Student Research Project / Bachelor Thesis

Design of a Hinge Mechanism for Nosecones of Reusable Launchers

At GAIA Aerospace, concepts for reusable nanolaunchers are currently being investigated in more detail. An essential component of such systems is the reuse of the payload fairing. This can either be jettisoned and returned to earth with parachutes or remain attached to the first stage by integrating the second stage and simply open it up to release the second stage including payload.

The second variant has the advantage that the entire first stage can return to earth with the aid of a single parachute system, when the parachute is integrated into the hinged nosecone. This also allows the parachute to be deployed at any time during the mission, thus ensuring that the launcher can be rescued in the event of an engine failure. However, the design of the hinge mechanism poses a particular challenge. On the one hand, it must be able to move the nosecone sufficiently to release the payload and second stage with minimal installation space. On the other hand, the latch must be able to bear the loads of the ejected parachute and the dry mass of the launch vehicle without plastic deformation of the system. In addition, the system must also prevent seawater intrusion during a splashdown. For this reason, this thesis will design a reusable hinge and latching mechanism for the nosecone of an appropriate launcher.

The work is divided into the following steps:

1. Literature review on reusable launchers, hinge mechanisms, payload fairings, parachutes, seals, electrical and pneumatic actuators, FEM and multibody simulations
2. Identification and definition of requirements for the design of the hinge mechanism
3. Creation of a morphological box to identify possible solutions
4. CAD modeling of promising solution approaches for the hinge and latching mechanism
5. Investigation of the design approaches by means of finite element method, multi-body simulation 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