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DECONFLICTING AVIATION AND SPACE OPERATIONS

Abstract

This paper examines the physical and technical aspects of deconflicting aviation and spaceflight.

Anticipating commercial opportunities, several nations have conceived spaceports. Some anticipate horizontal takeoff and landing or closely related air launch and horizontal landing. Some recognize the heritage of vertical launch with horizontal landing or vertical landing. Most are remote from population. Others share air and space ports. All must share airspace. Spaceports must also recognize satellite presence at altitudes that even suborbital trajectories must traverse.

The paper will categorize diverse national and industrial spaceport concepts according to their demands on share airspace and near Earth environments. Calling on the author's decades of experience with North American airspace management and satellite operations, the paper will consider factors such as air and spacecraft observability, maneuverability, guidance, and control.

Airspace control in the United States relies on interrogating transponders. Few satellites have transponders. Knowing the position and velocity of a satellite does not assure knowing its future state well. This leads to wide safe passage margins and long avoidance intervals. Windows for launching satellites or even suborbital trajectories are very sensitive and often very short, necessitating complete absence of overhead traffic. Remote space operations require feeder transport for passengers, cargo, and propellants. Co-located air and space operations introduce severe hazards to population. Orbital and long range suborbital flights are not continuously observable or able to be tracked actively often. Orbital and suborbital craft must dissipate significant amounts of energy in order to operate reasonably in controlled airspace. The Space Shuttle required nearly a whole continent to slow to "hot" landing speeds, and it was not very maneuverable during slowdown. It was difficult to to estimate reentry corridors. Large volumes of airspace were cleared. The author contributed to forensics of the Columbia demise, which involved unconventional sensors such as large infrasonic arrays. The paper will examine quantitatively the ability to track spacecraft and aircraft simultaneously, the ability of spacecraft to maneuver, and the requirements of airspace sharing.

There are many economic considerations, particularly the payload burdens of spacecraft operation in shared airspace. Aerodynamic devices diminish orbital payload. Reusable launch vehicles aerodynamic and landing propellant and mechanisms detract from payload at altitude. These may compromise profitability for the sake of sharing airports or airspace. . Will passengers gain much from intervals of even days accessing suborbital flight that lasts about an hour?