

Narendra Laxman Gajbhiye, Ph.D.

Assistant Professor
Department of Mechanical Engineering
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EDUCATIONAL BACKGROUND

Doctor of Philosophy	April 2016 Department of Mechanical Engineering Indian Institute of Technology Kanpur, Uttar Pradesh
Master of Technology	July 2006 - September 2008 Department Mechanical Engineering National Institute of Technology Hamirpur, Himachal Pradesh
Bachelor of Engineering	September 2002 - July 2006 Department Mechanical Engineering Bapurao Deshmukh College of Engineering, Sewagram RTM Nagpur University, Nagpur, Maharashtra

TEACHING & RESEARCH EXPERIENCE

Assistant Professor:
Department Mechanical Engineering
Maulana Azad National Institute of Technology Bhopal
Feb 2019 - continuing

Assistant Professor:
Department Mechanical Engineering
National Institute of Technology Puducherry
June 2018 - Feb 2019

Post-Doctoral Fellow:
Department Mechanical and Aerospace Engineering
Indian Institute of Technology Hyderabad
April 2016 - June 2018

Senior Research Fellow:
Department Mechanical and Aerospace Engineering
Indian Institute of Technology Hyderabad
July 2015 - April 2016

RESEARCH INTEREST

Computational Fluid Dynamics (CFD) and Heat Transfer

Magnetohydrodynamics

CFD Solver Development

Electrostatic Precipitator

CFD with OpenFOAM

TEACHING INTEREST

Fluid Mechanics

Heat and Mass Transfer

Basic and Advance Computational Fluid Dynamics

Engineering Thermodynamics

Viscous Flow Theory

Sponsored Projects Undertaken

Title of project: Development of electrohydrodynamic pump for thermal management of electronics devices

Sponsoring Agency: Science and Engineering Research Board (SERB)

Grant Amount: Rs. 40.65 Lakh **Period:** May 20223 - May 2026

Role: Co-Principal Investigator

Title of project: Numerical investigation of MHD flow and pressure drop in 3-D sudden expansion with partitioned channels using wall-function treatment

Sponsoring Agency: Science and Engineering Research Board (SERB)

Grant Amount: Rs. 26.89 Lakh **Period:** March 2022 - March 2025

Role: Principal Investigator

Title of project: Development of miniaturized pressure regulator (non-moving type) for low flow rate applications

Sponsoring Agency: Indian Space Research Organization (ISRO)

Grant Amount: Rs. 12.27 Lakhs **Period:** Feb 2022 - Feb 2024

Role: Co-Principal Investigator

Title of project: Experimental and Numerical Investigation of Earth-Air Heat Exchangers

Sponsoring Agency: MANIT Bhopal

Grant Amount: Rs. 3.9 Lakh **Period:** November 2020 -November 2022

Role: Principal Investigator

Title of project: Development of Ballast Control Algorithm for Floating Docks

Sponsoring Agency: Larsen & Toubro

Period: February 2020 - March 2022

Role: Co-Principal Investigator

Title of project: 3-D numerical computation of liquid metal MHD flow at very high Hartmann number for complex geometry related to ITER interest

Sponsoring Agency: Science and Engineering Research Board (SERB)

Grant Amount: Rs. 19.2 Lakh **Period:** April 2016 - April 2018

Role: Principal Investigator

RESEARCH PROFILE

Post-Doctoral:

Title of the project: 3-D numerical computation of liquid metal MHD flow at very high Hartmann number related to ITER interest.

Mentor: Dr. Raja Banerjee (IIT Hyderabad)

Brief Summary:

The current Indian role is to design the Indian Test Blanket Module (TBM) which is to be tested in the ITER facility. This requires us to address some of the MHD issues of the complex geometry related to TBM design and help in optimization of the design. In fusion reactors, liquid Lead-lithium is circulated in the first walls to extract neutron energy and breed tritium.

