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# LASER-LINK ACQUISITION MANEUVER PLANNING FOR GRAVITATIONAL WAVE DETECTION UNDER COUPLED MULTI-AXIS CONSTRAINTS

**Abstract**

In space mission of gravitational wave detection carried out by formation flying satellites, the movable payloads of laser emitters and telescopes are built on each satellite to accomplish laser acquisition and accurate pointing. For three satellites that form an equilateral triangle configuration, for instance, each one requires scan and pointing of two laser beams emitted by two payloads respectively for intersatellite acquisition. Although movable payloads can provide additional degrees of freedom for attitude maneuver, the satellite maneuver paths are under restrictions of payload installation structure and slewing angle limit. With presence of sun-avoidance and other pointing constraints, the acquisition procedure involves the problem of attitude maneuver planning for satellite with movable payloads under pointing constraints applied to multiple body-fixed axes, i.e., coupled multi-axis constraints. On account of the problem that the feasible region of attitude maneuver under multi-axis constraints is limited, considering the slewing angle and configuration limit of payloads, the geometric projection diagram of payload pointing in two-dimensional state parameter space of azimuth and elevation is designed and forms a variable polygon. As each node of the polygon corresponds to a payload pointing, the polygon's deformation extent is confined by the coupled relationship of payloads and slewing range of them each. On the basis of the diagram, a dynamic constraint model is constructed. Furtherly, a path planning algorithm is raised by adopting synchronous transfer strategy to payload state nodes based on heuristic information. Considering the limitation of the payload polygon, deformation to extreme extent means using up the maneuverability of payloads, causing the attitude unwinding of satellite base. It's hoped that slewing angles of payloads are kept at an intermediate value. Based on this thought, in the process of path expansion of all polygon nodes, a heuristic comparative evaluation function is designed for each node, and the adaptive adjustment of slewing angles of payloads is realized. During path searching, synchronously transfer the updated polygon nodes when previous nodes violate constraint regions. The safe attitude path planning is achieved. Considering the smooth and steady requirement of attitude maneuver, an expected average angular velocity is set. The angular velocity-stable inverse kinematics attitude trajectory planning method is applied to realize smooth path planning for satellite base and movable payloads. Proposed

maneuver planning method are applied in simulation cases to present a good performance of searching efficiency and anti-unwinding path. The feasibility of planned path is validated.