NASA SBIR 2018 Phase I Solicitation

A1.05 Computational Tools and Methods

Lead Center: LaRC

Participating Center(s): ARC, GRC

Technology Area: TA15 Aeronautics

The CFD Vision 2030 Study (https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20140003093.pdf) highlighted the many shortcomings in the existing technologies used for conducting high-fidelity simulations, and made specific recommendations for investments necessary to overcome these challenges. Areas of research that help to significantly reduce CFD workflow are the subject of this solicitation. It was recognized that the generation of meshes suitable for high-accuracy CFD simulations constitutes a principal bottleneck in the simulation workflow process as it requires significant human intervention. As more capable high performance computing (HPC)Â hardware enables higher resolution simulations, fast, reliable mesh generation and adaptivity will become more problematic.Â The other area of research pertains to extracting knowledge of physical relevance from computed and experimental data from wind tunnels and flight.Â

To enable accurate CFD solutions for complex configurations, proposals are solicited for generating unstructured and mixed-element meshes for accurate flow solutions. The new capability will be demonstrated for configurations of interest to NASA aeronautics (http://www.aeronautics.nasa.gov/programs.htm) in terms of accuracy, speed and robustness. Of particular interest is theÂ NASA juncture flow model (AIAA Paper 2016-1557) for which grids suitable for unsteady flow simulations (e.g., large eddy simulation (LES) and wall-modeled LES) needs to be generated. Another potential test case is the aircraft landing gear requiring hybrid RANS/LES solutions. The metrics for success are the quality and speed of grid generation. The proposers must present a convincing case that the proposed approach has the potential for dramatic decreaseÂ in CFD workflow time while generating quality grids that would produce physically relevant results. Proposers should also specify how the grid quality will be determined.Â

The second area of research for which proposals are solicited pertain to merging of high-fidelity CFD simulations with other aerodynamic data**.Â** With wind tunnel and flight testing still expected to play a key role in the aerospace system design process, methods to merge and assimilate CFD simulation data with other experimental/computational data sources to create an integrated database, including some measure of confidence level and/or uncertainty of all (or individual) portions of the database, are required. Currently, the merging of large amounts of experimental and variable fidelity computational data is mostly carried out through experience and intuition using fairly unsophisticated tools.Â Well-founded mathematically and statistically-based approaches are required for merging such data, for eliminating outlier numerical solutions as well as experimental points, and for generally quantifying the level of uncertainties throughout theÂ data base.Â

Phase I research is expected to develop the technology and demonstrate it on relatively simpler configurations, while Phase II will increase the technology readiness level and include demonstration forÂ more complex flow configurations.