At present there are only commercial codes of uncertain reliability and methodology that can be used to compute the flow. The main aim of the this project to compute flow behavior under very high magnetic fields related to ITER interest for complex geometries such as L-bend, U-bend and Z-bend using the ANUPRAVAHA general purpose CFD solver developed in-house by our research group.

Doctoral thesis:

Title: Numerical simulation of magnetohydrodynamics (MHD) flow and Heat transfer in enclosures and ducts.

Thesis Advisers: Prof. Vinayak Eswaran (IIT Hyderabad) and Prof. K. Muralidhar (IIT Kanpur)

Brief Summary:

Magnetohydrodynamics (MHD) combines the theories of electromagnetism and fluid mechanics to describe the flow of an electrically conducting fluid in the presence of a magnetic field. In this thesis, a numerical code is developed (implemented MHD module in the ANUPRAVAHA solver – a general purpose CFD solver developed by our research group) to solve the Navier-Stokes, temperature and associated equations for electromagnetics using the finite volume technique in two and three dimensional complex geometries.

The solver is also capable of solving the conjugate problem for heat conduction and electrical potential in the walls. A wall-function treatment is implemented in the module to solve the high Hartmann number flows relevant to Test Blanket Module (TBM) interest. This method avoids the necessity of fully resolving the extremely thin boundary-layers, called Hartmann layers, perpendicular to the magnetic field.

The thesis presents problems that can mainly be divided into two parts based on geometric configuration, namely *enclosures* (2-D complex and 3-D cubical) and *ducts* (straight duct and L bend).

Master thesis:

Title: Numerical Simulation of Particle Collection Efficiency in an Electrostatic Precipitator

Thesis Advisers: Prof. Anoop Kumar (NIT Hamirpur), Prof. Arun Kumar Saha (IIT Kanpur) and Prof. Vinayak Eswaran (IIT Kanpur)

Brief Summary

Prediction of particle collection efficiency of an electrostatic precipitator is an important as it causes air pollution. The electro-hydrodynamic (EHD) flows are those which involve the flow of fluids under the action of electrical body forces. The Navier Stokes and continuity equations along with the Poisson's equation for electric field and current continuity are solved using ANUPRAVAHA a finite volume based solver developed at IIT Kanpur.

A parametric study on the performance of electrostatic precipitator has been performed for a number of discharge electrode wires, shape of collecting plate, electrical potential, inlet velocity and different particle diameters.

STUDENTS GUIDANCE**Doctoral Thesis**

1. Mr. Sivakumar S., Investigation on heat transfer during turning of AISI 630 stainless steel through minimum quantity lubrication (in-progress), *Co-Supervisor*.
2. Mr. Harshad Raghuvanshi., Experimental and numerical investigation of cold room performance using modified air circulation arrangements (in-progress), *Co-Supervisor*.
3. Mr. Sudhir Kumar., Experimental and numerical investigation of ground-coupled heat exchanger (in-progress), *Supervisor*
4. Mr. Rupesh Banoriya., MHD Flow in sudden expansion (in-progress), *Co-Supervisor*
5. Mr. Vinay Yadav., EHD pump for thermal management of electronic devices (in-progress), *Co-Supervisor*
6. Mr. Ashish Bowade., Flow behaviour in the Tesla valve (in-progress), *Co-Supervisor*

Master Thesis

1. Deepesh Viswakarma., Numerical investigation of liquid lithium in the presence of magnetic field at different constant heat flux (May 2021)
2. Sunil Dodkey., Numerical investigation of earth air heat exchanger (May 2021)
3. Bharti Bhaghel., Flow control using magnetic field in diverging micro-channel (May 2022)
4. Vikash Kumar., Computational study of spiral earth-air heat exchanger (May 2022)
5. Rahul Bisen., Numerical simulation of MHD flow in diverging microchannel (May 2023)
6. Shravan Kurmi., Thermal analysis and optimization of parallel plate type of heat sink inside the collimator of digital radiography machine (May 2023)
7. Deepak Swarnkar., Numerical analysis of head losses in different geometries (May 2023)

LIST OF PUBLICATIONS**INTERNATIONAL JOURNAL**

1. **Narendra Gajbhiye**, Vinayak Eswaran, "Numerical simulation of MHD flow and heat transfer in a rectangular and smoothly constricted geometry", *International Journal of Heat and Mass Transfer*, Volume 83, pp. 441-449, 2015.

