

44th SYMPOSIUM ON SAFETY AND QUALITY IN SPACE ACTIVITIES (D5)
A Big Challenge : Safety in Aerospace Missions (1)

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USING MONTE CARLO SIMULATION FOR SAFETY AND RISK ASSESSMENTS OF WINGED
RE-ENTRY PASSENGER VEHICLES

Abstract

Winged re-entry vehicle with orbital and suborbital flight velocities gained recent attention. Especially in the context of the newly emerging and fast growing sector Space Tourism. However, safety is a decisive property in order to gain acceptance in the public and hence establishing this new industry. Winged re-entry vehicles often have to fulfill contradicting requirements in respect of the mission scenario:

- high safety standards and high flexibility,
and the system architecture:
- versatility and robustness of the design.

The higher the flexibility of the mission and the versatility of the vehicle, the higher is the complexity of the total design. A measure of the complexity of a system is the non-linearity of the describing mathematical model. The intention of the paper is to investigate these factors using the example of the SpaceLiner¹ which is a winged re-entry passenger vehicle.

In its first part, the paper describes the technological concept of the SpaceLiner and its major features. This includes the mission (i.e. the flight trajectory) and the system architecture (i.e. configuration, propulsion, aerodynamics and thermal protection). In its second part, the paper analysis and identifies, based on the SpaceLiner, the key risk elements that are decisive for the risk assessment. Moreover it is necessary to determine the mission requirements, like minimal landing ellipse, maneuverability, maximal loads in order to derive the system requirements, like GNC² and lift over drag.

A common way to characterize a non-linear system is by using statistical methods. This is done in the third part via Monte Carlo Simulations. Strong non-linear coupling of two properties can be illustrated by the skewness of the resulting probability distribution. The propagation of uncertainties and errors throughout the system will be focused.

Based on the results of the second and third part, a risk analysis shall be performed. The impact of the above discussed requirements on the risk assessment shall be highlighted. In addition it will be discussed to what extend these results are applicable to other concept.

¹Martin Sippel, Arnold van Foreest: *Progress in Research on the SpaceLiner High-Speed Passenger Transportation Concept*, IAC-07-D2.7.07, September 2007 India, Hyderabad

²Guidance Navigation and Control