Reliability Engineering for Hybrid Robot-Cloud Systems

SRECon Americas

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Agility

Who we are
What we do

- 10 year old humanoid robotics startup
- Redefining labor for a future where humans and humanoids work together with ease
- Robots deployed in warehouses and factories alongside humans.
- Robots as a Service

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01 A Tale of Two Platforms

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Humanoid robots are distributed systems with actuators

A robot is:

- Constrained compute
- On unreliable WiFi
- Running long-lived workloads
- Connected to a cloud control plane
- Producing telemetry

Only difference: It can move

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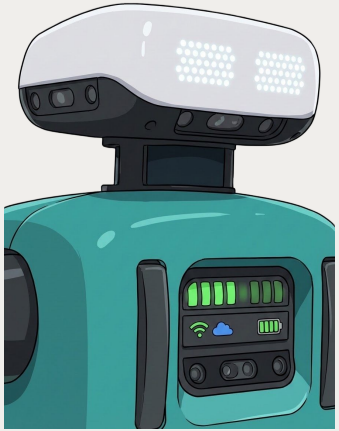
Robot Software Systems



- State
- Control
- Perception
- Inference
- Skills
- Protocol Clients
- Observability
- System Management

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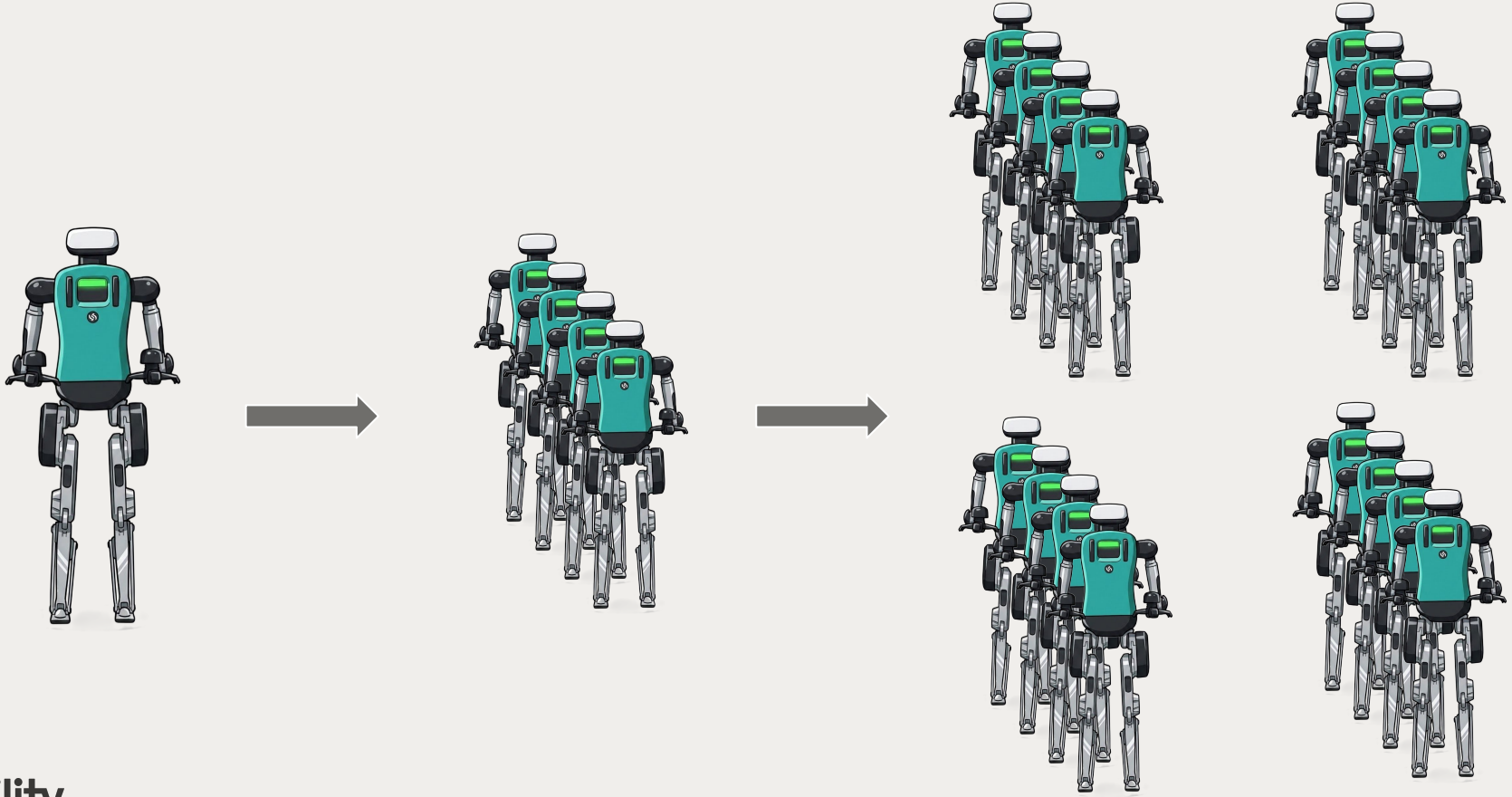
Scaling Up – Fleets of Fleets



