Open-Loop Flight Testing of COBALT GN&C Technologies for Precise Soft Landing

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A terrestrial, open-loop (OL) flight test campaign of the NASA COBALT (CoOperative Blending of Autonomous Landing Technologies) platform was conducted onboard the Masten Xodiac suborbital rocket testbed, with support through the NASA Advanced Exploration Systems (AES), Game Changing Development (GCD), and Flight Opportunities (FO) Programs. The COBALT platform integrates NASA Guidance, Navigation and Control (GN&C) sensing technologies for autonomous, precise soft landing, including the Navigation Doppler Lidar (NDL) velocity and range sensor and the Lander Vision System (LVS) Terrain Relative Navigation (TRN) system. A specialized navigation filter running onboard COBALT fuzes the NDL and LVS data in real time to produce a precise navigation solution that is independent of the Global Positioning System (GPS) and suitable for future, autonomous planetary landing systems. The OL campaign tested COBALT as a passive payload, with COBALT data collection and filter execution, but with the Xodiac vehicle Guidance and Control (G&C) loops closed on a Masten GPS-based navigation solution. The OL test was performed as a risk reduction activity in preparation for an upcoming 2017 closed-loop (CL) flight campaign in which Xodiac G&C will act on the COBALT navigation solution and the GPS-based navigation will serve only as a backup monitor.

I. Introduction

Introduction will discuss the NASA need for Precision Landing and Hazard Avoidance (PL&HA) technologies for future, prioritized solar-system destinations (robotic and human missions), as well as provide an overview for the COBALT project and how it fits within the NASA PL&HA technology development roadmap.

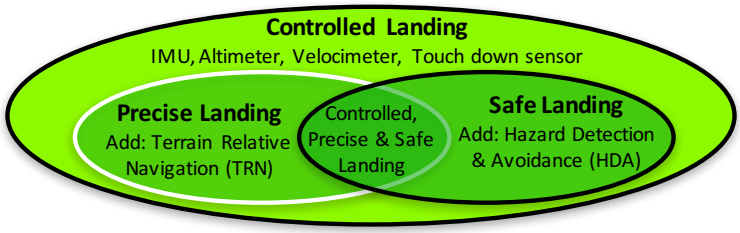

Figure 1. GN&C landing system capabilities enabled with PL&HA technologies.

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II. COBALT Platfrom Overview

A high-level overview of the hardware components within the COBALT platform.

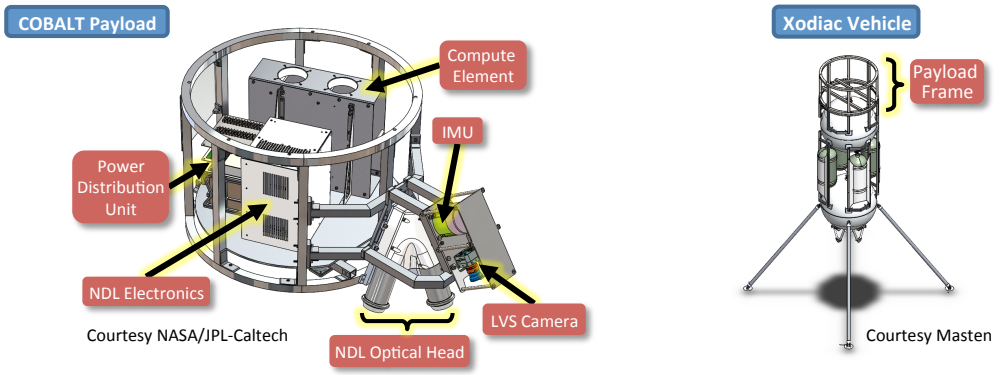

Figure 2. CAD models of COBALT payload (left) and Xodiac vehicle (right).

Figure 3. Images of the fully-integrated COBALT payload hardware

III. Flight Campaign Concept of Operations

Overview of the flight campaign ConOps and the Xodiac vehicle.

