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INERTIAL-VISUAL COLLABORATIVE NAVIGATION METHOD FOR MASTER-SLAVE MULTI-LUNAR-BASED EQUIPMENT

Abstract

Lunar exploration is the focus of deep space exploration. During the years of human exploration to the moon, the feat from flying over the moon to manned landing on the moon has been achieved. Establishing a base on the surface of the moon will be the trend of lunar exploration. The unknown environment, complex terrain and lack of complete navigation and positioning system on the lunar surface all put forward stringent requirements for the precision and performance of the navigation system. The navigation system will encounter the following difficulties when exploring the lunar surface. Firstly, there are many unknown parameters involved in lunar surface, so it's difficult to establish environmental model. Secondly, considering the current launch capability of the launch vehicle, the equipment carried by the lunar base equipment is required to be light and low consumption, and the common sensor may be inapplicability. In addition, the lunar environment is an unstructured environment with no evident changes, which will increase the difficulty of collaborative navigation and improve the requirements for navigation and positioning performance and precision of lunar equipment. In view of the above problems, this paper mainly does the following research work. Firstly, in view of the large uncertainty of the lunar environment, a multi-machine cooperative SLAM localization technology is proposed, which can enable the lunar equipment to build an environmental model and estimate its own motion without prior environmental information. Secondly, the global image operator is introduced to identify the common view area of the multi-month based equipment, realize the information association among the multi-month based equipment, and optimize the robustness of the visual navigation system to environmental changes such as illumination. Finally, the motion state information between the equipment is exchanged by radio communication, and the measured value is filtered and fused with the information obtained by inertial navigation system. The joint filter model is used to simulate the information fusion process of the lunar equipment. The information allocation factor is calculated by the primary filter. The EKF is used to estimate the position and attitude information obtained by the sub-filter, and the above information is fused according to the weight of the allocation factor, so as to make the target positioning more accurate. The simulation results show that the proposed algorithm can further restrain the divergence of positioning errors and improve the positioning accuracy of the lunar-based equipment, which verifies the effectiveness of the proposed algorithm.