Books & Reports

Part 1 of a Computational Study of a Drop-Laden Mixing Layer

This first of three reports on a computational study of a drop-laden temporal mixing layer presents the results of direct numerical simulations (DNS) of well-resolved flow fields and the derivation of the large-eddy simulation (LES) equations that would govern the larger scales of a turbulent flow field. The mixing layer consisted of two counterflowing gas streams, one of which was initially laden with evaporating liquid drops. The gas phase was composed of two perfect gas species, the carrier gas and the vapor emanating from the drops, and was computed in an Eulerian reference frame, whereas each drop was tracked individually in a Lagrangian manner. The flow perturbations that were initially imposed on the layer caused mixing and eventual transition to turbulence. The DNS database obtained included transitional states for layers with various liquid mass loadings. For the DNS, the gas-phase equations were the compressible Navier-Stokes equations for conservation of momentum and additional conservation equations for total energy and species mass. These equations included source terms representing the effect of the drops on the mass, momentum, and energy of the gas phase. From the DNS equations, the expression for the irreversible entropy production (dissipation) was derived and used to determine the dissipation due to the source terms. The LES equations were derived by spatially filtering the DNS set and the magnitudes of the terms were computed at transitional states, leading to a hierarchy of terms to guide simplification of the LES equations. It was concluded that effort should be devoted to the accurate modeling of both the subgrid-scale fluxes and the filtered source terms, which were the dominant unclosed terms appearing in the LES equations.

This work was done by Nora A. Okong'o and Josette Bellan of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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Some Improvements in Signal-Conditioning Circuits

Two documents present wide-ranging discussions of some issues in the design and operation of signal-conditioning circuits. The first document focuses on active low-pass filter circuits that contain resistors, capacitors, and operational amplifiers. It describes design and operational problems encountered previously, deficiencies of prior designs, and four design improvements to overcome the deficiencies. These improvements are as follows:

1. An offset-calibration feature in which an electronic switch isolates a filter capacitor in order to preserve its voltage during a calibration performed to measure the offset voltage of the operational amplifier;
2. Configuring a pair of complementary operational amplifiers to prevent latchup and decrease the degree of nonlinearity in overall response;
3. Minimizing distortion by taking the filter output from the operational-amplifier output nodes instead of from one of the other nodes as in prior designs; and
4. Providing for switching different feedback resistors to change filter break frequencies.

The second document addresses topics in the architecture of signal-conditioning and multiplexing circuitry. Improvements are described as being made with respect to greater compactness, increased flexibility in accommodating a variety of inputs, improvements in filter performance, simplification of wiring, and reconfigurability of designs.

This work was done by Robert L. Shuler of **Johnson Space Center**. *For further information, contact the Johnson Commercial Technology Office at (281) 483-3809.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-23538/9.