VISION-AIDED AUTONOMOUS LOCALIZATION FOR LUNAR AND PLANETARY SATELLITES

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The main goal of the proposed research is to develop a new method for vision-aided autonomous localization and navigation for lunar and planetary satellites based on three-view geometry. The main outcome of the proposed method is position estimation in GPS-denied environments for lunar and planetary satellites equipped with a standard inertial navigation system and a single camera only, **without using any a-priori information** such as crater or landmark catalogues.

Images taken along the satellite orbit are stored and associated with partial navigation data. By using sets of three overlapping images and the concomitant navigation data, constraints relating the motion between the time instances of the three images are developed. These constraints include, in addition to the well-known epipolar constraints, a new constraint related to the three-view geometry of a general scene.

The scale ambiguity, inherent to pure computer vision-based motion estimation techniques, is resolved by utilizing the navigation data attached to each image. The developed constraints are fused with an inertial navigation system using an implicit extended Kalman filter. The proposed method reduces the position and velocity errors to the levels present while the first two images were captured. Reduced computational resources are required compared to bundle adjustment and Simultaneous Localization and Mapping. The proposed method will be experimentally validated at the Technion's Distributed Space Systems Laboratory using real navigation and imagery data. A statistical study based on simulated navigation and synthetic images will be presented as well.