SUMAN MUPPIDI

Email: suman.muppidi@gmail.com Minneapolis, MN

PROFILE

- Over ten years of Computational Fluid Mechanics experience including five years post-PhD, using commercial CFD applications as well as in-house solvers.
- Proven experience in both low speed (incompressible) and high speed (compressible) regimes, high-fidelity numerical schemes, grid generation, and large-scale simulations and analysis of turbulent flows.
- Demonstrated excellent oral and written communication skills by means of conference lectures, technical reports, journal articles and grant proposals
- Experience with leading individual and collaborative projects, mentoring and supervision.
- Real-world consulting experience in using CFD as a design tool.
- Employment status: Permanent resident of the U.S. (Green card holder).

EXPERTISE AND SKILLS

Research-related	Numerical methods for fluid mechanics, Algorithm and code development for unstructured solvers, Validation and optimization, Generation of unstructured grids for engineering geometries, Large-scale simulations using RANS, LES and DNS.
Research Areas	Turbulent Mixing, Jets in Crossflow, Scalar transport in incompressible and high speed flows, Transition to turbulence, Shock-boundary layer interaction, Chemically reacting flows.
Software Packages	ANSYS, Fluent, TGrid, GAMBIT, Tecplot, Mathematica, Matlab.
Programming	Scientific programming using Fortran 90, C++ and MPI.

CONSULTING EXPERIENCE

CFD Modeling of a Wind Tunnel and Testing Facility

- Utilized commercial CFD tools to study the flow uniformity in a proposed wind tunnel & testing facility in Asia. CFD results were instrumental in finalizing the wind tunnel geometry/design.
- Generated the computational mesh for the detailed tunnel geometry, including the surroundings, stairs and catwalk, engine support etc. Performed multiple simulations at different crosswind conditions for two different engines in the test section.
- Interacted regularly with the client and provided periodic reports. Evaluated and presented parameters of interest to the client (such as mass flow rate, bypass ratio, flow distortion), along with pertinent flow visualization and best simulation approaches.
- Completed project within schedule and met all client requirements.

RESEARCH EXPERIENCE

University of Minnesota Minneapolis, MN

Research Associate 2009 - present

Transition to Turbulence in High Speed Flows

- Performed DNS of supersonic transition induced by distributed surface roughness. Explained transition mechanism as a consequence of the near wall deceleration and formation of a shear layer, and its perturbation due to the unsteady vortices shed by the roughness. Detailed data from the simulation can be used toward prediction of the onset of transition for given flow and roughness distribution.
- Simulated the effect of blowing and suction on a laminar supersonic boundary layer. Validated the turbulent flow region, examined the transition mechanism, and isolated the unsteady events that result in transition.
- Co-authored the study of supersonic transition achieved in the presence of discrete roughness elements. These simulations are being performed at conditions of experiments at NASA. This work also examines the role of hairpin vortices in flow transition.

Direct Numerical Simulations of Shock-Boundary Layer Interaction

- Performed highly resolved DNS of a turbulent supersonic flow past a compression corner, aimed at understanding the low frequency unsteadiness caused by shock-turbulent boundary layer interactions. Simulations show excellent agreement with experimental results, and provide extensive temporal data to pursue the origin of the low frequency unsteadiness.
- The novel feature of the above simulations is the use of a physically developing boundary layer, avoiding a rescaling-type turbulent inflow and the related assumptions and simplifications.
- Demonstrated the inherent unsteadiness of compression corner and incident shock flows at suitable Reynolds numbers, even when the incoming flow is steady and laminar.

University of Minnesota Minneapolis, MN

Post-doctoral Research Associate 2006 - 2009

Development of an Unstructured Compressible Flow Solver

- Developed an algorithm to solve the compressible Navier-Stokes equations on unstructured grids. The algorithm employs an all-Mach number formulation, is non-dissipative yet robust, and discretely conserves energy.
- The algorithm also uses a shock-capturing scheme based on characteristic filtering, applied in a predictor-corrector approach to ensure that regions away from discontinuities experience no numerical dissipation.
- Extensively validated the algorithm on various flow configurations to understand and showcase the algorithm's characteristics and capabilities.

University of Minnesota Minneapolis, MN

Graduate Research Assistant 2001 - 2006

Direct Numerical Simulations and Modeling of Jets in Crossflow

- Evaluated the effects of jet and crossflow velocity profiles on jet trajectory using controlled simulations. Existing trajectory scaling did not account for these parameters, and did not collapse experimental trajectories. Proposed a new scaling that considerably reduces the scatter.
- Performed a first-time direct numerical simulation of a fully turbulent transverse jet. Validated the simulation using detailed comparisons. Computed the turbulent kinetic energy budget and employed the results to discuss reasons for poor prediction of this flow by existing engineering models.
- Designed and implemented a second-order spatial discretization for unstructured grids, and a predictor-corrector algorithm for passive scalar computation. Enabled accurate simulations of scalar transport even on very bad meshes, using these improvements.
- Analyzed the scalar and velocity fields to study mixing characteristics of transverse jets. Proposed a pressure-based explanation for the observed entrainment features.
- Simulated a two-dimensional model problem whose solution explains the evolution of jet cross-section and the counter-rotating vortex pair in jets in crossflow. Explained experimentally observed dependence of jet's evolution on the velocity ratio.

