

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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A STUDY ON AUTONOMOUS VIDEO NAVIGATION SENSOR IN CLOSE RANGE WITH A
COOPERATIVE TARGET

Abstract

Rendezvous and docking (RVD) in space is one of the important space advanced techniques. It is the precondition to realize super space operations such as assemblage, maintain, retrieve of spacecraft, space station and the other huge aircrafts in orbit as well as space supply and send/receive astronauts. It has a great significance to develop space techniques and utilize space resources. In close distance, the method using optical imaging sensor and image processing is prior to the method by using radar and other sensors. The development of the optical imaging sensors for determining the relative position and attitude between two spacecrafts in RVD at the latest 40 years were analyzed and summarized in this paper. Especially, several typical schemes used by American and Russian as well as ESA etc. were compared and analyzed. On this foundation, the main conception of our autonomous video navigation system was determined. Fixed lens double camera system was used, and active luminous device was used to design beacon lamp of cooperative target beacon system. Then, the design of autonomous video navigation system in close distance was given. Beacon system was composed of five beacon lamps, and had four invariant features relative to transformations of rotation, translation and scale, and was delaminated to two layers to settle the contradiction between the measurement accuracy in the longer distance and the field of view in the shorter distance. Two sets of double camera system constituted by three fixed lens cameras with short focus were applied to the longer distance and the shorter distance respectively, which not only could ensure the field of view, but also could increase the measurement accuracy as soon as possible. Three kinds of measures were put forward to suppress the interference of miscellaneous lights including the interference of the sun and other kinds of celestial bodies as well as the radiation and reflection of the components of aircraft. At last, the study and simulation of beacon recognition as well as the determination of relative position and attitude were completed, the algorithm flow chart and corresponding simulation results were given which had shown the feasibility of our design.