

Enhancing Autonomy of Aerial Systems via Integration of Visual Sensors into their Avionics Suite

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Objective of Thesis:

Using Systems Engineering approach to explore autonomous system capabilities using quadrotors, on-board processors and visual sensors.

Main Research Ideas:

- Achieving search path optimization by pre-processing the area of operation (AO) to filter out illogical search area, followed by solutioning using binary integer linear program (ILP).
- Performing collision avoidance (CA) of known obstacles by solving Inverse Dynamics in the Virtual Domain (IDVD), a form of direct-method based trajectory generator.
- Navigating to commanded waypoints generated from mixed guidance commands.
- Acquiring targets using computer visioning and image-processing.

Research Results:

- Figure 1 illustrates the operational view of employing autonomous system in the domain of target acquisition. It guided in the subsequent functional analysis, which led to development of a proposed system architecture as drawn in Figure 2.
- Search path optimization is successfully performed as seen in Figure 3, which saved approximately 30% of flight resources by avoiding the illogical area within the AO.
- Figure 4 verified the ability of the autonomous system to navigate along waypoints generated from mixed guidance commands, including CA using IDVD.

Benefit of Research:

- A step forward into understanding and achieving autonomous capabilities for combat platforms.

Follow-up Research:

- To continue with image-processing using wireless video camera.

Reference:

Cowling, Ian D., Oleg A. Yakimenko, James F. Whidborne, and Alastair, K. Cooke. 2010. "Direct Method Based Control System for an Autonomous Quadrotor." *Journal of Intelligent and Robotic Systems* 60 (2): 285–316. doi:10.1007/s10846-010-9416-9.