2. **Narendra Gajbhiye**, V Eswaran, A K Saha, Anoop Kumar, "Numerical calculation of particle collection efficiency in an electrostatic precipitator", *Sadhana*, Volume 40, pp. 863-873, Issue 3, 2015.
3. **Narendra Gajbhiye**, T. Praveen, Vinayak Eswaran, "Validation and Verification of a Robust 3-D MHD Code", *Fusion Engineering and Design*, Volume 128, pp. 7-22, 2018.
4. **Narendra Gajbhiye**, Vinayak Eswaran, "Thermo-MHD buoyant flow in a cubical enclosure at low to high Hartmann number", *International Journal of Thermal Sciences*, Volume 134, pp. 168-178, 2018.
5. **Narendra Gajbhiye**, Vinayak Eswaran, "Effect of radial magnetic field on the natural convection in a semi-circular curved enclosure for different aspect ratios", *Sadhana*, Volume 44, pp. 78-88, 2019.
6. Sivakumar Subramani, N. M. Sivaram, **Narendra Gajbhiye**, "A numerical study on the influence of minimum quantity lubrication parameters on spray characteristics of rapeseed oil as cutting fluid", *Industrial Lubrication and Tribology*, Volume 74, pp. 197-204, 2022.
7. Sivakumar Subramani, N. M. Sivaram, **Narendra Gajbhiye**, "A study on the sustainable machining of AISI 630 stainless steel under minimum quantity lubrication", *Int. J. Materials Engineering Innovation, in-press*
8. Sivakumar Subramani, N. M. Sivaram, **Narendra Gajbhiye**, "Effect of fluid properties and MQL system parameters on spray characteristics – A numerical approach", *Materials and Manufacturing Processes*, **Under review**
9. Harshad Raghuwanshi, K R Aharwal, **Narendra Gajbhiye**, "Effect of fluid properties and MQL system parameters on spray characteristics – A numerical approach", *Energy Sources, Part A: Recovery, Utilization and Environmental*, **Under review**

INTERNATIONAL PROCEEDINGS

1. Sunil Dodkey, **Narendra Gajbhiye**, "Numerical investigation of pressure drop and MHD flow through sudden expansion in presence of inclined magnetic field", *Proceedings of the 9th International and 49th National conference of Fluid Mechanics and Fluid Power (FMFP-2022)*, December 14-16, 2022, IIT Roorkee, India
2. Harshad Raghuwanshi, K R Aharwal, **Narendra Gajbhiye**, "Effect of vent position on temperature inhomogeneity inside apple storage package: A numerical study", *Proceedings of the 9th International and 49th National conference of Fluid Mechanics and Fluid Power (FMFP-2022)*, December 14-16, 2022, IIT Roorkee, India
3. Rupesh Banoriya, Manoj Arya, **Narendra Gajbhiye**, "Effect of vent position on temperature inhomogeneity inside apple storage package: A numerical study Asymmetric analysis of MHD flow in sudden expansion", *Proceedings of the 9th International and 49th National conference of Fluid Mechanics and Fluid Power (FMFP-2022)*, December 14-16, 2022, IIT Roorkee, India
4. Deepsh Vishwakarma, **Narendra Gajbhiye**, "Numerical investigation of liquid lithium in the presence of magnetic field at different constant heat flux", *Proceedings of the 26th National and 4th International ISHMT-ASTFE Heat and Mass Transfer Conference December 17-20, 2021*, IIT Madras, India
5. Sunil Dodkey, **Narendra Gajbhiye**, "Effect of pitch and tube arrangement on thermal performance of earth-air heat exchanger", *Proceedings of the 26th National and 4th International ISHMT-ASTFE Heat and Mass Transfer Conference December 17-20, 2021*, IIT Madras, India
6. Sudhir Kumar, **Narendra Gajbhiye**, Harshad Raghuwanshi, "Effect of pitch and tube arrangement on thermal performance of earth-air heat exchanger", *Proceedings of the 26th National and 4th International ISHMT-ASTFE Heat and Mass Transfer Conference December 17-20, 2021*, IIT Madras, India

