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# COOPERATIVE NAVIGATION METHOD FOR LUNAR BASE EQUIPMENT BASED ON MULTI-SOURCE INFORMATION FUSION

**Abstract**

With the development of space technology, more and more countries have formulated plans to build lunar bases. Among them, high-precision positioning and cooperative navigation of lunar base equipment are key technologies for lunar surface operations. Different from the earth, the surface environment of the moon is complex and unknown, and the lack of navigation information makes it difficult for single equipment to achieve long-term navigation. At present, there is a mode of multi-equipment collaborative navigation, which realizes large-scale navigation on the lunar surface through information interaction between multiple equipment and independent positioning fusion. For this collaborative navigation method, it is necessary to design an appropriate multi-source information fusion strategy while consider the impact of navigation information quality on the system to realize large-scale and high-precision navigation of lunar base equipment. In the process of multi-source information fusion, the following difficulties will be encountered. Firstly, the sampling frequencies of lunar base equipment's various sensors are inconsistent, resulting in insufficient use of navigation information when fusing at low-frequency cycles. Secondly, fusion of low-quality ranging information between different equipment can leads to a decrease in navigation system accuracy. In addition, since the precision of each sensor is different in different scenarios, assigning the same weight to navigation information with varying precision reduces system stability and may cause filtering divergence. In view of the above problems, this paper mainly does the following research work. Firstly, comprehensively utilize optical cameras, laser radar, etc. to obtain absolute navigation information, and introduce relative navigation information such as radio ranging into navigation systems. Designing an absolute/relative information fusion correction algorithm to improve the cooperative navigation performance. Secondly, the information entropy (IE) algorithm is proposed to evaluate the cooperative navigation information, selecting the optimal information to update the position of the lunar base equipment to decrease the influences of the low quality measurement information. Then, a method combining the residual chi-square detection method and the sliding window average method based on the information sequence is designed for low confidence measurements from sensors, processing the fault information to ensure the accuracy of the measured value. Finally, a self-adaptive IAF algorithm is designed to adaptively distribute the information to each filtering subsystem, giving higher weight to the high-precision navigation subsystem in different scenarios, enhancing the stability and accuracy of the navigation system. The simulation results show that the cooperative navigation method can realize large-scale and high-precision navigation on the lunar surface.