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RELATIVE DETERMINATION FOR NON-COOPERATIVE SPACECRAFT BASED ON BINOCULAR VISION SYSTEM

Abstract

Relative position and attitude determination is the prerequisites for failure spacecraft capture and removal. In this work, the binocular vision determination strategy based on three-dimensional reconstruction is developed for non-cooperative spacecraft final approach and capture, and the ground-based vision system is also established to demonstrate the effectiveness of the relative determination method. The rectangle vertexes of the solar panel are selected as the feature points for three-dimensional reconstruction. It should be noted that, the starry background pose an effect on the accuracy of feature point extraction, in order to suppress this optical interference, the filter based on threshold calculation is designed and applied for image binary transformation. The feature point extraction is performed as follows: firstly, the Canny edge detector is used to detect geometrical edges in the image, then the Hough transform is applied to discriminate the straight lines from the curve edges, finally, the feature points of the solar panel vertexes are determined by threshold calculation from the intersection points group. The relative position and attitude determination algorithm is also presented by reconstructing the feature points in three-dimensional space, after the necessary coordinate transformations, the target relative position and attitude can be achieved in world reference frame. In order to demonstrate the performance of the proposed relative determination method, the ground-based binocular vision experimental system is established. In the experimental system, a 3-DOF translation platform with two CCD cameras is used to simulate the tracking spacecraft, and 3-axies rotation platform is used to simulate the malfunction satellite. During the simulation, both CCD cameras works simultaneously to measure relative position and attitude of the target spacecraft; by using the relative information, the target approaching motion is simulated by closed-loop control, the binocular vision determination method with high real time capability and accuracy is demonstrated, and the simulation results verify the effectiveness of the proposed method.