PROFILE

I am currently working as an Assistant professor in the Deptartment of Mechaical Engineering at SV National Institute of Technology Surat, Gujarat, India. Prior to this, I was a postdoctoral fellow at IIT Bombay (2018-2019). I did my M.Tech. and Ph.D. from IIT Delhi and B.E. fom Sardar Patel University, Gujarat. I have more than six years of experience in the area of numerical heat transfer.

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VIPUL M. PATEL

Ph.D.

AREA OF INTEREST

- RADIATION TRANSPORT IN PARTICIPATING MEDIA
- FLUID FLOW AND HEAT TRANSFER IN OPEN CELL FOAM
- RADIATION THERAPY
- BIO-HEAT TRANSFER
- COMPUTATIONAL FLUID DYNAMICS (CFD)

SKILLS

- FORTRAN, C, MATLAB
- HIGH PERFORMANCE COMPUTING (HPC)
- ANSYS-FLUENT
- GAMBIT, ICEM
- NI LABVIEW

EDUCATION

2013-2018 — **PH.D., INDIAN INSTITUTE OF TECHNOLOGY DELHI, NEW DELHI, INDIA**

2009-2011 — **M.TECH., INDIAN INSTITUTE OF TECHNOLOGY DELHI, NEW DELHI, INDIA**

2003-2007 — **B.TECH., SARDAR PATEL UNIVERSITY, GUJARAT, INDIA**

EXPERIENCE

Oct 2019-Present — **ASSISTANT PROFESSOR, DEPARTMENT OF MECHANICAL ENGINEERING, SV NATIONAL INSTITUTE OF TECHNOLOGY SURAT, GUJARAT, INDIA**

Oct 2018-Oct 2019 — **POST-DOCTORAL FELLOW, DEPARTMENT OF MECHANICAL ENGINEERING, IIT BOMBAY, MUMBAI, INDIA**

Develoed Monte-Carlo based ray tracing based statistical models to simulate short-pulse laser transport in multi-layer tissue phantom and to calculate the subsequent temperature rise.

July 2011-Dec 2012 — **ASSISTANT PROFESSOR, IMS ENGINEERING COLLEGE, GHAZIABAD, UTTAR PRADESH, INDIA**

Responsible for teaching UG courses : Engineering Thermodynamics, Theory of Machine, Machine Design, Engineering Graphics, Material Science, Manufacturing Processes

July 2007-Feb 2008 — **SITE COORDINATOR, RELIANCE PETROLIUM LTD., JAMNAGAR, GUJARAT, INDIA**

- Preparing bill of material for piping and erection.
- Publishing weekly and monthly erection reports.
- Data analysis of erection records.
- Revised spool drawing.
- Operating smart plan review model

