

# THE DLR-D2AE – A SHORT MEDIUM RANGE AIRCRAFT CONFIGURATION FOR AEROELASTIC INVESTIGATIONS

*Thomas Klimmek and Matthias Schulze*

*Institute for Aeroelasticity / DLR German Aerospace Center,  
Bunsenstr. 10, 37073 Göttingen  
Germany*

## ABSTRACT

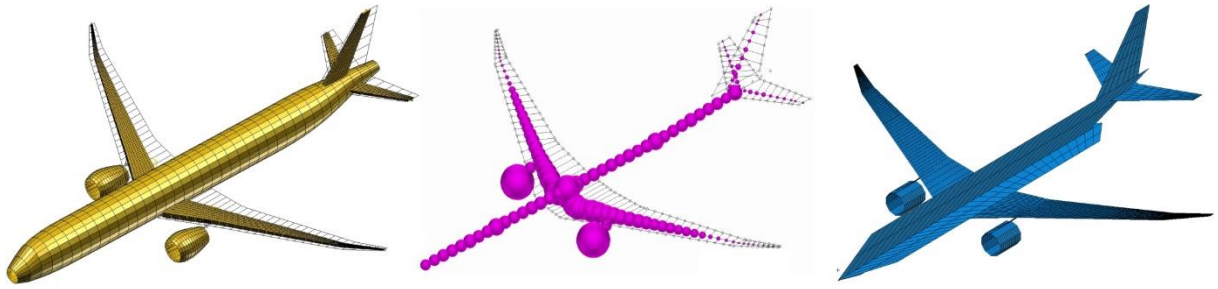
In future aircraft designs, aeroelastic characteristics are anticipated to gain increasing significance. Several key factors underscore this evident trend. First, the growing adoption of lightweight structural materials, such as carbon fibre composites, combined with advanced design methodologies like structural optimization, is likely to result in a reduction in the stiffness of load-bearing structures. Additionally, the development and implementation of technologies aimed at comprehensive load alleviation and flutter suppression, even within the bounds of the aeroelastic stability envelope, further contribute to this progression. Another notable factor is the ongoing trend of increasing wing aspect ratios to enhance aerodynamic performance, which also plays a pivotal role in shaping these advancements.

The Institute of Aeroelasticity at DLR (DLR-AE) initiated the development of a single-aisle, short to medium-range aircraft, referred to as the D2AE configuration, with the primary goal of studying the aeroelastic properties of future aircraft designs. This new configuration is derived from the D239+ configuration, which was originally developed by DLR's Institute of System Architectures in Aeronautics (DLR-SL) to accommodate up to 239 passengers in a single-class layout.

The most significant distinction between the D239+ and the D2AE lies in their wing planform. The D239+, with a wingspan of approximately 36 meters, fits neatly within the ICAO Code C classification. In contrast, the D2AE's wingspan is extended to 42.5 meters, but it still adheres to Code C requirements by incorporating a folding wingtip mechanism at a span position of roughly 36 meters. Additionally, the D2AE features an increased aspect ratio of 12.5 and a larger wing area of 131 square meters, compared to the D239+, which has an aspect ratio of 9.4 and a wing area of 124 square meters.

The D2AE configuration design incorporates the conceptual design tool openAD, developed by DLR-SL, alongside the parametric aeroelastic design methodology cpacs-MONA from DLR-AE. The cpacs-MONA process integrates the evaluation of aeroelastic loads with structural dimensioning, employing structural optimization techniques to refine the design. The structural modeling of the entire aircraft is conducted at a preliminary design stage. Leveraging a parametric approach facilitates efficient updates to the simulation models, even when dealing with complex configurations, thereby streamlining the overall design process.

The paper provides an overview of the fundamental features of the D2AE configuration, along with the aeroelastic studies conducted to date. The most recent advancement in the D2AE configuration involves creating a structural model for the fuselage, incorporating both shell and beam elements. A comparison between the fuselage stick model and the shell/beam model is presented. Plans are underway to make the structural model (separate stiffness model and mass models) and the aerodynamic model (VLM/DLM), created using NASTRAN input data, accessible online for researchers interested in further exploration.



*Figure 1 D2AE stiffness model (left), mass model (middle), and DLM aerodynamic model (right)*