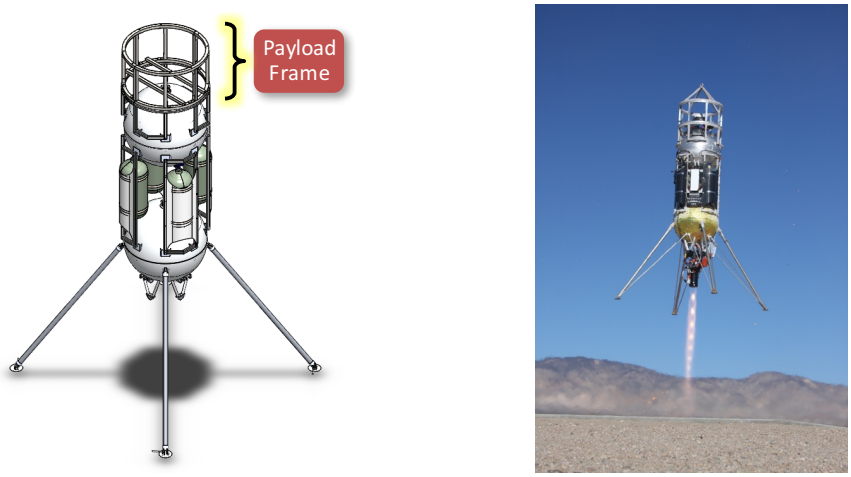

Figure 4. Xodiac Illustration and Free-Flight Image (photo credit: Masten).

IV. Pre-Campaign Ground Tests

Discussion of some of the pre-campaign ground testing that occured in preparation for integration of the COBALT platform onto Xodiac.

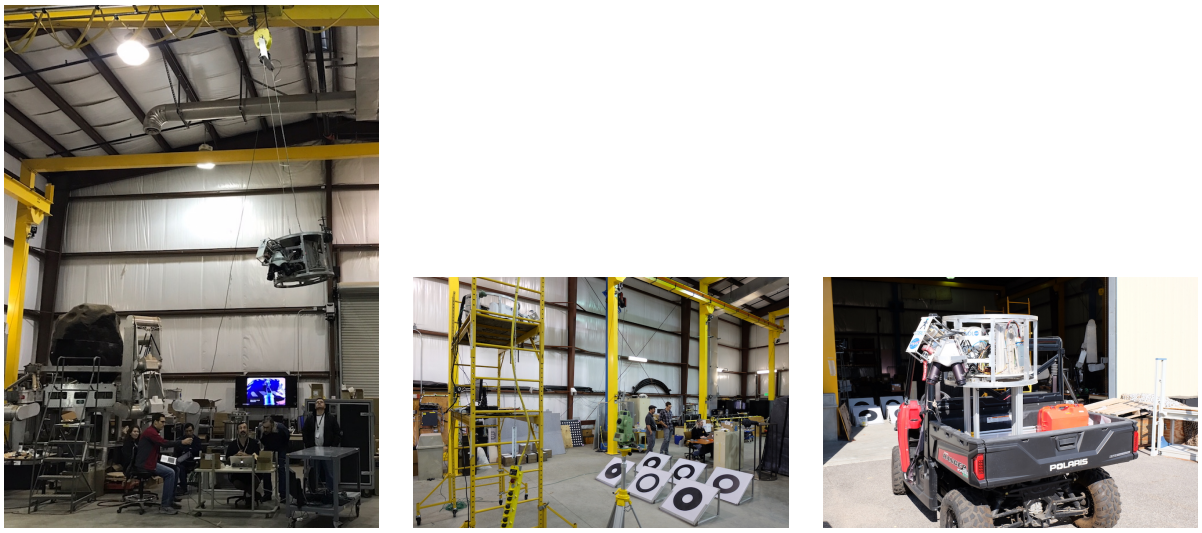

Figure 5. Swing Tests (left), PIP tests (center), Driving Tests (right)

V. Open-Loop COBALT Performance

Overview of the COBALT performance, navigation filter highlights, and data analysis.

VI. Revisions and Steps to Closed-Loop

Discussion of post-test revisions in work and plans for closed-loop flight test campaign

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