

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Virtual Presentations - IAF ASTRODYNAMICS SYMPOSIUM (VP)

Author: Dr. Weihua Ma

National Key Laboratory of Aerospace Flight Dynamics, Northwestern Polytechnical University, China

Mr. Luo Jianjun

National Key Laboratory of Aerospace Flight Dynamic, Northwestern Polytechnical University, China

INITIAL ORBIT IMPROVEMENT AND BEST OBSERVATION TIME WINDOW DETERMINATION
BASED-ON ANGLES-ONLY MEASUREMENTS

Abstract

Angles-Only Navigation has been focused to estimate the target's initial position mainly in recently years. However, if the target's initial position has been supplied roughly by other equipments and the chaser are required to flight to target immediately, how does the angles-only navigation method work for the following RV flight? The possible working mode is estimating target's relative motion parameters continuously by Extend Kalman Filter based on the angles-only measurement. But is it the possible best mode?

Here, a new application method for angles-only navigation is discussed for this case. During the RV flight stage, the angles-only navigation could be used to improve the precision of target's initial position and velocity only by very limited angles-only measurements and analytical calculation. No filter is used. The possible best precision and observation time windows are valued too. The method should be more convenient in engineering application since the angles-only measurements and calculation are very limited.

The main research work are followed. Since the target's initial orbit information is roughly, the errors of the initial position and velocity are selected as the unknown variables. The target's orbit information could be integrated roughly. The relationship model among the target's initial information, errors of the target's initial orbit information and the revised target's orbit information is constructed based on the CW equation. The measurement model among angles-only measurements, chaser's orbit information and revised target's orbit information are constructed based on the geometry relationship. Combined the two models together, the analytical resolution of target's initial errors could be constructed. If the chaser finished two maneuver and measurements is collected in different time, the initially errors would be resolved and initial orbit is improved.

The analytical precision model for initially errors is derived by introducing the angles-only measurement, angles-only measurement error, position of target and chaser. The best precision decided by these parameters could be modeled, too. Then the possible best precision for motion information and the best observation time windows are valued, too.

Simulations valid the method's performance. The distance between target and chaser is about 50km, the measurement precision of angles-only and target's initial position is about 10" and 2000m, respectively. The precision of target's initial position could be improved to 200m by the mentioned method and would be benefit for the following RV flight.

Keywords: Angles-only, Initial Orbit Improvement, Best Observation