

proof that the algorithm is guaranteed to initialize the formation as required.

This work was done by Scott Ploen, Daniel Scharf, and Fred Hadaegh of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-43040.



DNSs of Multicomponent Gaseous and Drop-Laden Mixing Layers Achieving Transition to Turbulence

A paper describes direct numerical simulations (DNSs) of three-dimensional mixing-layer flows undergoing transition to turbulence; the mixing layers may or may not be laden with evaporating liquid drops. In contrast to most studies in this field, the general case is

investigated here where both the gas and the liquid drops' composition encompasses a very large number of species. The simulations were performed using a mathematical model discussed in several prior NASA Tech Briefs articles; the prior studies described a laminar mixing layer, whereas the present study describes a mixing layer that has all attributes of turbulence. The model includes governing equations in an Eulerian and a Lagrangian reference frame for the gas and drops, respectively. To mathematically describe the myriad of species, the model relies on continuous thermodynamics concepts. The paper succinctly reiterates the model and discusses results of the new numerical simulations. Comparisons are performed with previous single-species similar simulations and with the laminar simulations using the same model. The paper presents several conclusions, the main one being that differences be-

tween single- and multi-species turbulent flows having the same initial conditions are so significant that neither experiments on, nor theoretical studies of, single-species flows are adequate as surrogates for studies of multi-species flows.

This work was done by Josette Bellan and Laurent Selle of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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