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Platforms

Robot Fleet Management Platform

ARC

- Runtime configuration
- Tasking and Workflows
- SaaS platform
- Event based

Control and Data Plane for managing robot work

Device Fleet Management Platform

- Device Communications
- Device Security
- Device Identity
- Software Delivery

Control and Data Plane for managing device lifecycle

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02 Reliably Managing Fleets of Robots and their tasks

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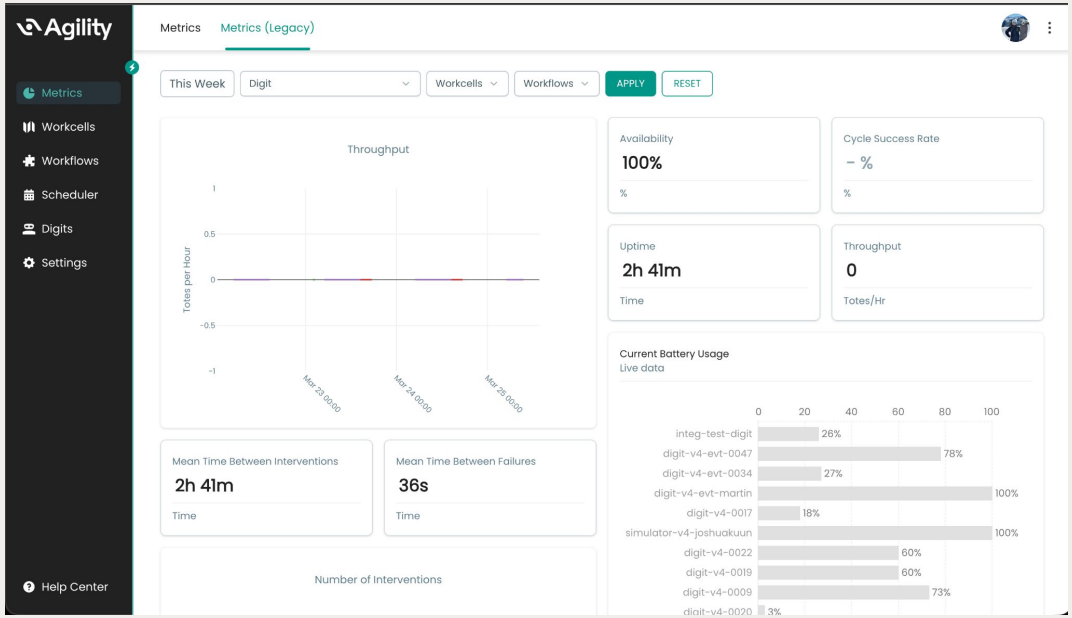
Arc: Looks Like SaaS

Our Fleet Management System

From the cloud view:

- Multi tenant and single tenant
- APIs + Web UI
- Workflow engine
- Standard observability
- CI/CD deployments
- On-call rotation