Figure 1

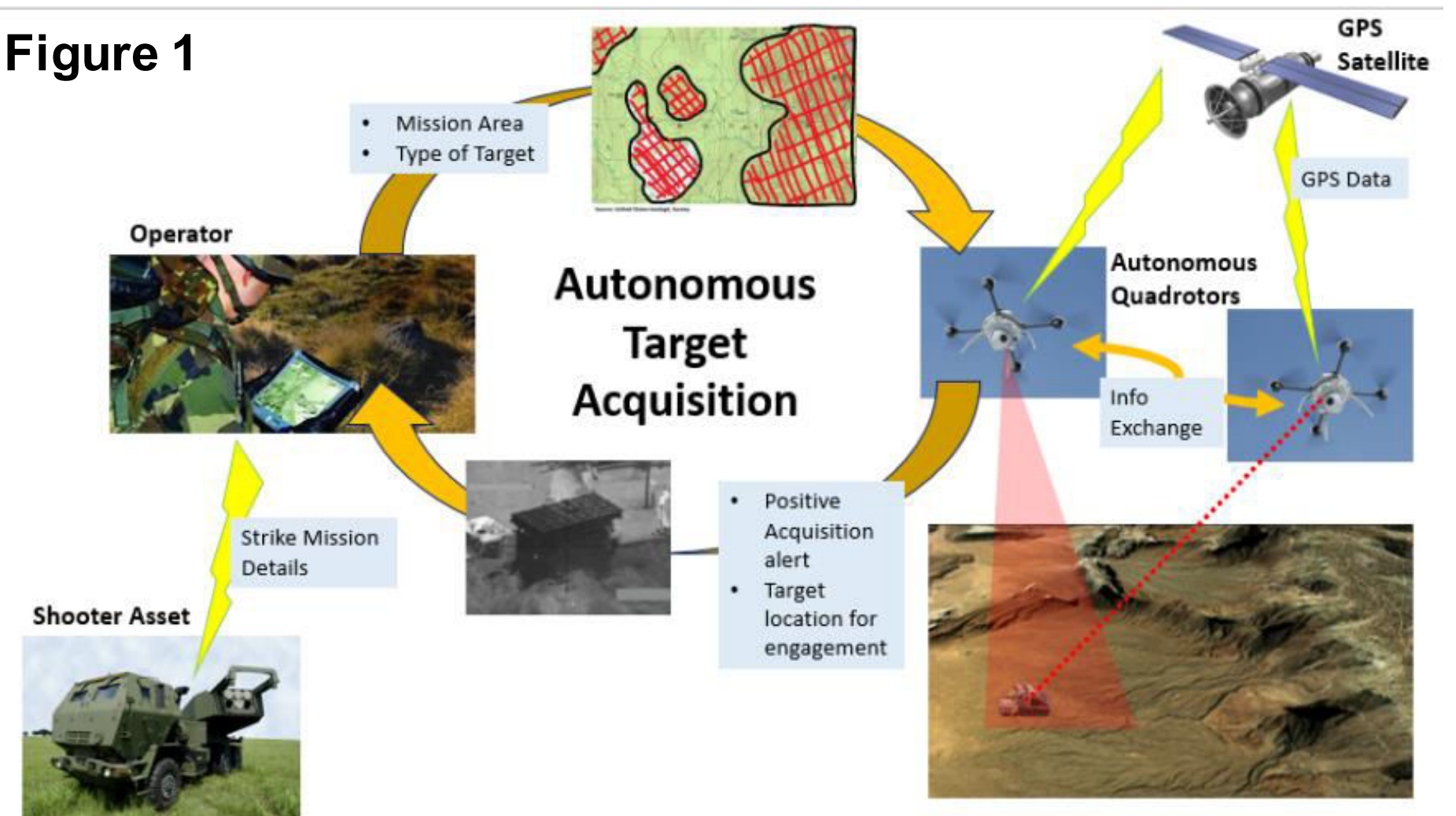


Figure 2

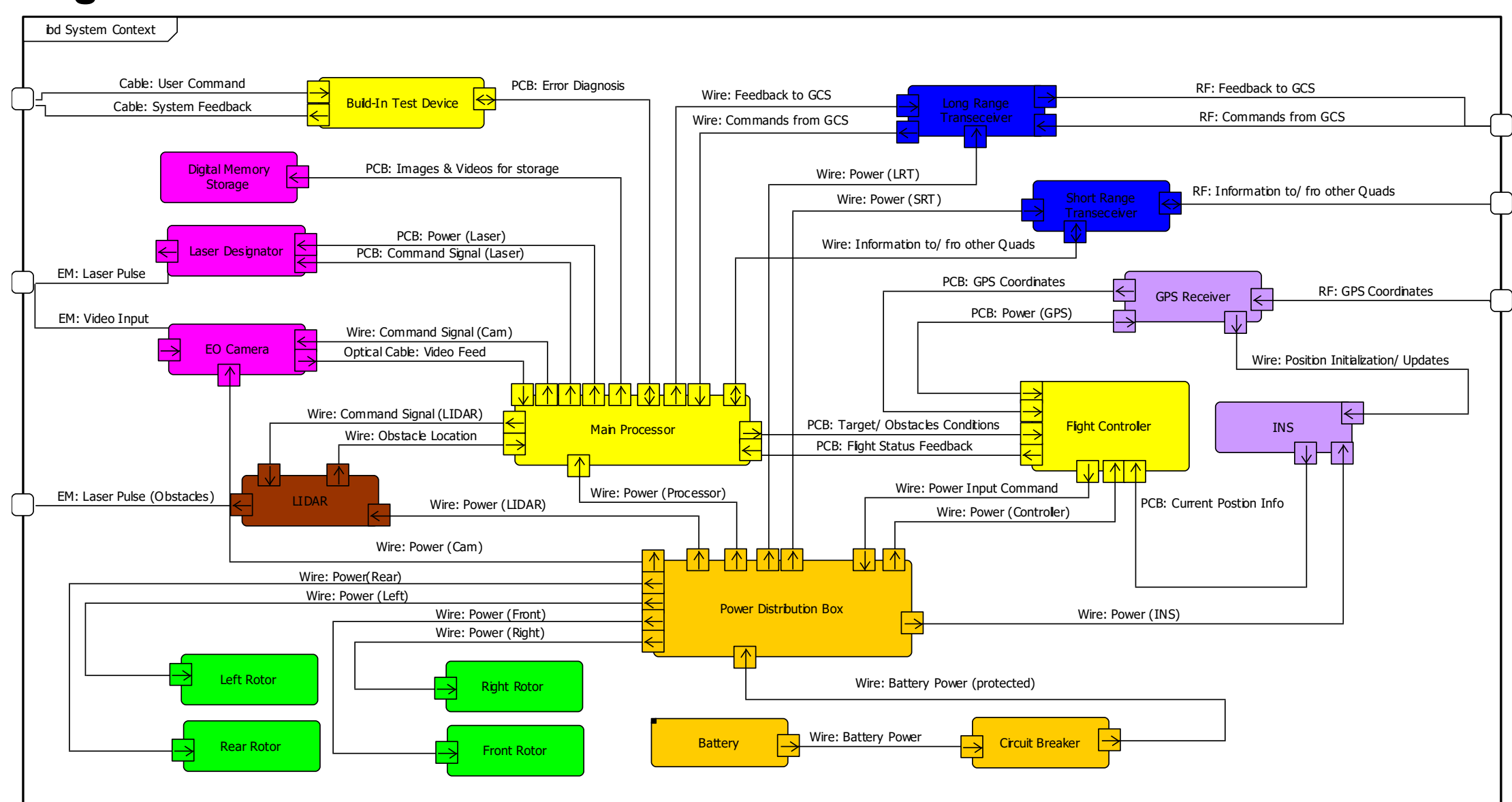


