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CONCEPT FOR ATMOSPHERIC FLIGHT AT SUPER-ORBITAL-SPEED USING DOWNWARD LIFT

Abstract

The ability to fly at super-orbital-speed has applications in many areas such as rapid global reach and emergency rendezvous or interception. Conventional flight around the Earth can not exceed the orbital speed; otherwise the spacecraft will leave the Earth. This paper presents a concept that provides additional centripetal force by using the downward lift force, so that the spacecraft can fly around the Earth at a speed larger than the orbital speed. Thrust from solid rocket is used to offset the drag loss. A method for calculating the fuel consumption of super-orbital-speed flight is derived from the spacecraft dynamic model in the vertical plane. A spacecraft with a maximum lift-to-drag ratio of 4.2 is designed for super-orbital-speed flight and numerical simulation. Preliminary results show that the proposed concept can achieve the 20,000 km global reach in less than 30 minutes, at a speed of 1.5 times of the orbital speed, while the maximum dynamic pressure is less than 30 kPa. The impacts of some design parameters (flight altitude, flight speed, lift drag ratio and angle of attack) are studied.