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A NOVEL INTEGRATED NAVIGATION SYSTEM FOR LUNAR LANDER BASED ON COMPUTER VISION AND INS

Abstract

One of the advanced navigation for lunar lander is based on computer vision. Aimed at accomplishing lunar lander's precise navigation task during the entry, descent and landing phase, a novel integrated navigation system based on computer vision and Inertial Navigation System(INS) is proposed. The computer vision module of said system can not only be applied to observe environment, avoid obstacles, but also obtain position and attitude information at real time; the INS module can obtain the position, speed and attitude information of the lunar lander; the Kalman Filter(KF) is designed using the 3D postion and attitude information measured by computer vision. In computer vision module, a new local features description method based on SURF-like(Speeded Up Robust Feature) algorithm is proposed and used. It can find plenty of special regions from the lunar images grabbed at real time. Each special region includes not only the position, size and direction of itself, but also includes a feature vector with shifting, rotation and scale invariance. According to that information, each special region in grabbed imaged can find a corresponding region in lunar features database using a new macthing method, and build a matchiing pair. So, the 3D position and 3D attitude of lunar lander can be estimated by the parameters on positions, size and directions of all the matching pairs. In the KF module, the algorithm is modified to settle the problem of time-lag introduced by computer vision. The novel integrated navigtaion system can decrease the error of INS. The simulation results show the novel integrated navigation system based on computer vision and INS can improve the precision of navigation.