IAF SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES (D6)
Commercial Spaceflight Safety and Emerging Issues (1)

Author: Mr. Eduard Gamper
TU Braunschweig, Institute of Space Systems, Germany, e.gamper@tu-braunschweig.de

Mr. Lars Schmidt
Technische Universität Braunschweig, Germany, lars.schmidt@tu-braunschweig.de
Dr. Thomas Feuerle
TU Braunschweig, Germany, t.feuerle@tu-braunschweig.de
Prof. Enrico Stoll
TU Braunschweig, Institute of Space Systems, Germany, e.stoll@tu-braunschweig.de

APPOACHES TO AND METHODS FOR THE INTEGRATION OF SPACE TRAFFIC INTO AIR TRAFFIC

Abstract

In the past decades, human spaceflight, space transportation, and thus research in space was regulated by governmental institutions of space-faring nations. However, the human spaceflight advanced due to technological advancements and privatization. Consequently, the number of spaceflights and also the available spaceports have recently increased. Moreover, a further increase of the numbers is expected. Both orbital and suborbital flights are in the focus. Several use cases, for example space tourism or point-to-point flights to connect intercontinental destinations, are investigated in the field of passenger transport.

As soon as the frequency of flights increases, it will be necessary to plan the routes with respect to start time, landing time, and factors that influence the scheduled trajectory. An important factor is the consideration of interactions with regular air traffic. The scheduled trajectory has to be integrated efficiently and safely to minimize the risk and to sustain a steady air traffic. Usually, huge areas with flight-restrictions are imposed for launching and reentering spacecraft.

The focus relies on the integration of re-entering space traffic in the air traffic. A review of possible trajectory determination methods is made by which an optimal re-entry trajectory could be achieved. Direct and indirect methods, pseudo-spectral methods, dynamic programming, and convex optimization are considered based on two scenarios (orbital and suborbital) and their constraints and hazards along the resulting trajectory.

The possibilities of more seamlessly integrating spaceflight into the future air traffic system will be considered. This includes new possibilities arising from new air traffic management (ATM) of SESAR and NextGen. Based on the orbital and suborbital scenario, options for current and future ATM for planning and operation of reentering spacecraft within commonly used airspace will be given.