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Displaced orbits generated by solar sails for the hyperbolic and degenerated cases

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Abstract Displaced non-Keplerian orbits above planetary bodies can be achieved by orientating the solar sail normal to the sun line. The dynamical systems techniques are employed to analyze the nonlinear dynamics of a displaced orbit and different topologies of equilibria are yielded from the basic configurations of Hill's region, which have a saddle-node bifurcation point at the degenerated case. The solar sail near hyperbolic or degenerated equilibrium is quite unstable. Therefore, a controller preserving Hamiltonian structure is presented to stabilize the solar sail near hyperbolic or degenerated equilibrium, and to generate the stable Lissajous orbits that stay stable inside the stabilizing region of the controller. The main contribution of this paper is that the controller preserving Hamiltonian structure not only changes the instability of the equilibrium, but also makes the modified elliptic equilibrium become unique for the controlled system. The allocation law of the controller on the sail's attitude and lightness number is obtained, which verifies that the controller is realizable.

Keywords: Solar Sail Displaced orbit stable Lissajous orbits hyperbolic equilibrium degenerated equilibrium

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