VirtualDrone: Virtual Sensing, Actuation, and Communication for Attack-resilient Unmanned Aerial Systems

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Abstract

As modern unmanned aerial systems (UAS) continue to expand the frontiers of automation, new challenges to security and thus its safety are emerging. It is now difficult to completely secure modern UAS platforms due to their openness and increasing complexity. We present the VirtualDrone Framework, a software architecture that enables an attack-resilient control of modern UAS. It allows the system to operate with potentially untrustworthy software environment by virtualizing the sensors, actuators, and communication channels. The framework provides mechanisms to monitor physical and logical system behaviors and to detect security and safety violations. Upon detection of such an event, the framework switches to a trusted control mode in order to override malicious system state and to prevent potential safety violations. We built a prototype quadcoper running an embedded multicore processor that features a hardware-assisted virtualization technology. We present extensive experimental study and implementation details, and demonstrate how the framework can ensure the robustness of the UAS in the presence of security breaches.

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