PUBLICATIONS

- **Patel, V.M.,** and Talukdar, P., 2016. "Evaluation of radiative properties of a representative foam structure using blocked-off region approach integrated with finite volume method", International Journal of Thermal Sciences, 108, pp. 89-99 (Impact Factor: 3.488)
- **Patel, V.M.,** and Talukdar, P., 2018. "Determination of radiative properties of representative and real open cell foam structures using the finite volume method", International Journal of Thermal Sciences, 132, pp. 117-128 (Impact Factor: 3.488)
- **Patel, V.M.,** Mendes, M.A.A., Talukdar, P., and Ray, S., 2018, "Development of correlations for effective thermal conductivity of a tetrakaidecahedra structure in presence of combined conduction and radiation heat transfer", International Journal of Heat and Mass Transfer, 127, pp. 843-856 (Impact Factor: 4.346)
- **Patel, V.M.,** and Talukdar, P., 2019. "Determination of heat transfer coefficient and thermal dispersion of a representative porous structure based on pore level simulations", In press Heat Transfer Engineering(Impact Factor: 1.703)
- **Patel, V.M.,** Srivastava, A., and Singh, S., 2019. " Development of Monte Carlo Model to Study Light Transport in Multilayered Tissue Phantom ", Accepted in Proceeding of the 25rd National and 3rd International Heat and Mass Transfer Conference, IHMTC2019, December28 – 30, Roorkee, Uttarakhand. India
- **Patel, V.M.,** and Talukdar, P., 2019. " Determination of Effective Thermal Conductivity of few Representative Open Cell Foam Structures ", Accepted in Proceeding of the 25rd National and 3rd International Heat and Mass Transfer Conference, IHMTC2019, December28 – 30, Roorkee, Uttarakhand. India
- **Patel, V.M.,**Sharma, M., and Talukdar, P., 2018. "Comparison of Finite Volume Method and Monte-Carlo Ray Tracing Technique to Evaluate Coefficient of Representative Open Cell Foam Structure", International conference on recent advances in fluid and thermal science, iCRAFT 2018, December 5-7, Dubai, U.A.E.
- **Patel, V.M.,** and Talukdar, P., 2017. "Numerical model to determine radiative properties of representative open cell foam structure", Proceeding of 2nd Thermal and Fluid Engineering Conference, TFEC2017, April 2-5, Las Vegas, NV, USA
- **Patel, V.M.,** and Talukdar, P., 2017. "A combined analytical-numerical model to determine radiative properties of tetrakaidecahedra cell structure", International Symposium on Advances in Computational Heat Transfer, Proceeding of CHT-17, ICHMT, May 28 – June 1, Napoli, Italy
- **Patel, V.M.,** and Talukdar, P., 2015. "Determination of interfacial heat transfer coefficient of a cubic cell porous structure", Proceeding of the 23rd National and 1st International Heat and Mass Transfer Conference, IHMTC2015-919, December17 – 20, Thiruvananthpuram, Kerala, India
- **Patel, V.M.,** and Tandon, N., 2015. "Acoustic emission monitoring of very slow speed thrust ball bearing", National Sympusium on Acoustics "Acoustics for Ocean Environment", NSA-2015, Goa, India
- **Patel, V.M.,** and Tandon, N., 2013. "Vibration monitoring of very slow speed thrust ball bearing", 20th International Congress on Sound and Vibration, ICSV20, Bangkok, Thailand

COURSES ATTANDED

JAN 21 - 26, 2019

Attended 5 days GIAN course on ***"Dosimetry and Advanced Radiotherapy Planning Techniques"***, organized at Anna University, Chennai, India.
Course Instructor: Dr. R. Prabakar (Lead Physicist & Associate Professor, Department of Physical Sciences, Peter MacCallum Cancer Centre)

JAN 5 - 16, 2016

Attended 12 days GIAN course on ***"Volume Averaging Method for Upscalling in Porous Media"***, organized at Indian Institute of Technology BHU, Varanasi, India.
Course Instructor: Prof. Krishna M. Pillai, University of Wisconsin, Milwaukee, USA

DEC 5 - 9, 2016

Attended 5 days GIAN course on ***"Introduction to Metal Foams and Cellular Metals"***, organized at Indian Institute of Technology Madras, Chennai, India.
Course Instructor: Prof. John Benhart, Technical University of Berlin, Germany

MAY 16 - JULY 9, 2012

Participated **SUMMER FACULTY RESEARCH FELLOW PROGRAMME-2012** at IIT Delhi, New Delhi, India.
Mentor Faculty: Prof. R. K. Pandey, Department of Mechanical Engineering, IIT Delhi, New Delhi, India

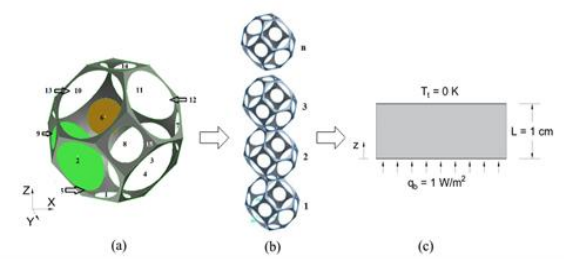
Research Summary

Project A

Development of Nunerical Models to Study Fluid Flow and Heat Transfer in Open Cell Foam