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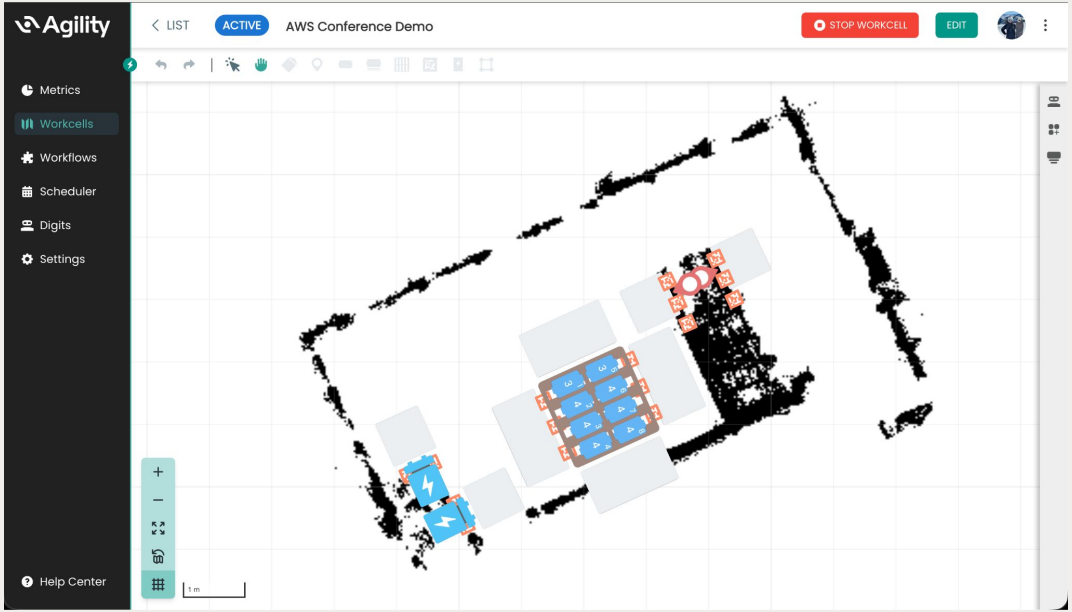
Arc: Stops Being SaaS

When Arc talks to Robots

- Intermittent connectivity
- Edge Buffering
- Long-lived sessions (MQTT)
- Partitioned state
- Eventual reconciliation
- Idempotent commands required



