Agility Robotics' Digit Walks Without Knowing What It Can Carry

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Agility Robotics' Digit is a bipedal humanoid robot designed for warehouse logistics: walking through human-designed spaces, picking up totes, and placing them on shelves and conveyors. The locomotion engineering is substantial, producing stable bipedal walking across varied surfaces with payload carrying capability. But Digit walks and manipulates without maintaining a persistent model of its own capability that evolves with conditions. Battery state, joint temperature, surface conditions, and payload characteristics all affect what Digit can safely accomplish, but no persistent capability envelope tracks these factors as a unified state. Capability awareness provides this: a first-class state variable that the robot maintains, forecasts, and negotiates.

What Agility built

Digit combines bipedal locomotion, upper body manipulation, and perception in a humanoid form factor designed for environments built for humans. The robot walks on legs with toe and heel joints, providing a gait that navigates warehouse aisles, thresholds, and ramps. The arms handle totes and packages within the payload range. The perception system identifies objects, plans grasps, and navigates through warehouse environments.

The engineering challenge of bipedal locomotion with payload is genuine. Maintaining balance while walking, turning, and carrying asymmetric loads requires real-time dynamic control that accounts for shifting center of mass, variable ground conditions, and payload momentum. Digit handles this through learned locomotion policies and model-based control.

The gap between locomotion control and capability awareness

Digit's locomotion controller maintains balance given current conditions. If the battery is depleting and motor torque capability is declining, the controller compensates by adjusting gait parameters. But the task planner that assigns Digit to carry a heavy tote up a ramp does not know that the current battery state plus the ramp grade plus the payload weight approaches the limit of what the locomotion controller can handle. The controller will attempt the task and either succeed with reduced margins or fail when the combined demands exceed capability.

The interaction between locomotion capability and manipulation capability adds complexity. Carrying a heavy payload reduces locomotion stability margins. Reaching for a high shelf reduces the base of support. Walking on a slippery surface reduces the reliable payload capacity. These capability interactions require a unified model that tracks the robot's current capability across all dimensions simultaneously, including how changes in one dimension affect others.

What capability awareness provides

The capability envelope tracks Digit's current capacity across locomotion, manipulation, and perception as an integrated state. Battery state reduces available torque, which narrows the payload envelope, which constrains which tasks the robot should accept. Surface condition estimates modify the locomotion stability margin, which in turn affects safe carrying capacity. Temporal forecasting projects how these capabilities will evolve: battery depletion over the next thirty minutes, thermal effects on motor performance, and expected surface conditions on the planned route.

Envelope negotiation enables Digit to communicate its current capabilities to the warehouse management system. When a task assignment falls outside the current envelope, the robot reports the specific gap: the assigned payload exceeds current carrying capacity given the remaining battery level and the ramp on the assigned route. The warehouse system can reassign the task, adjust the route, or schedule a battery swap.

The structural requirement

Agility Robotics achieved genuine bipedal humanoid locomotion for warehouse logistics. The structural gap is capability self-knowledge: the persistent, integrated model of what the robot can accomplish given its current state across all capability dimensions. Capability awareness as a computational primitive transforms a walking robot into one that knows what it can carry, where it can safely go, and how those capabilities will change over the next hour of operation.

Capability Awareness All 21 steps →

Know what you can do before you try.

Primary Technical Disclosure
○ Capability-, Time-, and Uncertainty-Aware Execution in Autonomous Computational Networks
Secondary Technical
○ Capability as First-Class Computational State○ Capability Envelope for Substrates○ Temporal Executability Forecasting○ Uncertainty as First-Class Propagated Variable○ Capability Envelope Negotiation○ Capability Genealogy Tracking○ Biological Capability Extension○ Network-Level Capability Pressure○ Capability-Permission Distinction○ Capability-Native Computation○ Execution Synthesis and Non-Synthesis○ Agent Behavior Under Constraints○ Predictive Network Planning○ Multi-Agent Contention Resolution○ Capability Robustness Mechanisms○ Capability-Modulated Discovery Traversal○ Capability as Confidence Input○ Embodied Capability Envelopes○ Substrate Resource Negotiation
Applications (General)
○ Robotic Capability Assessment Before Commitment○ Edge Computing Resource Governance Through Capability Envelopes○ Capability Awareness for Surgical Robotics○ Capability Awareness for Agricultural Robotics○ Capability Awareness for Mining Operations○ Capability Awareness for Offshore Energy Operations○ Capability Awareness for Warehouse Logistics Robotics○ Capability Awareness for Construction Robotics
Applications (Specific)
○ Tesla FSD Does Not Know What It Cannot Do○ John Deere's Autonomous Tractors Cannot Assess Their Own Limits○ KUKA Robots Execute Without Knowing Their Envelope○ FANUC Robots Have No Adaptive Capability Envelope○ Universal Robots Cobots Execute Without Knowing Their Limits○ ABB Robots Perform Without Self-Assessing Capability○ Yaskawa Motoman Robots Move Without Tracking Capability Drift○ Doosan Cobots Collaborate Without Capability Self-Knowledge● Agility Robotics' Digit Walks Without Knowing What It Can Carry○ Figure's Humanoid Learns Tasks Without Knowing Its Envelope
Capability Awareness overview →
AQ
deterministic
autonomy

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