CFD2030 Call for Papers (CFP)

<u>Aviation 2024</u>

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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) in four areas: Large Eddy Simulation (LES) of powered aircraft configuration across the full flight envelope, off-design turbofan engine transient simulation, Multi-Disciplinary Analysis and Optimization (MDAO) of a highly-flexible advanced aircraft configuration, and probabilistic analysis of a powered space access configuration. In 2021, three GCs were published in the following areas: high-lift aerodynamics (AIAA Paper 2021-0955), full engine simulation (2021-0956), and CFD-in-the-loop for space vehicle design (2021-0957). 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. **Advances in turbulence modeling and data-driven methods towards CFD Vision 2030 Goals.** 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 turbulence models for complex, 3D configurations at high Reynolds numbers, and could address applications to predict subsonic maximum lift, high-speed buffet, and flutter, among others. An additional focus area is the application of machine-learning (ML) and/or artificial intelligence (AI) techniques to improve CFD prediction capabilities, particularly turbulence modeling and/or ensemble aerodynamic database generation using high-fidelity CFD methods.
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 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.