Falcon

Foreseeing the next generation of Aircraft

D4.5 2nd Hybrid database on FSI experimental and numerical data

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BACKGROUND: ABOUT THE FALCON PROJECT

The FALCON project is a Research and Innovation Action funded by the Horizon Europe – the Framework Programme for Research and Innovation (2021-2027) aiming to develop a hybrid approach combining both cutting-edge numerical and experimental methods to analyse Fluid-Structure Interaction (FSI), better predict and control the aircraft aerodynamic unsteady loads, thus improving the aeroelastic properties and sustainability of aerostructures and reducing the related aerodynamical noise. This will ultimately contribute to upscale the current design capabilities of the European aircraft industry while enhancing the digital transformation of the European supply chain.

The project is implemented by a European consortium with 8 world-class partners including: i) Internationally recognized research groups in fluid-structure interaction using numerical simulation (AMU, KIT) and experiments (DLR); ii) Major companies developing numerical simulation software for fluid dynamics (CS) and solid dynamics. (MSC); iii) An internationally renowned research center for high-performance computing (IT4I@VSB); a leading company in France for the funding obtention, communication and dissemination of EU projects (EURONOVIA) and iv) a major actor in the European aeronautical industry (AIRBUS).

To upscale the actual design capabilities of the aeronautics industry, FALCON addresses open key-problems involving FSI phenomena to reduce noise and improve sustainability, based on a conceptual methodology built on four pillars: MEASURE, SIMULATE, BOOST, OPTIMIZE.

