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Title
Free-flight testing of proximal cubes in cold hypersonic flow

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Abstract
The accumulation of space debris objects on Earth's orbits imposes a crucial need to improve the engineering models applied by Design for Demise methodologies. Due to the complexity of the fragmentation, re-entry analysis toolkits usually simplify the dispersion process by neglecting the aerodynamic interference between the main object and the disintegrated pieces. They are considered as independent trajectories as soon as the structural joints vanish. Laurence et al. conducted a thorough analysis on the separation of two spheres [1] and the dispersion of sphere clusters [2], and proved that the interactions can cause a significant increase in the objects' flow-normal velocity.
The accurate aerodynamic analysis of proximal bodies challenges the capabilities of CFD tools due to the mutual interactions between the objects and also experimentally requires an elaborated measurement methodology. Free-flight testing in hypersonic wind tunnels has shown good capabilities for analyzing debris objects, providing accurate aerodynamic databases, and testing separation scenarios. The free-flight measurement methodology introduced by Grossir et al. [3] to the VKI Longshot facility was recently upgraded by adding a second optical access. The horizontal schlieren observation is complemented with a vertical backlit view which supplies information on the lateral motion of the object and hence extends the analysis to six degrees of freedom.
In the current work, the experimental setup is applied to study the separation of two cubes. The interaction scenario of two objects which can produce lift at certain angles of attack could be a fascinating complement to the previous work of Laurence et al. [1], which focused on two spheres. The analysis of the interfering objects is challenging for the image processing algorithms and requires their refinement since pictures of partially overlapping models are expected. The final manuscript will explain the experimental setup, detail the advancement of the data processing algorithms to handle multiple bodies, present the measurement results, and compare them to studies conducted on spheres.

References

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