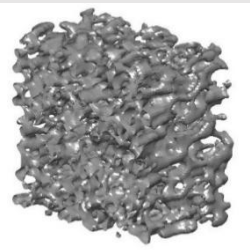
The improved thermal-hydraulic properties of open cell foams, such as low overall density, high specific surface area, moderately high effective thermal conductivity, considerably high tortuous flow path, and allowing flow with comparatively lower pressure drop attracts researchers to investigate their performance for various applications. Beforehand knowledge of the effective thermo-mechanical properties of porous foams allows the designer to improve the performance of systems that use them for different purposes. We focus on development of numerical models to calculate such effective thermos-mechanical properties of open cell foam. Brief discussion on some of the numerical models, developed so far, is as follows:

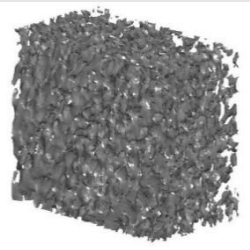
A.1 Development of a zonal method based unit cell model to calculate radiative properties, i.e., extinction coefficient (β) and scattering albedo (ω) of the representative open cell foam structures.



A combined analytical-numerical model is developed to determine radiative properties of representative porous media using pore structure modelling along with radiation interaction with the solid matrix. The genetic algorithm (GA) code based on inverse method is developed and integrated to the FVM code. The obtained results of recurrence relationships are used in the FVM-GA code to determine extinction coefficient and scattering albedo of an equivalent homogeneous participating medium. Effects of solid reflectivity and pore density on the radiative properties of the porous media have been studied using the proposed model.

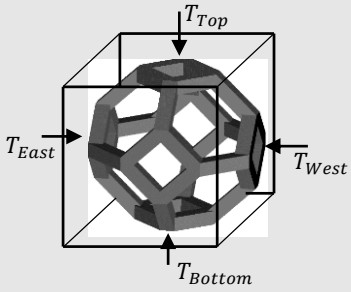
A.2 Development of voxel information based numerical model to calculate radiative properties, i.e., extinction coefficient (β) and scattering albedo (ω) of open cell foam structures :





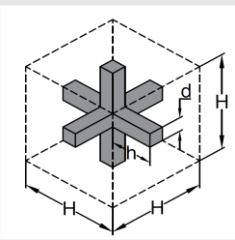
The numerical model is based on direct solution of the standard radiative transfer equation integrated with the inverse method based Genetic algorithm. The numerical model was developed in FORTRAN language where the standard radiative transfer equation, in a three dimensional porous domain was solved using the finite volume method. The actual structures of open cell foam were obtained using the CT scan images.

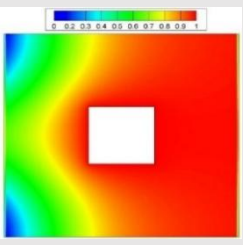
A.3 Development of a numerical model to calculate effective thermal conductivity of the representative open cell foam structure:



The numerical model is based on Cartesian coordinate based blocked-off region approach, integrated with the finite volume method of the coupled conduction-radiation heat transfer equation. The variations in the total effective thermal conductivity of a tetrakaidecahedra unit cell structure as functions of porosity, thermal conductivity of the solid phase and average temperature of the medium are presented. For this purpose, the governing energy conservation equation is numerically solved using the blocked-off region approach based on the finite volume method. The model was developed in collaboration with Dr. Miguel A.A. Mendes of Instituto Superior Tecnico, Universidade de Lisboa, Portugal and Prof. Subhashis Ray of Institute of Thermal Engineering, Technische Universitat Bergakademie Freiberg, Germany. The developed FORTRAN code was run on a super-computing facility (HPC) of IIT Delhi with total of 120 processors.

