Gaurav Kumar

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ACADEMIC DETAILS

Degree	Department	Institute	Year	CPI
Doctor of Philosophy	Aerospace Engineering	IIT Kanpur	2016 - Present	9.0/10.0
Master of Technology	Aerospace Engineering	IIT Kanpur	2011 - 2016	10.0/10.0
Bachelor of Technology	Aerospace Engineering	IIT Kanpur	2011 - 2016	7.7/10.0

FIELDS OF INTEREST

- Computational Fluid Dynamics, Turbulence modeling, Reduced order modeling, High speed flows

JOURNAL PUBLICATIONS

- **Gaurav Kumar** and Ashoke De. "Numerical study of viscous interaction between shock waves and separation region over a double wedge", submitted to Journal of Fluid Mechanics (March 10, 2020).
- Mitesh Thakor, **Gaurav Kumar**, Debopam Das, and Ashoke De. "Numerical investigation of low Reynolds number airfoil undergoing asymmetric sinusoidal pitching motion at a high reduced frequency", submitted to Physics of Fluids (March 5, 2020).
- **Gaurav Kumar** and Ashoke De. "An improved density based compressible flow solver in OpenFOAM for unsteady flow calculations", submitted to Computers and Mathematics with Applications (Dec. 29, 2019).
- Alok Mishra, **Gaurav Kumar**, and Ashoke De. "Prediction of separation induced transition on thick airfoil using non-linear URANS based turbulence model." Journal of Mechanical Science and Technology 33.5 (2019): 2169-2180.
- **Gaurav Kumar**, Ashoke De, and Harish Gopalan. "Investigation of flow structures in a turbulent separating flow using hybrid RANS-LES model." International Journal of Numerical Methods for Heat & Fluid Flow 27.7 (2017): 1430-1450.
- **Kumar, G.**, Lakshmanan, S. K., Gopalan, H., & De, A. "Investigation of the sensitivity of turbulent closures and coupling of hybrid RANS-LES models for predicting flow fields with separation and reattachment." International Journal for Numerical Methods in Fluids 83.12 (2017): 917-939.

CONFERENCE PROCEEDINGS

- **Gaurav Kumar** and Ashoke De. "Self-induced oscillations of the shock structures in a hypersonic flow over double wedge", to be presented at 25th International Congress of Theoretical and Applied Mechanics (25th ICTAM), August 23 - 28, 2020.
- **Gaurav Kumar**, Ashoke De "Effect of turbulence in unsteady shock interaction and heat transfer mechanism in a hypersonic flow over double wedge", "32nd International Symposium on Shock Waves", Conference proceedings ISSW32. 2019.
- **Gaurav Kumar**, Ashoke De "A density based compressible flow solver in OpenFOAM with Mach number preconditioning and Low-diffusive Flux Splitting Scheme" 7th International and 45th National Conference on Fluid Mechanics and Fluid Power (FMFP2018), Mumbai, India. 2018.
- **Gaurav Kumar**, Harish Gopalan, Dominic Chandar, Vinh-Tan Nguyen, and Ashoke De. "Verification of length scale effects on solution accuracy of hybrid RANS-LES methods." ASME 2016, 35th International Conference on Ocean, Offshore and Arctic Engineering. American Society of Mechanical Engineers, 2016.
- **Kumar, G.**, Lakshmanan, S. K., Gopalan, H., & De, A. "Comparative study of hybrid RANS-LES models for separated flows." AIP Conference Proceedings. Vol. 1738. No. 1. AIP Publishing, 2016.

WORKSHOP ATTENDED

- "Immersed Boundary Methods for Turbulent Incompressible Flows" organised under "Global Initiative for Academic Networks" by IIT Kharagpur, December 18 - 22, 2017

PH.D THESIS

- **Numerical Study of Viscous Interaction between Shock Waves and Separation Region over a Double Wedge** *(Supervisor: Prof. Ashoke De)*
    - Designed and implemented a new density based compressible flow solver in an open-source CFD platform called OpenFOAM.
    - Demonstrated the improved stability and accuracy of the new solver through various test cases involving shock waves, boundary layer and separated flows.
    - Studied the hypersonic flow over double wedge configuration in detail to understand unsteady interaction between shock-waves and boundary layer/separation region.
    - Identified a window of geometric parameter which is crucial in avoiding design conditions which could result in catastrophic failures of hypersonic flights.

M.TECH THESIS

- **Investigation of Turbulent Separated Flow using Hybrid RANS-LES Models**
  (Supervisors: Prof. Ashoke De, Dr. Harish Gopalan)
    - Introduced a non-linear blended turbulence modeling framework for computational fluid Dynamics.
    - Performed a comparative study to investigate the sensitivity of hybrid RANS-LES models to the choice of RANS, LES and interface switching criteria.
    - Investigated unsteady flow structures in the tubulent separated flows to examine the effectiveness of hybrid RANS-LES models in the prediction of an accurate instantaneous flow fields.
    - Demonstrated that the newly developed hybrid RANS-LES model can produce improved results at a very economical cost as compared to the previous turbulence models.

INTERNSHIPS AND MAJOR PROJECTS

- **Hindustan Aeronautical Limited, India** (Research Assistant, Oct - Dec, 2016)
  (Supervisor: Prof. Bishakh Bhattacharya, Professor, IIT Kanpur)
    - **Project Goal:** Simulation of Cabin Pressure Control System.
    - **Goal achieved:** Developed a computer program to simulate the on and off-design performance of a cabin pressure control system. Identified optimal design parameters for constraining the off-design performance of the cabin pressurization system within the regulations of FAA.

- **Institute of High Performance Computing, Singapore** (Research Assistant, Jan - May, 2016)
  (Supervisors: Dr. Harish Gopalan, Dr. Vinh-Tan Nguyen, Scientist)
    - **Project Goal:** Numerical simulation of flow past tandem square columns at high Reynolds number using hybrid RANS-LES models.
    - **Goal achieved:** Carried out the numerical simulations for flow past tandem square columns at high Reynolds number using hybrid RANS-LES models. Applied the reduced order modeling techniques to find out a simple force prediction method on such tandem column configurations.

- **National Aerospace Laboratories, Bangalore, India** (Research Assistant, May - July, 2014)
  (Supervisor: Dr. S. Venkat Iyengar, Senior Scientist, Propulsion Division)
    - **Project Goal:** Development of endothermic fuel platform for scramjet engines and to probe Technology Readiness Levels (TRL) achieved by different countries.
    - **Goal achieved:** Proposed a detailed roadmap to the development endothermic fuel technology and to incorporate it in hypersonic scramjet air vehicle. Recommended a set of experiments required to be conducted and facilities required to be established in order to realize a TRL of 4.

TEACHING EXPERIENCE

- **Teaching assistant:** Introduction to Finite Volume Method II (*under NPTEL initiative*), Thermodynamics, Engineering Drawing, Fluid Mechanics and Rate Processes, Technical Communication.

SKILLS

- **Languages:** English (Professional working proficiency), Hindi (Native mother tongue), German (Elementary proficiency), Chinese (Elementary proficiency)

- **Programming & Scripting**: C/C++, R, MATLAB, gnuplot, HTML/HTML5, CSS/CSS3

- **Softwares & Tools**: Ansys CFD Tools, OpenFOAM CFD toolbox, Tecplot, Paraview, AutoCAD, MS office

EXTRA-CURRICULAR

- Playing Tennis, running, swimming, reading and traveling.