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MODEL PREDICTIVE CONTROL WITH SEQUENTIAL CONVEX PROGRAMMING (SCP) FOR
COOPERATIVE/NON-COOPERATIVE FORMATION FLYING SATELLITES**Abstract**

Future spacecraft formation flying missions, particularly those involving hundreds of elements, will necessitate onboard guidance and control capabilities that are rapid and robust. Utilizing nonlinear Model Predictive Control (MPC), researchers have demonstrated that convex quadratic programming techniques can produce optimal 3-DOF trajectories. Due to rotational dynamics and collision avoidance requirements, this method is however not readily scalable to tackle 6-DOF trajectory optimization. Combining the MPC algorithm with a sequential convex program (MPC-SCP) to optimize 6-DoF trajectories for cooperative and non-cooperative target vehicles, addresses these limitations. In addition, the proposed method avoids using a collision avoidance scheme at every iteration, resulting in an algorithm that is computationally efficient. The collision avoidance algorithm is invoked only if a minimum distance threshold is met, otherwise the spacecraft follow a collision free trajectory to their desired position. The MPC-SCP algorithm is implemented numerically, and despite linearization and discretization errors, it is able to maintain the spacecraft within a few millimeters of their desired terminal state.