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**Title**

# 3D flow simulations of space launchers stage separations through overset approach

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**Abstract**

Space launchers are based on multistage configuration for boosting the payload capabilities. As a consequence, the capability of understanding and evaluating aerodynamic effects during stage separation is a challenging issue among CFD community and, in particular, it is strongly related to the success/failure of the mission.

In the proposed study, this task is achieved by applying the overset method implemented in the CFD commercial solver CFD++ [1]. To illustrate the features of this technique, let us consider for sake of simplicity the case of the separation between two stages of a space launcher. The overset method is based on two 3D unstructured grids: the former, called 'overset grid', is built around the first stage, which is in relative motion with respect to the second stage. In particular, the overset grid moves over a fixed tetrahedral volume mesh containing the second stage due to the aerodynamic forces and the first stage weight. At each time-step, the elements of background mesh which fall inside the overset grid are blanked out: by doing so, a hole is carved within the background volume mesh. Then, this cavity is filled by the overset grid in order to obtain a new computational mesh that is used by the CFD++ solver to compute the flow-field solution referred to this time-step.

This technique will be applied to perform 3D numerical simulations of space launchers stage separation both in design and off-design conditions: indeed, one of the aims of the proposed study will be the evaluation of the multistage rocket aerodynamic behaviour consequent to an abnormal functioning of the stage separation system, as an example due to a retro rocket failure during this phase.

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