exclusively by Company.

8. Protocol Updates

1. This Protocol shall be reviewed and updated annually or as required by significant technological advances.
2. All updates must be approved by Company's Chief Technology Officer and Chief Robotics Officer.

9. Compliance

1. All AMR operations must strictly adhere to this Protocol.
2. Deviations require written authorization from the Director of Engineering or higher authority.

10. Certification

The undersigned hereby certifies that this Protocol has been reviewed and approved for implementation.

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Dr. James Barrett

Chief Robotics Officer

Date: January 15, 2024

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Marcus Chen

Chief Technology Officer

Date: January 15, 2024

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