Figure 3

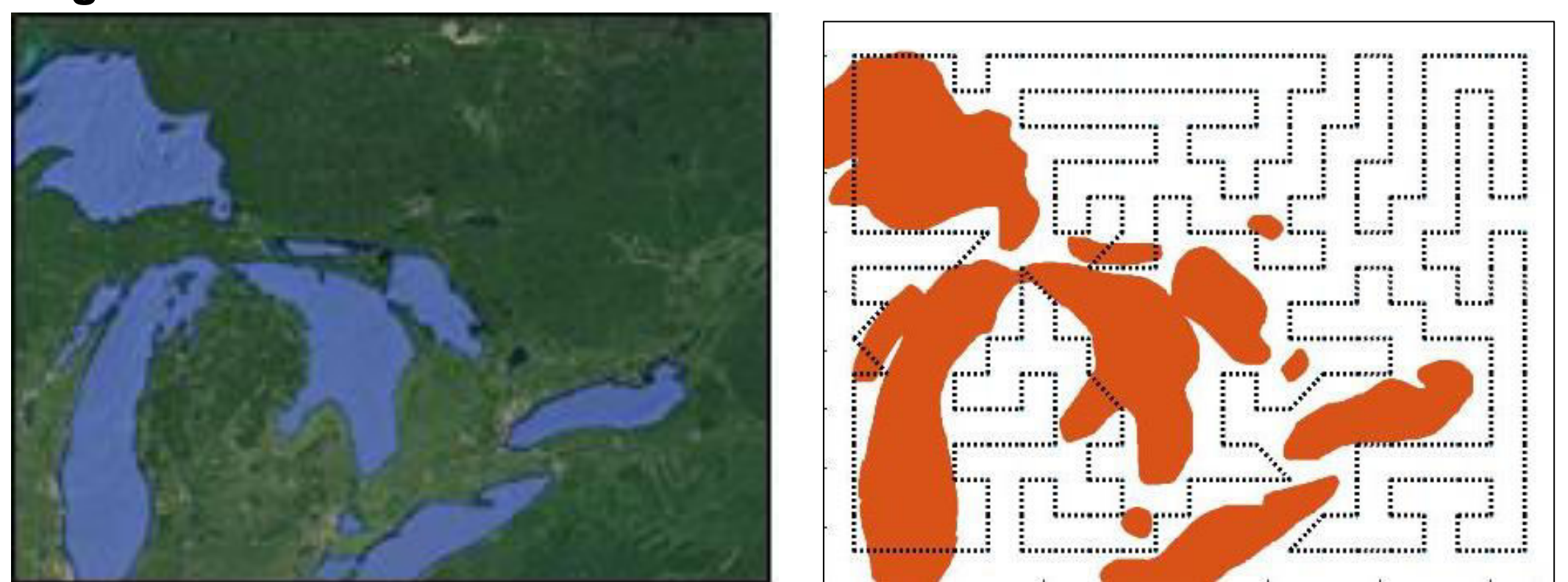


Figure 4

