Machine Learning to Augment Small Drone Autopilot

ResCon Technologies offers an adaptive autopilot for small Unmanned Aerial Systems (sUAS, or "drones") that makes them safer, more agile, and more efficient thanks to a breakthrough in Machine Learning (ML) that is 1,000,000 times faster than traditional approaches and can run on extremely low-power computing devices.

Most drones employ proportional-integral-derivative (PID) controllers to affect basic flight control commands. While simple and cheap, PID-based autopilots are fundamentally limited in their complexity and flexibility—once tuned for performance, the controller's gains are fixed and cannot adjust to changing conditions. If a drone sustains in-flight damage or encounters a dynamic situation outside of its control limits, the autopilot has no ability to compensate. ResCon has developed a new ML paradigm based on *reservoir computing* to learn and adjust to changing conditions in real-time. A reservoir computer (RC) is extremely fast and low power, enabling ML implementation on commercial hardware not normally associated with advanced artificial intelligence processes. Traditional ML algorithm training takes days and requires intensive cloud-based computing resources. RCs can accomplish training in as little as one-one-millionth of the time, which means the algorithms can train (and retrain) on-the-fly while using minimal power. When paired with a PID-based autopilot, the system can recognize and adjust to anomalies such as airframe damage, propulsion failures, gusting winds, or shifting payloads.

ResCon's autopilot addresses several Combatant Command requirements including the need for persistent, survivable airborne Intelligence, Surveillance and Reconnaissance (ISR) platforms and the general desire for edge processing of sensor data while reducing the size, weight, and power of deployed systems. The UAS market is pursuing more advanced designs featuring flexible airframes and unique propulsion configurations that legacy PID autopilots will not be able to adequately control. The next generation of aircraft requires an advanced autopilot that can be implemented on ubiquitous, cheap, low-power hardware. ResCon Technologies provides the solution to these needs.

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