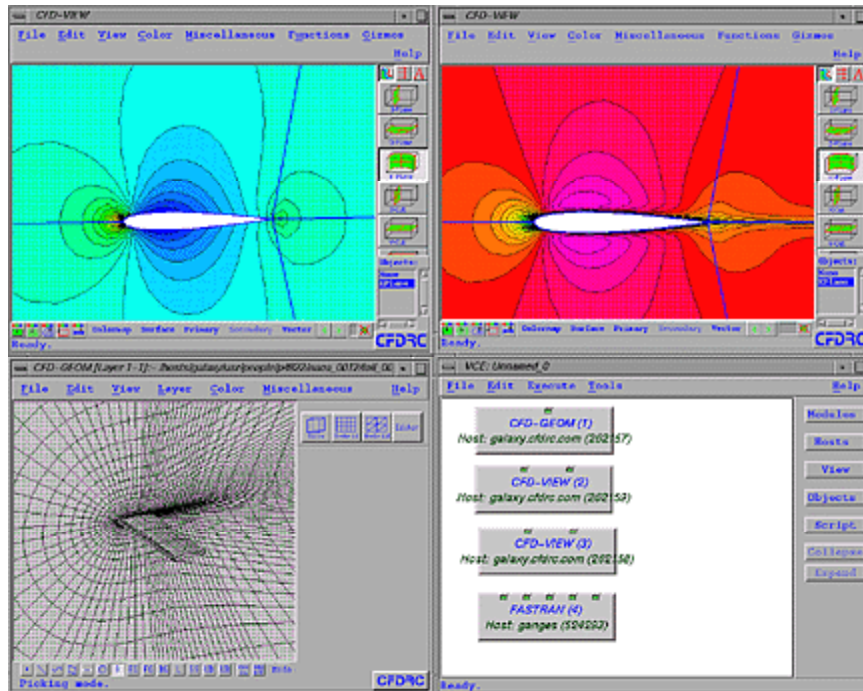# Visual Computing Environment

The Visual Computing Environment (VCE) is a NASA Lewis Research Center project to develop a framework for intercomponent and multidisciplinary computational simulations. Many current engineering analysis codes simulate various aspects of aircraft engine operation. For example, existing computational fluid dynamics (CFD) codes can model the airflow through individual engine components such as the inlet, compressor, combustor, turbine, or nozzle. Currently, these codes are run in isolation, making intercomponent and complete system simulations very difficult to perform. In addition, management and utilization of these engineering codes for coupled component simulations is a complex, laborious task, requiring substantial experience and effort. To facilitate multicomponent aircraft engine analysis, the CFD Research Corporation (CFDRC) is developing the VCE system. This system, which is part of NASA's Numerical Propulsion Simulation System (NPSS) program, can couple various engineering disciplines, such as CFD, structural analysis, and thermal analysis.

The objectives of VCE are to (1) develop a visual computing environment for controlling the execution of individual simulation codes that are running in parallel and are distributed on heterogeneous host machines in a networked environment, (2) develop numerical coupling algorithms for interchanging boundary conditions between codes with arbitrary grid matching and different levels of dimensionality, (3) provide a graphical interface for simulation setup and control, and (4) provide tools for online visualization and plotting.

VCE was designed to provide a distributed, object-oriented environment. Mechanisms are provided for creating and manipulating objects, such as grids, boundary conditions, and solution data. This environment includes parallel virtual machine (PVM) for distributed processing. Users can interactively select and couple any set of codes that have been modified to run in a parallel distributed fashion on a cluster of heterogeneous workstations. A scripting facility allows users to dictate the sequence of events that make up the particular simulation.

*Typical Visual Computing Environment (VCE) screen.*

Several test simulations of differing complexity have been completed, validating the basic design and pointing out areas that need further improvements. NASA Lewis, Pratt & Whitney, and CFDRC are using VCE as part of the National Combustor Code for combining grid generator, flow solver, and visualization capabilities in one integrated environment. The NASA Ames Research Center is using VCE as an interface protocol and generic remeshing environment for deformable and moving-body simulations. NASA Lewis plans to continue to develop VCE for multidisciplinary and intercomponent simulations.

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