

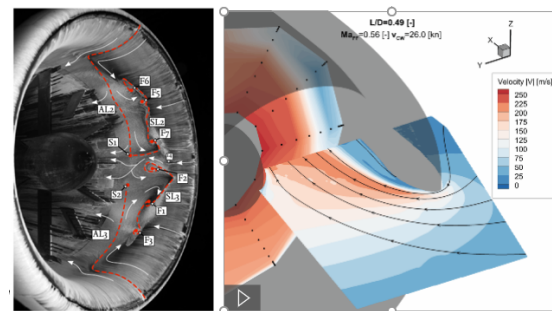
# Numerical investigations of the fan-intake-interaction of future high bypass ratio turbo fan engines

## Studienarbeit/Masterarbeit

Modern ultra-high bypass ratio (UHBR) jet engines tend to increase their propulsive efficiency by an increasing fan - and therefore nacelle - diameter. To counter the occurring negative effects, like increasing drag and overall engine weight, the intake geometries are shortened. By this, the interaction of intake and fan is moving into focus due to their decreasing axial distance. Therefore, the need of a detailed knowledge of intake aerodynamics in presence of a rotating fan and the fan behaviour in a distorted intake flow becomes necessary in an earlier stage in design.



(a) INFRa-Rig im PTF



(b) Experimentelle Ergebnisse

**Figure 1:** INFRa-Rig im PTF des IFAS der TU Braunschweig und Messungen der Einlaufstörung bei Seitenwindbedingungen

For this purpose the propulsor test facility (PTF), an advanced wind tunnel setup designed to simulate head and crosswind flow conditions while accommodating powered test rigs, is available at the institute for jet propulsion and turbomachinery of the TU Braunschweig. The PTF features an open Eiffel-configuration wind tunnel combined with a second closed wind tunnel surrounding the test section. The test section can house experimental rigs of various designs and purposes, connected to a drive shaft, allowing for the testing of an operating fan stage integrated into an intake geometry. This setup is particularly focused on studying the interaction between the intake and the fan under varying velocities and

angles of attack, including pure crosswind scenarios.

The INFRA (Integrated Nacelle Fan Rig Assembly) rig, developed collaboratively by the institute of jet propulsion and turbomachinery (IFAS), the German Aerospace Center (DLR) and Rolls-Royce Deutschland (RRD), is the test rig used in this work. The INFRA rig is specifically designed to investigate fan-intake interactions under variable and highly critical inflow conditions, such as crosswinds of varying strength and large angles of attack typical during take-off. It represents the cold stream of a high bypass ratio turbofan engine with a scaling factor of approximately 1:3. Equipped with numerous probes, the INFRA rig assesses the performance of both the fan and intake under these challenging off-design conditions.

The results of the student thesis should include a comparison of global fan stage performance data, such as pressure rise and efficiency, under variable inflow conditions like varying headwind velocities and different levels of inlet distortions caused by crosswind using numerical simulation methods.

If you are interested, please send your details:

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