Indian Institute of Technology Madras Chennai, India

Research Assistant 1999 - 2000

Experimental Investigation of Confined Supersonic Flow Past Rectangular Cavities

- Fabricated a transparent wind tunnel for flow visualization purposes, and a nozzle to achieve a Mach 2 airflow.
- Studied the effect of cavity size on the resulting acoustic oscillations using pressure probes.
- Designed the optical setup and conducted flow visualization experiments.

MENTORING AND COLLABORATION

- Currently mentor four graduate students and work with two post-doctoral research associates.
- Supervised an undergraduate project on superhydrophobic surfaces.
- Collaborated with a post-doctoral research associate and a graduate student during the last two years of PhD.

EDUCATION

Doctor of Philosophy, Aerospace Engineering and Mechanics — Minneapolis, MN
University of Minnesota — Nov 2006
2005 Doctoral Dissertation Fellowship Recipient

Master of Science, Aerospace Engineering and Mechanics — Minneapolis, MN
University of Minnesota — July 2004

Bachelor of Technology, Aerospace Engineering — Chennai, India
Indian Institute of Technology Madras — June 2000

PUBLICATIONS

1. S Muppidi & K Mahesh, DNS of roughness-induced transition in supersonic boundary layers, *Journal of Fluid Mechanics*, accepted for publication.
2. S Muppidi & K Mahesh, 2008, Passive scalar transport and mixing in turbulent jets in crossflow, *Journal of Fluid Mechanics*, vol. 598.
3. S Muppidi & K Mahesh, 2007, Direct numerical simulation of round turbulent jets in crossflow, *Journal of Fluid Mechanics*, vol. 574.
4. S Muppidi & K Mahesh, 2006, A two-dimensional model problem to explain CVP formation in a transverse jet, *Physics of Fluids*, vol. 18 (085103).
5. S Muppidi & K Mahesh, 2005, Study of trajectories of jets in crossflow using direct numerical simulations, *Journal of Fluid Mechanics*, vol. 530.
6. P Iyer, S Muppidi & K Mahesh, Boundary layer transition in high-speed flows due to roughness, AIAA Paper 2012-1106.
7. S Muppidi & K Mahesh, DNS of unsteady shock boundary layer interaction, AIAA Paper 2011 – 724.
8. P Iyer, S Muppidi & K Mahesh, Roughness-induced transition in high speed flows, AIAA Paper 2011-566.
9. S Muppidi & K Mahesh, DNS of transition in supersonic boundary layers, AIAA Paper 2010–4440.
10. P Iyer, S Muppidi & K Mahesh, Transition of hypersonic flow past flat plate with isolated and distributed roughness, AIAA Paper 2010–5015.
11. S Muppidi & K Mahesh, Simulating turbulent viscous high-speed flows on unstructured grids, AIAA paper 2009–1509.
12. S Muppidi & K Mahesh, Passive scalar mixing in jets in crossflow, AIAA paper 2006–1098.
13. S Muppidi & K Mahesh, 2005, Velocity field of a round turbulent transverse jet, TSFP4-197.
14. S Muppidi & K Mahesh, Direct numerical simulation of turbulent jets in crossflow, AIAA paper 2005–1115.

AFFILIATIONS AND RELATED ACTIVITIES

- Session Chair, 50th Aerospace Sciences Meeting, American Institute of Aeronautics and Astronautics, 2012
- Session Chair, 62nd Annual meeting of Division of Fluid Mechanics, American Physical Society, 2009.
- Judge, Minnesota State Science Fair Paper competition 2010, Minnesota Academy of Sciences.
- Invited reviewer:
  - Journal of Fluid Mechanics
  - Experiments in Fluids
  - American Society of Mechanical Engineering Journal
  - American Institute of Chemical Engineering Journal
  - European Journal of Fluids
  - Journal of Visualization
  - ETH Zurich Research commission (research proposal for ETH's individual investigator's research award)
  - 62nd Annual meeting of the Division of Fluid Mechanics, American Physical Society
- Member: American Physical Society, American Institute of Aeronautics and Astronautics.

CONFERENCE LECTURES

AIAA Aerospace Sciences Meeting and Exhibit, Nashville, TN	Jan 2012
American Physical Society, Division of Fluid Mechanics, Baltimore, MD	Nov 2011
AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL	Jan 2011
American Physical Society, Division of Fluid Mechanics, Long Beach, CA	Nov 2010
AIAA Fluid Dynamics Conference, Chicago, IL	Jun 2010
American Physical Society, Division of Fluid Mechanics, Minneapolis, MN	Nov 2009
AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL	Jan 2009
American Physical Society, Division of Fluid Mechanics, San Antonio, TX	Nov 2008
American Physical Society, Division of Fluid Mechanics, Salt Lake City, UT	Nov 2007
American Physical Society, Division of Fluid Mechanics, Tampa, FL.	Nov 2006
AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV.	Jan 2006
American Physical Society, Division of Fluid Mechanics, Chicago, IL.	Nov 2005
AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV.	Jan 2005
American Physical Society, Division of Fluid Mechanics, Seattle, WA.	Nov 2004
American Physical Society, Division of Fluid Mechanics, Dallas, TX.	Nov 2002

TEACHING EXPERIENCE

University of Minnesota Minneapolis, MN

Teaching Assistant 2000 - 2001

Courses: Deformable Body Mechanics, Aerospace Propulsion

- Conducted a weekly hour-long seminar, aimed at solving exercise problems, to a class of 45 students.
- Evaluated and graded the students' performance based on their examinations and homework assignments.
- Provided assistance and feedback to the students via regular office hours.