The National Combustion Code was developed under a NASA/Department of Defense/Department of Energy/U.S. industry partnership. Recent efforts have been focused on developing a computational combustion dynamics capability that will meet combustor designer requirements for model accuracy and analysis turnaround time, incorporating both short and long-term technology goals. As a first step, a baseline solver for turbulent combustion flows, CORSAIR-CCD, was developed under a joint modeling and code development effort between the aeronautics industry and NASA Lewis. CORSAIR-CCD is a Navier-Stokes flow solver based on an explicit four-stage Runge-Kutta scheme that uses unstructured meshes and runs on networked workstations. The solver can be linked to any computer-aided design system via the Patran file system. Turbulence closure is obtained via the standard k-ε model with a high Reynolds number wall function. The following combustion models have been implemented into the code: finite-rate chemical kinetics emulations for Jet-A and methane fuels, turbulence-chemistry interactions via an assumed probability density function for temperature fluctuations, and thermal emissions of nitrogen oxides. CORSAIR-CCD can switch between a parallel virtual machine (PVM) interface and a message-passing interface (MPI) by using compiler flags. Its parallel performance on several platforms has been analyzed; and on the basis of the results, several improvements have been made. Applications of the CORSAIR-CCD code to date include simulating swirling flow and simulating ignition-delay experiments; computing a generic swirling flow for a can-combustor and a multishear flow for a low-NOx fuel nozzle; calculating a multiwalled production fuel nozzle and an IMFH/Cyclone "1-cup sector"; (which contains one cyclone and an integrated set of mixing and flame holder tubes); and providing computational support for tests of the NASA LDI-MVS sector rig combustor (which uses lean direct injection and a multiple venture swirler).
Typical results for the National Combustion Code (NCC), a combustor design and analysis system.

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