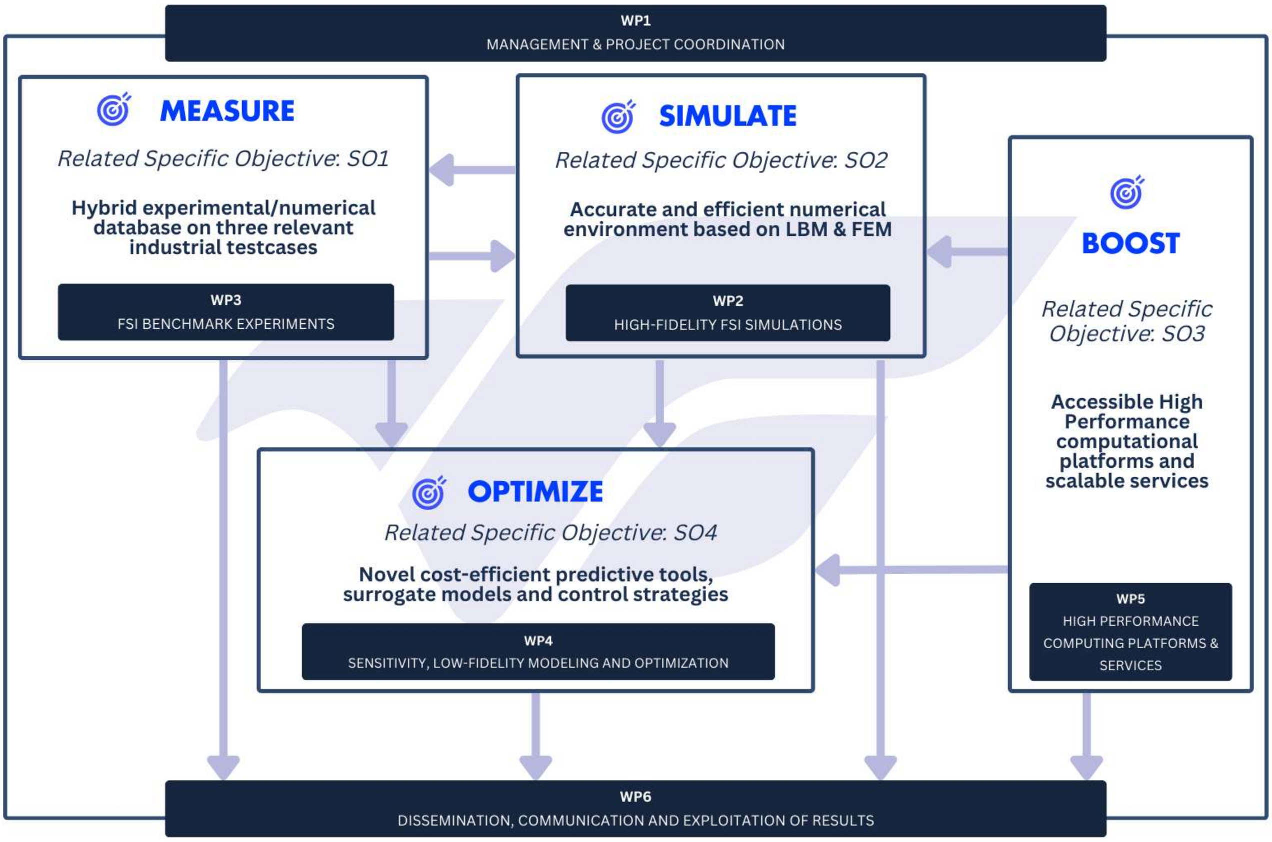

Figure 1: FALCON conceptual approach

EXECUTIVE SUMMARY

This document is a deliverable of the FALCON Project, funded under the European Union's Horizon Europe research and innovation programme under the grant agreement No 101138305.

This deliverable aims to collect numerical and experimental data in the hybrid database. Over the past year, the hybrid database has continued to expand both in scope and structure, consolidating new datasets relevant for advancing Fluid-Structure Interaction (FSI) modelling, sensitivity analysis, and surrogate model development. The hybrid database remains a versatile and comprehensive resource designed to support research activities across the consortium by integrating academic, numerical, and experimental datasets into a unified platform. The overarching goal is to strengthen the reliability, robustness, and applicability of numerical and machine learning models, thereby facilitating the transition from theoretical investigations to industrial deployment.

During the current reporting period, several significant updates have been incorporated. New experimental data from the TC1 test campaign have been added to the database. These data include detailed measurement sets intended to validate and calibrate FSI numerical solvers developed within the project. In addition to the experimental contributions, the numerical section of the hybrid database has been extended with a new 2D coupled FSI example from the OpenLB–ESPRESO workflow. This example, referred to as the *perpendicular flap* case, provides a fully reproducible dataset demonstrating fluid–structure coupling in a simplified yet representative configuration. It serves both as a validation case for ongoing solver development and as a reference scenario for sensitivity and surrogate modelling studies.

In parallel with the numerical and experimental developments, work has progressed on the creation of AI-based surrogate models for FSI. Initial training datasets have already been generated as part of this effort, focusing on simplified FSI scenarios and reduced-order representations relevant for machine learning workflows. These datasets, along with future AI-related data collections, will be made accessible through the hybrid database according to the chosen licensing framework during the upcoming year. Their inclusion will support the project's long-term objective of integrating physics-based and AI-driven modelling approaches.

The development of the project's in-house FSI solver is still actively ongoing. As the solver matures and additional validation cases become available, a major expansion of the hybrid database is anticipated in the coming project year. The most substantial updates—especially those linked to 3D test cases, full-scale TC campaigns, and advanced coupled simulations—are scheduled for integration once the solver reaches a stable milestone.

Since the datasets included in the hybrid database are generated progressively by multiple project partners, the upcoming year will also focus on establishing a clear and comprehensive definition of data rights and licensing conditions. This effort aims to ensure that datasets can be gradually released and made accessible to external communities in accordance with the project's Data Management Plan and the consortium's exploitation strategy. Clear licensing frameworks will support responsible data sharing, maximise scientific impact, and facilitate long-term reuse of FALCON-generated resources.

The database continues to be non-public during the initial phase of the project, until 31/12/2026, and remains accessible exclusively to consortium members via secure login. Data are progressively added in

alignment with experimental measurement progress and numerical workflow development. In the subsequent project phases, M24 and M36, the consortium will determine the classification of the datasets. Based on these decisions, data will be separated into public and non-public categories. Publicly accessible data will be disseminated through an open repository, following the guidelines defined in the project's Data Management Plan and in alignment with the exploitation strategy.