Doosan Cobots Collaborate Without Capability Self-Knowledge

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Doosan Robotics builds collaborative robots with six-axis torque sensors integrated into every joint, providing the force sensitivity needed for safe human-robot collaboration. The torque sensing enables compliant motion, contact detection, and force-controlled manipulation that make Doosan cobots effective in assembly, polishing, and machine tending applications. But torque sensing for safety and compliance is not capability awareness. The cobot detects and responds to forces in real time without maintaining a persistent model of what it can accomplish given its current state. Capability awareness provides this missing self-knowledge: a persistent envelope that tracks, forecasts, and communicates the robot's evolving capability.

What Doosan built

Doosan's cobots feature six-axis torque sensors at every joint, providing force and torque measurement throughout the kinematic chain. This distributed sensing enables collision detection at any point along the arm, compliant motion that yields to human guidance, and force-controlled operations like polishing and insertion where the robot must regulate applied forces precisely. The sensing resolution enables the cobot to detect contact forces below thresholds that would cause injury.

The torque sensing serves two functions: safety through collision detection and task execution through force control. Both functions operate in real time on current sensor readings. The safety system stops the robot when unexpected forces are detected. The force controller maintains desired force profiles during contact tasks. Neither function maintains a model of the robot's evolving capability.

The gap between force sensing and capability awareness

A Doosan cobot performing a polishing task maintains a target contact force through its torque sensors. If the tool has worn, the effective polishing action changes even though the force profile remains correct. The cobot maintains the right force. It produces the wrong surface finish because its tool capability has degraded. The torque sensors detect force. They do not detect that the combination of current tool state, current force capability, and current positioning accuracy no longer achieves the required polishing outcome.

In collaborative scenarios, capability unawareness limits the quality of human-robot coordination. A human operator working alongside a Doosan cobot may attempt to delegate a task that the robot could handle at the start of the shift but can no longer accomplish due to accumulated drift. The cobot accepts the task because it has no basis for refusing. It executes within its force limits. The outcome fails to meet quality requirements.

What capability awareness provides

The capability envelope integrates force control capability with positioning accuracy, tool condition, and environmental factors into a multi-dimensional representation of current capability. Temporal forecasting projects how these capabilities will evolve based on tool wear rates, thermal models, and operating conditions. The joint condition of capability, time, and uncertainty provides a principled answer to the question: can this robot accomplish this task at this moment with acceptable certainty?

Envelope negotiation enables the cobot to communicate its current capability to human collaborators and task planners. When a delegated task falls outside the current envelope, the robot explains the gap rather than attempting and failing. The human operator can adjust the task, change the tool, or recalibrate the robot based on specific capability information rather than discovering limitations through quality failures.

The structural requirement

Doosan Robotics provides sensitive, force-aware collaborative robots. The structural gap is capability self-knowledge: the persistent model that integrates force capability, positioning accuracy, tool condition, and environmental factors into an evolving envelope the robot maintains and communicates. Capability awareness as a computational primitive transforms a force-sensitive cobot into a capability-aware one that knows what it can accomplish, forecasts how its capability will change, and communicates its limits before task failure reveals them.

Capability Awareness All 21 steps →

Know what you can do before you try.

AQ
deterministic
autonomy

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