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A LONG-RANGE AND HIGHLY RELIABLE AUTONOMOUS NAVIGATION METHOD FOR LUNAR SURFACE EXPLORATION

Abstract

A long-range and highly reliable autonomous navigation method based on strapdown inertial navigation system(SINS)/vision navigation system(VNS)/celestial navigation system(CNS) is put forward facing application requirement of lunar surface exploration within complex and unstructured environment.Firstly,measurement models of tight SINS/CNS combination based on original observation angle and improved SINS/VNS model are established,which can reduce calculating error of celestial navigation and is beneficial to determine measurement nosie variance.Secondly,adaptive filtering algorithm considering asynchronous measurement characteristics is used to improve the accuracy and reliability of autonomous navigation for lunar rover. The algorithm can solve two engineering problems in lunar surface exploration.One is asynchrony of measurement caused by different kinds and numbers of navigation sensors and the other is the difficulty of determination of measurement nosie variance attributed to unstructured environment and variable conditions.Lastly,mathematical simulation results show that this method has satisfactory accuracy for absolute position and attitude determination, which are better than 50m (3σ)and $0.1(3\sigma)$, with high reliability and robustness, and can meet the autonomous navigation application requirement.