AEROBOT AUTONOMOUS NAVIGATION AND MAPPING FOR PLANETARY EXPLORATION (IPPW-7)

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ABSTRACT

Mobility is a key requirement for planetary exploration missions. Autonomous airships (aerobots) can be used to explore unknown environments without obstacle avoidance problems, mapping large areas and complex land systems (such as canyons or fluvial areas) to different resolutions and perform a wide variety of measurements and experiments on planetary surface and on the atmosphere too.

Sensor fusion between Inertial Measurement Unit (IMU) and vision systems can be used to support vehicle navigation and variable resolution surface mapping. In this work a minimal sensor suite composed by a navigation-grade IMU and stereo camera pair has been studied.

Vision subsystem can provide range, bearing and elevation measurements of a set of scattered points on the planetary surface. Simultaneous Localization and Mapping (SLAM) extended Kalman filter algorithm has been adapted to deal with monocular and stereo camera observations. Sensor fusion with IMU measurements is used to track rapid vehicle movements and to maintain the vehicle position and attitude estimation also if, for a limited time period, no vision measurements are available. Moreover the SLAM algorithm produce a scattered points map of the whole travelled area.

In this work vehicle position, attitude and mapping estimation accuracy have been assessed through tests on a set of simulated vehicle trajectories on Titan to show the reliability of this navigation solution.