



# GAIA

## AEROSPACE

### Student Research Project / Master Thesis **Behavior of Air Launch Systems in the Downwash of Carrier Aircraft**

GAIA Aerospace is currently investigating the launch procedure of various air launch systems. During the launch procedure of an air launch system, the launcher falls back slightly after release because the propulsion system has not yet been ignited and thus shifts in the direction of the rear fuselage segment under the carrier aircraft. In this area, a downwash is formed due to the finite wings of the carrier aircraft. This can lead to a negative angle of attack on the launcher's finards and result in an uncontrolled pitching of the launcher. If the launcher pitches up too much, additional lift can affect the launcher, which in the worst case can lead to a collision of the rocket with the tail unit of the carrier aircraft.

Depending on the size, geometry and aspect ratio of the wings of the carrier aircraft as well as the positioning of the launcher under the carrier aircraft, the downwash effect can have a different impact on the launch of the air launch system. For this reason, this thesis will examine in more detail how an air launch system would behave during the drop from different carrier aircraft and what potential danger exists for the launcher and the carrier aircraft.

For this purpose, the work is divided into the following steps:

1. Literature research on air launch systems, carrier aircraft, downwash and wake vortices, flight mechanics and aerodynamics of aircraft and rockets.
2. Definition of suitable carrier aircraft and drop scenarios for a predefined air launch system
3. Definition of mathematical downwash models for the appropriate carrier aircraft
4. Implementation of the carrier aircraft and downwash models into a predefined flight simulation of the air launch system in a Matlab/Simulink environment
5. Performance of drop simulations using the previously defined drop scenarios
6. Critical analysis of the flight mechanical behavior of the air launch system and the collision probability with the respective carrier aircraft
7. Summary of the results and presentation of possible approaches for collision avoidance

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Execution only after consultation of supervising university institute

