Ansys

CASE STUDY /

Ansys + Penn State University

"Ansys Fluent allowed us to implement, verify, and validate the theory of using partial pressure fields (PPFs) for aircraft drag decomposition which has the potential to improving our collective understanding of the various sources of drag and their interference."

Sven Schmitz
Boeing / A.D Welliver Professor / The Pennsylvania State University

CASE STUDY

A Nearfield Drag Decomposition Using Ansys Fluent Poisson Solver

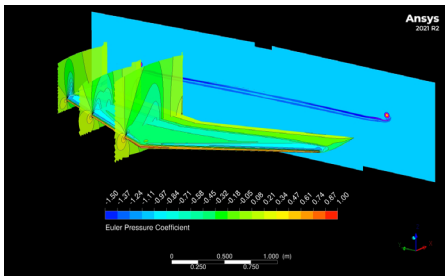
Drag decomposition into profile, induced, and wave drag is a valuable tool for analysis and design of current and future aircraft configurations. Traditionally, drag decomposition is performed in the farfield (e.g., Maskell's induced drag formula or Oswatitsch's entropy integral). A novel concept based on partial pressure fields (PPFs) allows for a drag decomposition in the nearfield, thereby providing phenomenological pressure fields as opposed to single-valued integrals.

Challenges

The long-term goal is to have a reliable means of aircraft drag decomposition that applies equally to current and future aircraft configurations (e.g., blended wing-body, integrated propulsion systems, etc.) and is unambiguous to the particular choice of integration planes. The required software had to be both capable of overset meshes for quantitative comparisons to farfield drag integration and able to supply user-defined Poisson equations to solve for the PPFs.

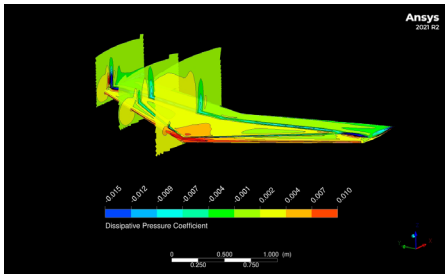
Engineering Solution

- High-quality structured meshes provide verification and validation
- User-defined scalars are easy to implement.
- Ansys Fluent user-defined functions (UDF) package allows for an unparalleled degree of customization.
- The unique capability of an available Poisson solver within user-defined transport equations is included.
- Overset meshing allows for farfield drag decomposition to be conducted concurrent with nearfield PPF decomposition.



Benefits

- Ansys Fluent enabled simultaneous nearfield and farfield drag decomposition.
- The inclusion of a 3D Poisson solver within Fluent is unique and is not commonly available in other commercial CFD packages.
- Ansys Fluent was critical to NASA University Leadership Initiative (ULI) research on ultra-efficient commercial aircraft.



Ansys Products Used

Ansys Fluent, User-Defined Functions (Adjust, Source Terms)

Company Description

The Pennsylvania State University

The Department of Aerospace Engineering at Penn State has a renowned national and international reputation in basic & applied research in aeronautics, acoustics, rotorcraft, space systems, and autonomy. Prof. Sven Schmitz leads the Rotary Wing Aerodynamics Group and has published more than 40 journal and 70 conference papers in aeronautics, rotorcraft aeromechanics, and wind energy.