

CONSULTANTS IN ENGINEERING  
AND ENVIRONMENTAL SCIENCES

**Dr. Madhukar M. Rao**

Curriculum Vitae

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**TITLE**            **Project Engineer**

**EXPERTISE**    Computational Fluid Dynamics and Heat Transfer  
Fluid Dynamics, Turbulence, Two-Phase and Free Surface flows, and  
Solidification and Moving Boundary Problems.

### **EXPERIENCE**

Development and application of CFD models for problems in **gas turbine engine performance analysis, heat transfer and turbulence.**

Developed and implemented unstructured mesh algorithms into a commercial finite volume CFD code, ANSWER™. Implemented Reynolds Stress Turbulence model and other advanced turbulence models into ANSWER which is used as the CFD engine for the Advanced Combustor Code of GE Aircraft Engines.

Computed and analyzed reacting flow fields in the General Electric LM 6000 and other combustors. Principal Investigator on over 10 projects covering CFD, Heat Transfer, Gas Turbine Analysis and Turbulence.

### **EMPLOYMENT HISTORY**

Project Engineer, ACR, Inc. (1996-present).

Graduate Research Assistant, University of Florida, Gainesville (1991-1996)

Graduate Teaching Assistant, University of Florida, Gainesville (1988-1990)

### **ACADEMIC BACKGROUND**

Ph.D., in Aerospace Eng., Univ. of Florida, Gainesville, 1996

M.S., in Aerospace Eng., Univ. of Florida, Gainesville, 1990

B.S. in Aerospace Eng., Indian Institute of Technology, Madras, India, 1988

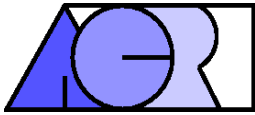
### **PUBLICATIONS**

*Computational Fluid Dynamics with Moving Boundaries*, Taylor and Francis, Washington, D.C., 1996. Co-authors: W. Shyy, H.S. Udaykumar, and R.W. Smith, ISBN: 1-56032-458-9.

Rao, M. M. and Shyy, W. 1997 "Moving Boundary Computation of the Float-Zone Process," *International Journal for Numerical Methods in Engineering*, vol. 40, p. 1231 – 1261.

Udaykumar, H. S., Shyy W. and Rao, M. M., 1996 "ELAFINT -- A mixed Eulerian-Lagrangian method for fluid flows with complex and moving boundaries," *International Journal for Numerical Methods in Fluids*, vol. 22, p. 691 - 712.

Madhukar M. Rao and Wei Shyy, 1996 "Simulation of Phase Change and Convective Heat Transfer during Float Zone Processing," presented at the 1996 International



Congress & Exposition, Heat Transfer Division of the ASME, Atlanta, GA, November 17 - 22, 1996.

Shyy, W. and Rao, M. M., 1995 "Calculation of meniscus shapes and transport processes in float zone," *International Journal of Heat and Mass Transfer*, vol. 38, No. 12, pages 2281 - 2295.

Shyy, W., Rao, M. M. and Udaykumar, H. S. 1995 "Scaling procedure and finite volume computation of phase-change problems," *Engineering Analysis with Boundary Elements*, vol. 16, No. 2, p. 123 - 147.

Shyy, W., Ouyang, H., Hung, C.-I. and Rao, M. M. 1994 "Modeling of transport processes and interfacial dynamics during vertical Bridgman crystal growth," in Challenges of High Temperature Heat Transfer Equipment, T. H. Hwang and R. N. Smith (editors), HTD-Vol. 282, ASME 1994, pages 1 - 13.

Shyy, W. and Rao, M. M., 1994 "Enthalpy based formulations for phase-change problems with application to g-jitter," *Microgravity Science and Technology*, vol. 7, pages 41 - 49.

Madhukar M. Rao and Wei Shyy, 1994 "Calculation of meniscus shapes and transport processes in float zone," presented at the 47th meeting of the Division of Fluid Dynamics of the American Physical Society, Atlanta, GA, November 1994.

Wei Shyy and Madhukar M. Rao, 1993 "Enthalpy based formulations for phase-change problems with application to g-jitter," presented at the 24th AIAA Fluid Dynamics Conference, Orlando, FL, July 1993.

Shyy, W. and Rao, M. M., 1993 "Simulation of transient natural convection around an enclosed vertical channel," *Journal of Heat Transfer*, vol. 115, pages 946 - 954.

Shyy, W. and Rao, M. M., 1992 "Convection treatment for high Rayleigh number laminar natural convection calculation," *Numerical Heat Transfer*, part B, vol. 22, pages 367 - 374.