# Pterodactyl: Control System Demonstrator Development for Integrated Control Design of a Mechanically Deployed Entry Vehicle

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## Abstract

The NASA-funded Pterodactyl project is a design, test, and build capability to (i) advance the current state of the art for Deployable Entry Vehicle (DEV) guidance and control (G&C), and (ii) determine the feasibility of control system integration for various entry vehicle types including those without aeroshells. This capability is currently being used to develop control systems for one such unconventional entry vehicle, the Lifting Nano-ADEPT (LNA) vehicle. ADEPT offers the possibility of integrating control systems directly onto the mechanically deployed structure and building hardware demonstrators will help assess integration and design challenges. Control systems based on aerodynamic control surfaces, mass movement, and reaction control systems (RCS) are currently being investigated for a down-select to the most suitable control architecture for the LNA.

To that effect, in this submission, we detail the efforts of the Pterodactyl project to develop a series of hardware demonstrators for the different LNA control systems. Rapid prototypes, for a set of quarter-model or eighth-model vehicle segments, will be developed for all three architectures to validate mechanical design assumptions, and hardware-in-the-loop (HIWL) control approaches. A ground test control system demonstrator will be designed and built after the trade study is complete. The industrial-grade demonstrator will be designed so that it can be incorporated into a HWIL simulation to further validate the findings of the initial trade study. The HWIL simulation will leverage the iPAS environment developed at NASA's Johnson Space Center which facilitates integration testing to support technology maturation and risk reduction, necessary elements for the hardware demonstration development detailed in this paper.

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