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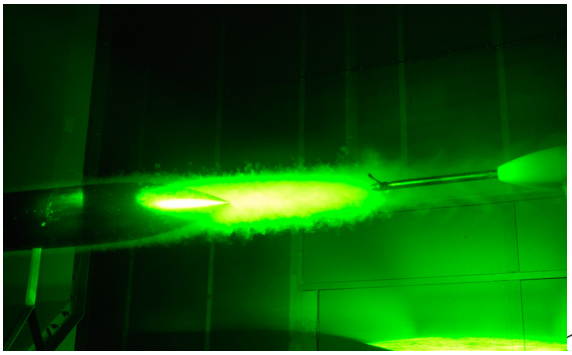
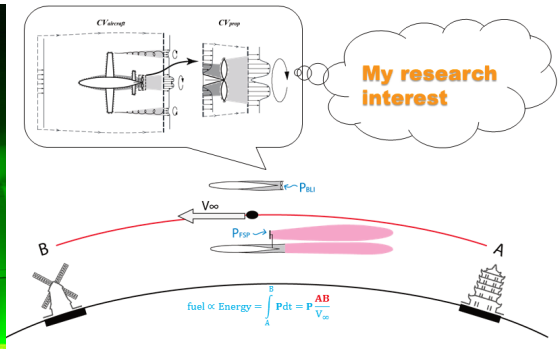
Boundary layer ingestion for transport aircraft

The benefit of wake-filling on power consumption is well known in the field of marine propulsion. Ship propellers are typically installed at the rear of vessel and operated within the current of boundary layer flow. This configuration is known as Boundary Layer Ingestion (BLI) or Wake Ingestion (WI) and it is also applicable to airborne systems. To better understand the physics of BLI applied to aircraft airframe and propulsion systems, this research is divided into two pillars: theoretical and experimental. The theoretical work focuses on conceptual studies to evaluate the performance of the propulsor and its associated vehicle in the configurations of WI and BLI. A power conversion analysis uses the power balance method to elaborate the power-saving mechanism of WI. The body-propulsor interaction occurring in the BLI configuration is qualitatively analysed to clarify its influence on the performance of the integrated vehicle. The experimental study aims at quantifying the power conversion processes. Stereoscopic particle-image velocimetry is employed for the first time to visualise the flow field at the location of interaction between a propeller and an incoming body wake, as well as to provide experimental data to be used for the power balance method. The results suggest that the minimisation of power consumption should be used as a theoretical design criterion for aircraft using BLI. The experiment shows that the utilisation of body-wake energy by the wake-ingesting propeller is the main mechanisms responsible for the efficiency enhancement in the experimental setup.





Key Characteristics

Ship propellers • Boundary Layer Ingestion (BLI) • Wake Ingestion (WI)