A.4 Numerical estimation of volumetric heat transfer coefficient and thermal dispersion of representative foam structure.





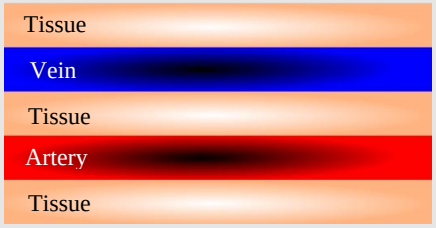
In order to estimate the volumetric heat transfer coefficient and thermal dispersion coefficient of the representative foam structure, pore level simulations were carried out in the commercial solver ANSYS-Fluent. The required mesh files were generated in ICEM tool. The employed numerical models are further utilized to determine the functional dependency of Nusslet number and dispersion coefficient on Reynolds number, Prandtl number, and porosity.

Project B

Development of Numerical Model for Cancer Treatment : Application to Radiation Therapy

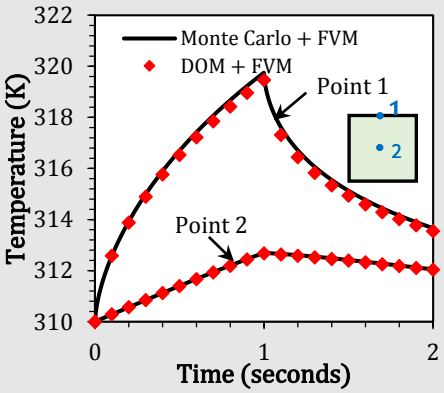
One of the important applications of the numerical modeling of heat transfer in porous media is laser-induced photothermal therapy where cancerous cells embedded inside biological tissue are destructed by inducing local hyperthermia using laser source. Since the successful destruction of the cancerous cells requires specified exposure time, a concrete understanding of light propagation inside the tissue phantom is essential.

B.1 Monte Carlo Ray Tracing based Statistical Model to Study Light-Tissue Interaction :



We developed a Monte Carlo ray tracing based statistical model to simulate radiation transport in biological tissue mimicking phantom. Both Snell's law and Fresnel's reflection are used to incorporate the optical interface treatment at the common interface of refractive index discontinuity. The effects of (i) nature of scattering, (ii) absorption and scattering coefficients, (iii) tissue layer thickness (iv) refractive index and (v) laser source on quantities such as reflectance, transmittance and fluence rate distribution are investigated. The developed model is further extended to investigate radiation transport in multi-layer tissue phantom with two blood vessels into consideration.

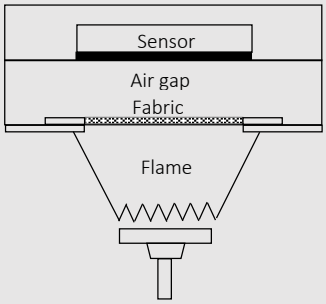
B.2 Combined Conduction-Radiation Model for Thermal Investigation of Laser Irradiated Tissue Phantom



Thermal investigation of two-dimensional tissue phantom, irradiated with short laser pulse, is carried out by importing the dosimetry data into Fourier conduction model. The multi-time scale approach, presented in the current study shows temporal variation of temperature at two distinct points, located at the top surface and at the centre of the tissue phantom. Two different numerical approaches, namely Monte Carlo technique and discrete ordinate method, tested in the present work show an excellent agreement.

Project C

Development of Numerical Model for Heat Transfer through Fabrics : Application to Firefighter Protective Clothing



Numerical simulations for heat transfer through fabric, exposed to fire is carried out as part of a study of the performance evaluation of thermal protective. The radiation modelling in air-gap is carried out using the finite volume method. The absorption of thermal radiation in fabric is modelled using Beer's law. The temporal increase of temperature of the sensor is calculated with the lumped capacitance method. The simulated temperature of the sensor is compared with the experimental data and good agreement is found for smaller air gaps.