Student Research Project / Bachelor Thesis

Design of a Release Mechanism for an Air Launch System with Cryogenic Propellants

For air launch systems, the pylon is the interface between the launcher and the carrier aircraft and is mounted either under the fuselage or the wing of the aircraft, depending on the aircraft type. For safe release of the launcher, the pylon must have a release mechanism that can be triggered by the crew during the mission. However, in addition to handling the load of the launcher itself, this mechanism usually faces other challenges in terms of reliable design.

A key issue is the contraction of the launcher in the course of fueling with cryogenic substances such as liquid oxygen, nitrogen and helium. For this purpose, the release mechanism must allow a certain amount of play, depending on the position and orientation of the latch. At the same time, however, the clearance must not be too large in order to prevent vibrations caused by aerodynamic forces during flight. In addition, ice buildup can occur on the launcher surface due to cryogenic fueling. Thus, when designing the pylon and the release mechanism, additional care must be taken to prevent the mechanism from freezing and the launcher sticking to the pylon. For this reason, a reliable release mechanism for a corresponding pylon is to be designed as part of this work.

The work is divided into the following work steps:

1. Literature research on air launch systems, release mechanisms, pylons, electrical actuators and heat elements, FEM, multi-body simulation, and reliability analyses
2. Identifiction and definition of requirements for the design of the release mechanism
3. Creation of a morphological box to identify possible solutions
4. CAD modeling of promising solution approaches for the release mechanism
5. Investigation of the design approaches using finite element method, multi-body simulation, reliability block diagrams as well as an operational simulation in Matlab/Simulink
6. Critical analysis of the final designs and presentation of further optimization potentials

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Execution only after consultation of supervising university institute