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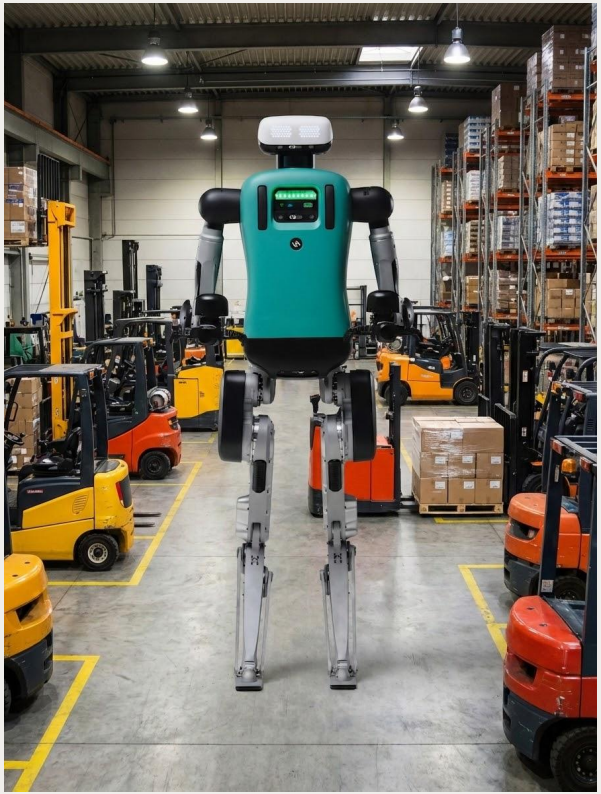
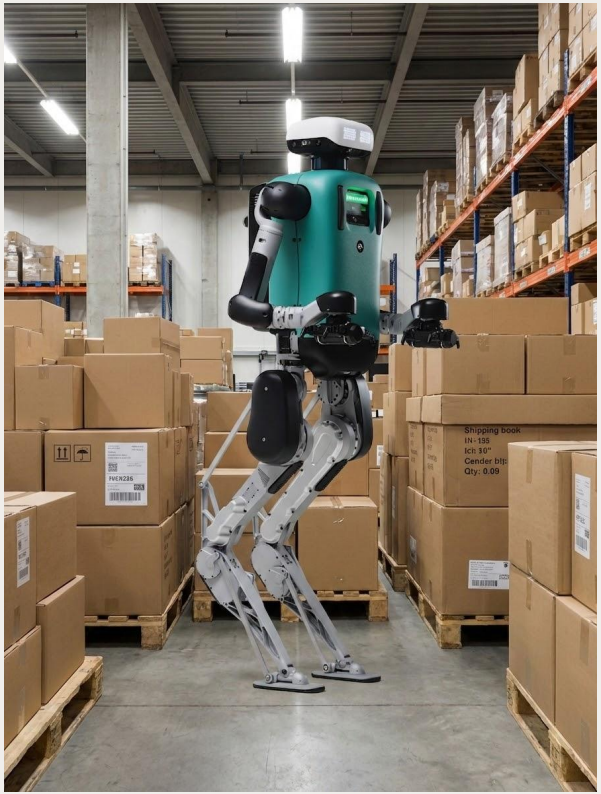
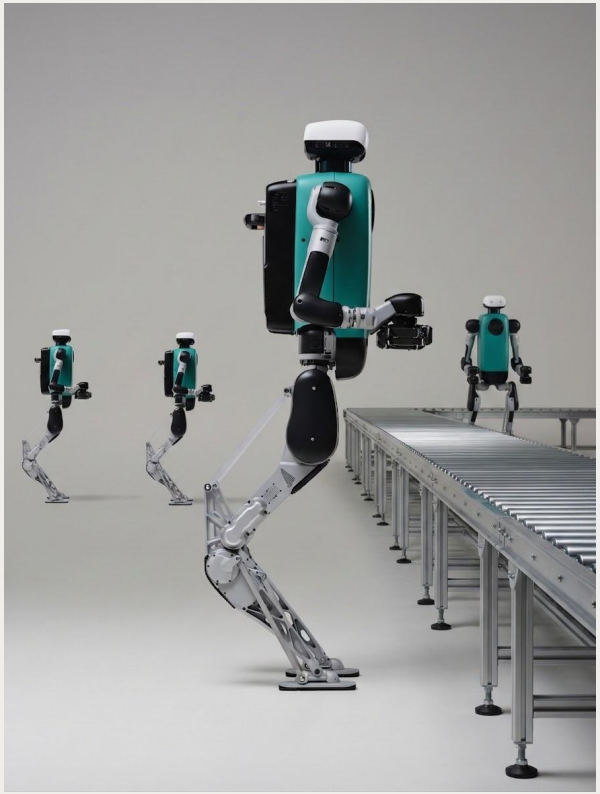
Network = Failure Domain







Amplified Edge Realities

Movement Amplifies Network Instability

Observability Under Partition

Cloud Dependency = Blast Radius

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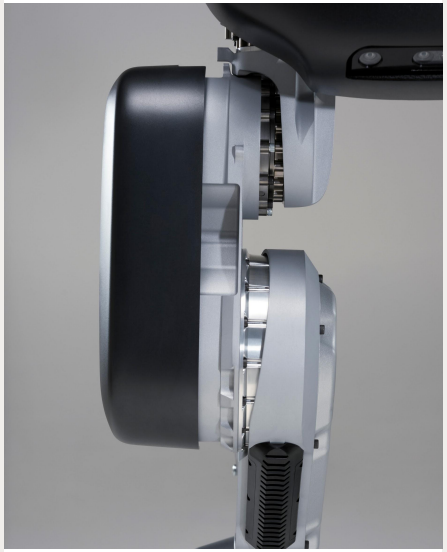
MTTR > Failure Prevention

Define Robot Availability SLO

Detect Faster MTTD



Correlate Alerts and Automate Paging

Reduce MTTR

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03 Reliably Managing Fleets of Remote Devices