7. **Narendra Gajbhiye**, V Eswaran, "Force convection in the presence of strong magnetic field with and without use of wall-function treatment", *7th International and 45th National Fluid Mechanics and Fluid Power Conference, December 10-12, 2018, IIT Bombay, INDIA*, Article ID: FMFP-203.
8. **Narendra Gajbhiye**, Praveen T., V Eswaran, "3-D numerical simulation of buoyancy driven flow in a cubical enclosure with different wall conductivities", *Proceedings of the 15th the International Heat Transfer Conference, IHTC-15, August 10-15, 2014, Kyoto, Japan*, Article ID: IHTC15-9138.
9. Praveen T., **Narendra Gajbhiye**, V Eswaran, "Effect of a cross electromagnetic field on mixed convection of a low-Pr fluid in a vertical duct", *Proceedings of the 15th International Heat Transfer Conference, IHTC - 15, August 10 - 15, 2014, Kyoto Japan*, Article ID: IHTC15-9259.
10. **Narendra Gajbhiye**, Vinayak Eswaran, "Effect of a magnetic field on natural convection in a curved geometry", *Proceedings of the 22th National and 11th International ISHMT-ASME Heat and Mass Transfer Conference, December 28-31, 2013, IIT Kharagpur, India*, Article ID: HMTC1300356.
11. Praveen T., **Narendra Gajbhiye**, V Eswaran, "On the electromagnetic control of convection in low Prandtl number fluids", *Proceedings of the 22th National and 11th International ISHMT-ASME Heat and Mass Transfer Conference, December 28-31, 2013, IIT Kharagpur, India*, Article ID: HMTC1300350.

PROFESSIONAL SKILLS

Programming Languages: Fortran, C

CFD Software: Fluent, CFX, OpenFOAM

Meshing Software: ICEM-CFD, GridZ, Grid-Pro

Other Software: Tecplot, VISIT, Latex, ParaView

Operating System: Linux, Windows, Mac

AWARDS AND ACHIEVEMENTS

National Post-Doctoral Fellowship by Science and Engineering Board (SERB).

Institute assistant-ship (MHRD fellowship) for the period 2008-2014.

GATE fellowship (MHRD) for the period 2006-2008.

Participated in School Game Federation of India Basket Ball tournament held at Ujjain (MP) in 2000 and played Basket Ball twice at National level competition.

Won first prize in 10 Km marathon run for the age group between 25-31 at IIT Kanpur.

ADMINISTRATIVE ACTIVITIES

Professor I/C Air Conditioner & Refrigeration and Walter Cooler and Filters May 2022 - Continuing

Co-Professor I/C Air Conditioner & Refrigeration and Walter Cooler and Filters April 2020 - May 2022

Assistant Proctor March 2019 - continuing

Assistant Warden March 2022 - continuing

Faculty In-Charge Examination February 2020 - March 2022

ISTE Co-coordinator August 2019 - continuing

PhD Senate member in the Student Gymkhana for the year 2008.

PERSONAL DETAILS

Name	Narendra Laxman Gajbhiye
Marital status	Married (2 sons)
Nationality	Indian
Language known	Hindi, English, Marathi
Date of birth and Place	12th August, 1983, Chandrapur, Maharashtra
Mailing Address	Department of Mechanical Engineering Maulana Aazad National Institute of Technology Pbhopal Madhya Pradesh, INDIA - 462 003
Permanent Address	Village+Post-Pimpalneri, Tahsil-Chimur, District-Chandrapur Chandrapur, Maharashtra Pin: 442903

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