

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

Author: Mr. Alexander Schütte
ArianeGroup, Germany, alexander.schuette@ariane.group

OPTIMIZATION OF LAUNCHER LIQUID PROPELLANT TANKS IN CFRP

Abstract

The launcher performance and therefore the weight of the structure is, besides others, an important competitiveness factor. Main components of the launcher are cryogenic propellant tanks. While today these structures are manufactured using Aluminum alloys, future launcher architectures may benefit from the application of CFRP.

This paper focuses on the structural optimization of CFRP launcher propellant tank structures. Since the primary design variables, such as geometrical properties of the stiffening concept and laminate stacking sequences, are already defined within the early design phases of the development, efficient tools for optimization of the structure design are needed that can be used already in the structure concept definition phase.

In this regard, a computationally efficient structural analysis and sizing tool is coupled with a structural optimization tool in order to perform optimization computations. Concerning the structure analysis tool, focus is put on problem adapted, simplified analysis methods rather than on commercial FE applications.

The effect of the pre-stress resulting from internal pressure is considered to correctly compute the discontinuity stresses at tank cylinder to dome junctions. Thus, an efficient optimization with regard to the shape of the tank dome (i.e. elliptical, CASSINI, spline) and with regard to laminate stacking sequence and thickness distribution can be performed to achieve a promising preliminary design.