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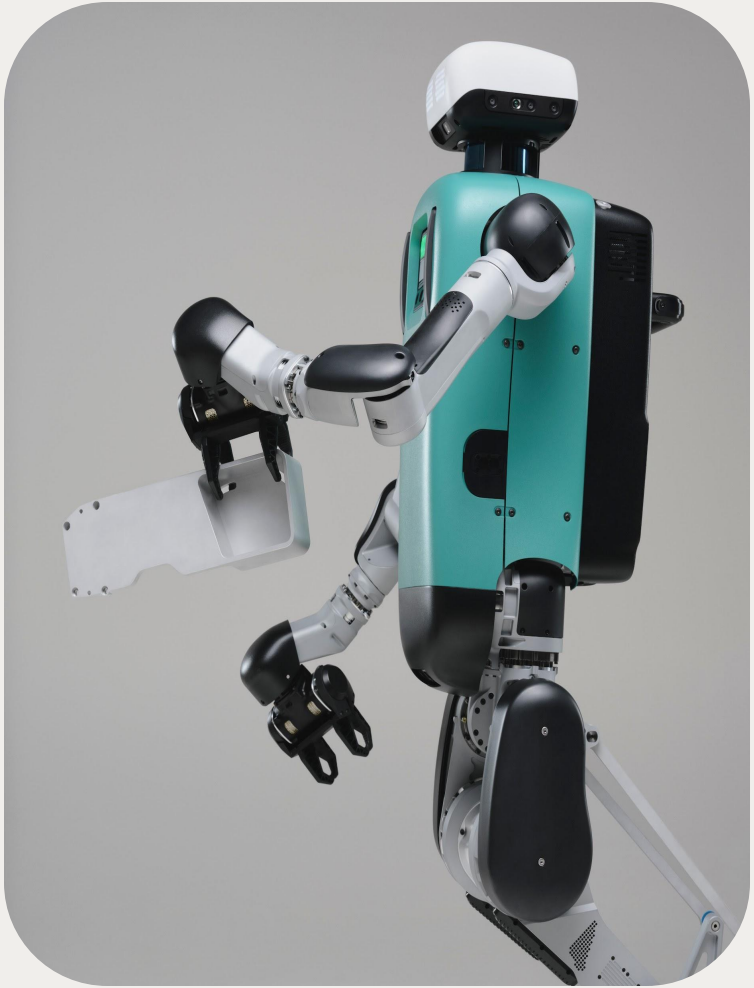
Managing lifecycle of heterogeneous devices

Devices

- Robots
- Safety Systems
- Charger Systems
- Integration Devices



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Platform Core Requirements

Connectivity

- Egress initiated
- Encrypted and Tunnelled
- Break Glass access
- JIT RBAC ingress
- Auditable

Device IAM

- Unique Identity
- Extensible
- Short Lived / Revocable
- Authentication and Authorization

Configuration Management

- Over the Air
- Declarative
- Deployments
  - Software
  - Configurations
  - Models
  - Calibrations
  - Secrets and Credentials

Observability

- Full stack observability
- Metrics
- Logging
- Tracing
- Close to realtime

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Adopt and Adapt

SRE practices, open source systems and frameworks that support

- Observability for System and software performance
- Declarative, Auto Reconciling and consistent configurations
- Self-healing, Fault tolerance Software lifecycle
- Reliable and secure connectivity
- Identity management
- Change auditability

