

Arathi(Arti) Gopinath

Goal

To obtain a full position in the area of Computational Fluid Dynamics(CFD), Aerodynamics, Numerical methods or related fields beginning early-mid 2007.

Education

Stanford University, Stanford, CA, Summer 2002 – present

M.S., PhD, Aeronautics and Astronautics, GPA: 3.935/4.0

Dissertation Title: *Time Spectral Method for Unsteady Time Periodic Flows.*

Indian Institute of Technology(IIT), Madras, India, Fall 1997 – Summer 2001

Bachelor of Technology, Naval Architecture, GPA: 3.47/4.0

Experience

Research Assistant, Summer 2002 – present

Department of Aeronautics and Astronautics, Stanford University, Stanford, CA

Supervisor: Prof. Antony Jameson and Prof. Juan Alonso

Pursuing research in areas of numerical methods for fluid dynamics applications. Development of the Time Spectral method, an algorithm for the fast computation of unsteady time periodic flows. Showed a factor of 5-10 savings in CPU requirements for turbomachinery applications compared to Dual Time Stepping Backward Difference Formula(BDF). Development of the nonlinear Harmonic Balance method(time-domain), a reduced-order pseudo-spectral method for URANS calculations on turbomachinery problems. This method promises dramatic savings compared to the BDF scheme by resolving only the dominant frequencies in each blade row(namely, the blade passing of its neighbors) and using phase-lagged boundary conditions on a computational grid consisting of a single blade passage per blade row. Supported by the *Advanced Simulation and Computing(ASC)* program, a Department of Energy(DoE) project.

Potential Applications: Turbomachinery, Helicopter Rotors, Wind Turbines, Flapping Wing Vehicles, Synthetic Jets.

Summer Internship, Summer 2005

Air Force Research Lab, Wright-Patterson Air Force Base, Dayton, OH

Supervisor: Dr. Phil Beran

Application of the Time Spectral Method for the *Prediction of Limit-Cycle Oscillations*, a periodic aero-structural phenomena. Performance and cost comparison with Finite Difference and Spectral Element methods(*h, p and h/p* refinement).

Student Exchange Program, Spring 2001

Hochschule Bremen, Germany

Supervisor: Prof. Kraus

Bachelor Dissertation on *Resistance and Flow Prediction in Ship Design*. After preliminary design and calculations, a model of a ship is obtained using the software NAPA. This geometry and panelization is imported into SHALLO and SHIPFLOW software that predict the flow around the ship hull under various depth and lateral boundary conditions. Resistance can be computed and the best hull design chosen for given water conditions.

Summer Student Fellow - Indian Academy of Sciences, Summer 2000

Indian Institute of Science(IISc), Bangalore, India

Supervisor: Prof. H. S. Mukunda

Fluid Flows in Reciprocating IC Engines - Study on the characteristics of the in-cylinder air motion in an IC engine during the induction and compression strokes. CFX-Solver was used to solve the laminar flow equations together with heat and mass transfer. Transient grids used for the changing geometry. The vortex structures and turbulence quantities studied for various crank angles.

Experience (continued)

Teaching Assistant, Fall 2001 – Spring 2002

Department of Aerospace Engineering, University of Minnesota, Twin Cities, MN

Supervisor: Daniel D. Joseph

One of two TA's for undergraduate course on Statics and Dynamics for a class of 60 students. Responsibilities included grading homeworks and exams and holding office hours twice a week for an hour each.

Skills

Computer Programming: Fortran 90/95, Visual Fortran, C++, Parallel Programming with MPI and OpenMP.

Computer Applications: Matlab, Gridgen, Tecplot, Ensignt, AutoCAD, CFX4, CFX-TascFlow, L^AT_EX, Microsoft Office.

CFD Codes:

Prof. Jameson's legacy of **FLO codes**, 2D and 3D, Euler and RANS, steady and unsteady (Time Spectral and Dual Time Stepping BDF), serial and parallel, together with Multigrid, RK local time stepping, residual smoothing etc.

SUMB (formerly TFLO) with similar capability in addition to use of data structures and multi-block capability on complex geometry for turbomachinery calculations. Experience using large-scale CFD software, making changes, setting up, running and post-processing solutions run on high performance computers.

Relevant Coursework: Linear Algebra, PDE's, Numerical methods, Parallel methods, C++ programming, Spectral methods, Optimization, CFD, Aerodynamics, Propulsion, Structures, Controls.

Selected Publications

Three-Dimensional Unsteady Multi-stage Turbomachinery Simulations using the Harmonic Balance Technique. A. Gopinath, E. van der Weide, J.J. Alonso, A. Jameson, K. Ekici, and K.C. Hall. AIAA paper 2007-0892, 45th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 8-11 2007.

Comparative Analysis of Computational Methods for Limit-Cycle Oscillations. A. Gopinath, P.S. Beran, and A. Jameson. AIAA paper 2006-2076, 47th AIAA Structures, Structural Dynamics and Materials Conference, Newport, RI, May 1-4 2006.

Application of the Time Spectral Method to Periodic Unsteady Vortex Shedding. A. Gopinath and A. Jameson. AIAA paper 2006-0449, 44th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 9-12 2006.

Turbomachinery Applications with the Time Spectral Method. E. van der Weide, A. Gopinath, and A. Jameson. AIAA paper 2005-4905, 17th AIAA Computational Fluid Dynamics Conference, Toronto, Ontario, June 6-9 2005.

Revisiting the Vertical-Axis Wind-Turbine Design using Advanced Computational Fluid Dynamics. J. Vassberg, A. Gopinath, and A. Jameson. AIAA paper 2005-0047, 43rd AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13 2005.

Time Spectral Method for Periodic Unsteady Computations over Two- and Three- Dimensional Bodies. A. Gopinath and A. Jameson. AIAA paper 2005-1220, 43rd AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13 2005.

Awards

One among top three students out of 20 from the Dept. of Naval Architecture, IIT Madras, chosen for the Student Exchange Program with Hochschule Bremen, Germany. Awarded best Bachelor's dissertation in the area of Shipping and Ship Building for the Class of 2001, Class NK-100 award (Nippon Kaiji Kyokai).

References

Available on request.