CFD2030 Call for Papers (CFP)

<u>**SciTech 2025**</u>

Please direct questions to:
Francisco Palacios, The Boeing Company
Mark Turner, NASA Glenn Research Center

The CFD2030 Vision report laid out a bold vision for future computational capabilities and their potential impact on aerospace engineering and design, and recommended the establishment of Grand Challenges (GCs) to drive CFD technology development. Since 2021, four GCs have been developed and published in key technical areas: high-lift aerodynamics (AIAA Paper 2021-0955), full engine simulation (2021-0956), CFD-in-the-loop for space vehicle design (2021-0957), and hypersonics (2024-0683). Under the CFD2030 topic, we are soliciting papers that address current efforts to advance CFD technology, to both highlight the current state-of-the-art and to help identify where technology advancements are needed to make significant progress towards achieving the GCs, in the following areas:

1. **CFD technology, tools, and/or processes utilizing Scale-Resolving Simulation (SRS) methods to predict aerodynamic characteristics at the edges of the flight envelope for complex aircraft configurations at flight scale.** This subtopic addresses a key shortcoming in the prediction of turbulent, separated flows, which is common across all of the GCs. Papers are requested that focus on the development, testing, and validation of SRS methods and tools for complex, 3D configurations at high Reynolds numbers, and could address applications to predict subsonic maximum lift, high-speed buffet, and flutter, among others.
2. **Development of testing techniques and/or representative experimental datasets to validate coupled aero/structural computational analysis of complex vehicle configurations.** Many of the GCs ultimately require coupled disciplinary analyses, so this subtopic specifically addresses efforts within the testing community to generate high quality datasets to help validate coupled aero-structural analysis tools and processes. Papers could focus on testing campaigns, testing techniques, coupled experimental/CFD studies, etc.
3. **Development of propulsion-related simulations toward Full Engine Simulation at design and off-design conditions and Propulsion-Airframe Interaction (PAI) applications.** This subtopic includes detailed component simulations at off-design conditions such as a compressor at near-stall or in-stall and coupled component applications such as combustor-turbine interaction or inlet-fan simulations. Focus areas include hybrid fidelity approaches, as well as high-fidelity approaches for PAI, and efforts that describe improved, more efficient algorithms and frameworks, and the integration of geometry at higher fidelity.
4. **Development of testing techniques and/or representative experimental datasets to validate hypersonic aerodynamics, structural dynamics, propulsion, and control, or integrated issues such as fluid-thermal-structural-integration or propulsion integration.** Accomplishing the hypersonic vehicle GC for boost glide, airbreathing, or reusable concepts will require significant ground and flight test experiments for verification and validation. Papers that describe useful available data sets in the above areas as well as descriptions of gaps in available datasets are welcome.

5. **Development of high-resolution aerodynamic databases including Uncertainty Quantification (UQ).** Success in achieving the GCs will feature the use of CFD simulation data within aerodynamic databases, to support vehicle flight control development, among other purposes. This subtopic covers not only tools and processes that utilize higher-fidelity numerical data in aerodynamic databases, but also the development of methods and approaches to incorporate an appropriate engineering-level assessment of data uncertainty to ultimately improve confidence in the use of the database.
6. **Development of Artificial Intelligence (AI)/Machine Learning (ML) for CFD Applications.** Emerging technologies involving the application of AI/ML to aerospace product development promises to better optimize system performance at potentially much less cost. CFD plays a central role in enabling the digital engineering of these future projects. This subtopic specifically focuses in two key areas: AI/ML for physical modeling improvements (like turbulence modeling), and the application of AI/ML to enable the development of integrated aerodynamic databases when multi-fidelity sources of data (i.e., CFD, WT, Flight), with quantified uncertainties, which can be effectively fused into a single database to support aerodynamic design (e.g., Loads assessments, Handling Qualities, etc.)