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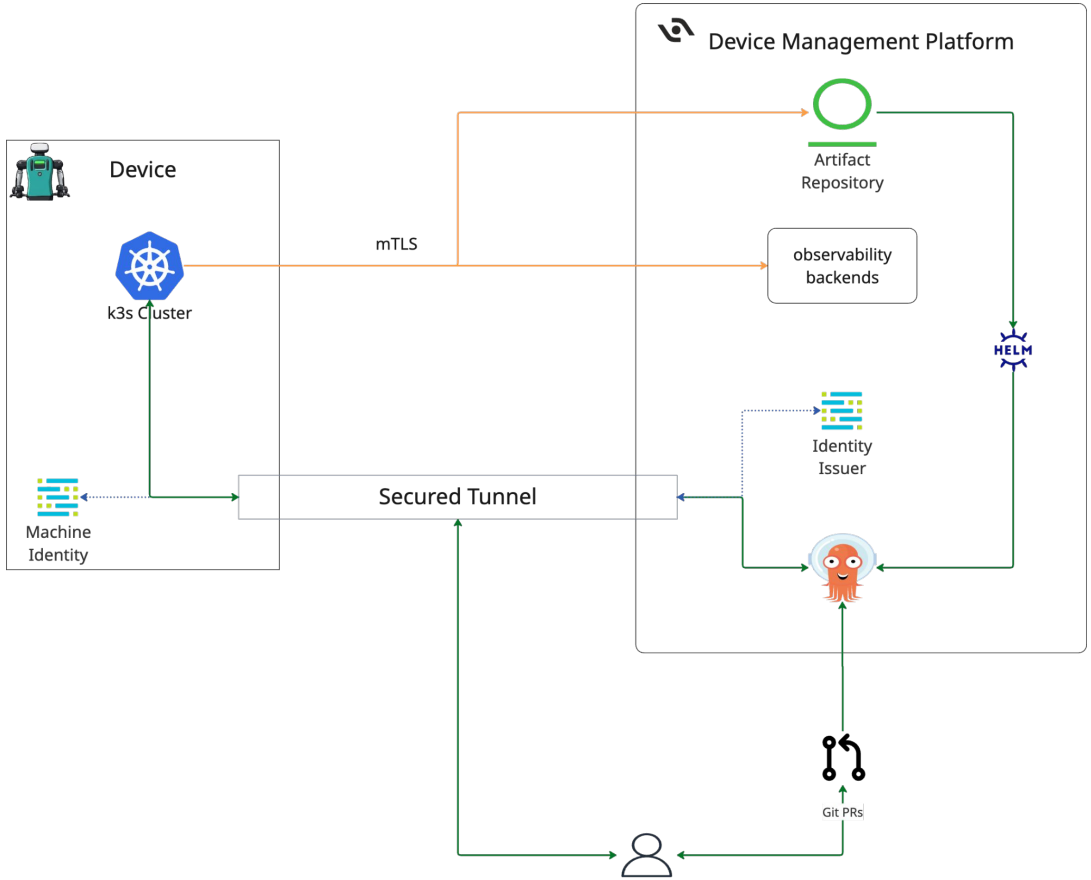
- Kubernetes (k3s)
- ArgoCD
- Helm Charts
- OCI artifacts
- Spiffe / Spire
- Teleport
- Open Telemetry
- FluentBit



Final Takeaways

Robots are edge devices in a distributed system

Movement and Remote Deployments amplify:

- Network instability
- Observability gaps
- Blast radius

SRE discipline provides:

- Best Practices
- Provent Systems
- Partition-tolerant design
- Explicit unknown states
- SLO-driven operations
- MTTR optimization

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Team Page

Matthew Greenwald

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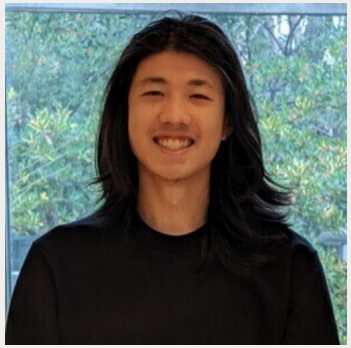

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Careers - We Are Hiring!

OPEN POSITIONS - https://www.agilityrobotics.com/careers	
Senior Staff Hardware Reliability Engineer	Hybrid - Any Office (Fremont, CA, Salem, OR, or Pittsburgh, PA)
Senior Data Engineer	Hybrid / Remote
Senior Software Engineer - Mobile & Web Apps Developer	Hybrid / Remote
Senior/Staff Build & Release Engineer(s)	Hybrid / Remote
Senior Robotics Software Engineer(s)	Hybrid / Remote
Director of AI	Hybrid / Remote
Senior Manager, Hardware Abstraction	Hybrid - Any Office (Fremont, CA, Salem, OR, or Pittsburgh, PA)

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Thank You

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