

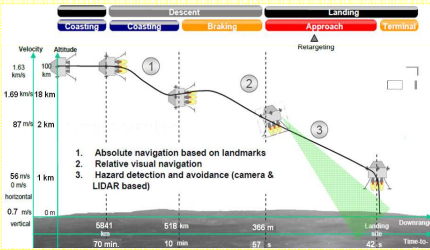
VISION BASED NAVIGATION FOR SAFE LANDING IN INTERPLANETARY MISSIONS

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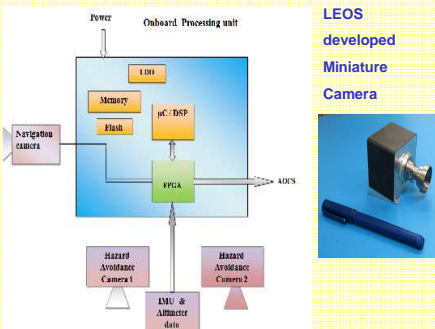
Design of low cost Vision based Navigation system for Crater detection and position estimation of the safe landing zone for future planetary landers using APS Camera and Processing Unit.

1. During the different phases of landing from 100 km to touch down, vision based system can give absolute or relative position of the lander. This along with Altimeter & IMU data can be used by NGC for orienting the Lander



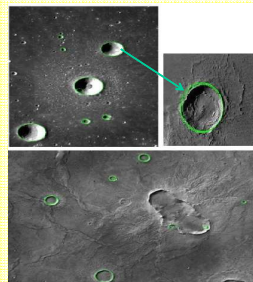
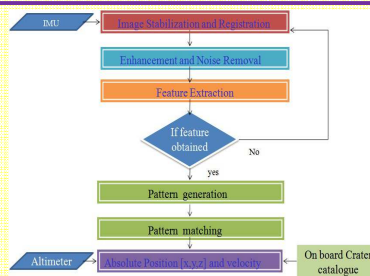
2. LEOS, ISRO has developed state-of-the-art Rad-hard Miniature Digital Navigation Camera for Chandrayaan-II Mission. This image will be used by the Image Processing unit for position estimation.

Block diagram of Vision based Navigation system



3. Crater based Navigation [100-20 km]

Crater geometry is unique, hence it is ideal landmark for navigation. The onboard crater catalogue contain the details such as crater centre, diameter, slope/slant edge) of all the craters. This is matched with the images taken during landing. Here the change in crater centre from subsequent frames is used to calculate the horizontal velocity and displacement (x & y).



4. Hazard Avoidance [3 Km – 3 m]

During terminal phase, the three hazards viz. shadow, slope and boulders are detected and avoided. Shadow is removed by standard statistical techniques. Shape From Shading (SFS) method is used for slope estimation. Sensor fusion of flash LIDAR gives boulder height. The MATLAB simulation of these algorithms for available imageries has given satisfactory results.

Flow Chart for Hazard Avoidance

