

Dr. Goutam Dutta

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Executive Summary

- **Present Assignment : Assistant Professor in IIIT DM Jabalpur** (July, 2009 onwards)
- **Ph.D. Work** (Ph.D. : June, 2009)
 - Developed a CFD model to analyze two-phase flow in boiling channels
 - Developed a 3D space - time kinetic nuclear coupled thermal-hydraulic model to analyze a commercial BWR
- **Professional Synopsis**
 - Teaching: Worked for NIT Warangal as visiting faculty after Ph.D. thesis submission
 - Industry: Worked for Eaton India Engineering Center as CAE analyst for a year
- **Technical Strength and Software Competency**
 - Domain knowledge in heat transfer and fluid flow related problems
 - Aptitude towards analytical and numerical problem solving skills
 - Proficient in programming with Fortran

Education

- **Ph.D. in Mechanical Engineering** Mumbai, India
Indian Institute of Technology Bombay 2004 - 2008
 - Thesis : Numerical Investigation of Nuclear Coupled Density Wave Oscillations in Reactors
 - CPI 9.45
- **Master of Technology in Mechanical Engineering** Mumbai, India
Indian Institute of Technology Bombay 2001 - 2003
 - Specialization : Thermal and Fluid Engineering
 - CPI 9.12
- **Bachelor of Mechanical Engineering** Kolkata, India
Jadavpur University 1996 - 2000
 - 74 %

Present Employment

- **Assistant Professor** IIIT DM Jabalpur
Mechanical Engineering July, 2009 onwards
 - **Course Responsibilities**
 - Thermodynamics (UG)
 - Mechanical Drives and Devices (UG)
 - Analytical Methods in Engineering (Introduced for PG students)

Professional Experience

- **Pump Design and Hydraulic Valve Project** Eaton India Engineering Center, Pune
CAE analyst 2003 - 2004
 - **Responsibilities**
 - Responsible for executing design conceptualities of a hydraulic valve
 - **Achievements**
 - Successfully implemented the design for proper functioning and control of the valve
 - **Software Exposure**
 - ProE, Solidworks, Hypermesh and CAD softwares

Ph.D. Project

Indian Institute of Technology Bombay

Teaching Assistant

2004 - 2008

- Thesis : Numerical Investigation of Nuclear Coupled Density Wave Oscillations in Reactors

Introduction and Motivation of Work

- Density Wave Oscillation (DWO), a dynamic instability of paramount importance in flow boiling systems, is potentially capable of producing catastrophic consequences to human beings and therefore, every effort is required to have a conservative safety analysis without compromising on the economy so that one can prevent and pre-empt the imminent instabilities or at least detect and take the countermeasures to mitigate the instabilities from growing into threatening danger.
- Analysis on DWOs is accepted world-wide as a very challenging research work which demands to solve a real life industrial problem with precise accuracy and it is a subject of interest among the scientists and practitioners for last few decades.
- Numerical time-domain investigations on DWOs require a space-time dependent nonlinear model to simulate two-phase flow dynamics, fuel heat conduction and reactor neutron kinetics.

Work Contents

- A nonlinear computational fluid dynamics (CFD) model applicable to thermal-hydraulics (TH) is developed in time-domain to simulate two-phase flow in boiling systems.
- The TH model solves the mass, momentum and energy conservation equations numerically with a characteristics-based implicit finite-difference scheme in Eulerian frame of reference.
- The model is validated against available numerical and experimental benchmarks.
- The model is extended to investigate pure flow induced DWOs for forced circulation (FC) systems and natural circulating (NC) loops.
- Both type-I and type-II instabilities are predicted with the model in appropriate conditions.
- The model is then used to simulate parallel channel instabilities of a reactor core undergoing in-phase and out-of-phase modes of oscillations in absence of neutronic feedback effects.
- The model can simulate limit cycle oscillations at the marginal stability boundary.
- Stability maps for FC and NC systems during in-phase and out-of-phase modes of instabilities are generated and compared.
- A significant conclusion is drawn on the occurrence of type-I and type-II instabilities for FC and NC systems.
- The effects of riser sections and axial heat flux profile on the stability of the boiling systems are studied.
- Results show that the in-phase instabilities are dominating over the out-of-phase modes of oscillations at the existing working condition.
- The TH model, next, is coupled with another well validated neutronic model with 3-D space-time kinetics capability to analyze a commercial BWR in presence of void-Doppler reactivity feedbacks effects.
- The integrated model has also been validated against standard benchmark and published results.
- The integrated model is further extended to simulate core-wide (in-phase) and regional (out-of-phase) modes of oscillations of a typical BWR subjected to operational transients.
- Separate studies are performed to evaluate the performance of the reactor core when neutronic feedback effects are not taken into account.
- Extensive parametric studies are carried out to predict the instability thresholds and preclude such instabilities in the operational regime of the BWR for both the modes of oscillations.

Special Features of the Work

- The CFD model developed takes into account the compressibility effect of two-phase flow dynamics.
- The model is relatively inexpensive in terms of computational time considering the accuracy obtained.
- Unique results are obtained to understand the importance of riser sections in different boiling systems.
- Coupling of such a TH model to a 3-D space-time kinetics neutronic model, based on improved quasi-static methodology and flux-factorization approach, involves limited approximations and is an efficient computational algorithm.
- The integrated model has demonstrated the capability of reproducing the real life core-wide and regional instabilities with the numerical simulations performed in desktop computers.

M.Tech. Project

Indian Institute of Technology Bombay

Teaching Assistant

2001 - 2003

- Thesis : Design and Performance Evaluation of Steam Jet Pump
- A numerical model is developed using mass, momentum and energy conservation equations.
- Its performance is evaluated at various operating conditions with an aim to investigate the possibilities of enhancing the efficiency of the system.

Publications

International Journal Papers

- G. Dutta and J. B. Doshi, “A Characteristics-Based Implicit Finite-Difference Scheme for the Analysis of Instability in Water Cooled Reactors”, *Nuclear Engineering and Technology*, **40 (6)**, 477-488, (2008)
- G. Dutta and J. B. Doshi, “Nonlinear Analysis of Nuclear Coupled Density Wave Instability in Time-domain for a Boiling Water Reactor Core Undergoing Core-wide and Regional Modes of Oscillations”, Accepted for publication in *Progress in Nuclear Energy*

International Conferences

- G. Dutta and J. B. Doshi, “Development of Characteristics Based Finite Difference Implicit Scheme to Analyze a Boiling Channel in Nuclear Reactors”, *19th National and 8th ISHMT-ASME Conference Heat and Mass Transfer Conference*, J.N.T.U. Hyderabad, India, 2008
- G. Dutta and J. B. Doshi, “Development of a Nonlinear Thermal-hydraulic Model to Analyze Parallel Channel Instability of a Boiling Water Reactor Core Undergoing In-phase and Out-of-phase Modes of Oscillations”, *20th National and 9th ISHMT-ASME Conference Heat and Mass Transfer Conference*, N.P.C.I.L. Mumbai, India, 2010

Award

- Recipient of National Doctoral Fellowship awarded by All India Council of Technical Education since 2004 to 2008 and it is awarded to top 50 Ph.D. students

Courses during Ph.D. and M.Tech.

Numerical Courses

- Computational Fluid Dynamics (CFD)
- Finite Element Methods (FEM)

Theoretical Courses

- Fluid Dynamics, Heat Transfer and Thermodynamics
- Thermal-hydraulics (Multi-phase Fluid)
- Nuclear Reactor Theory

Computer Skills

Programming Languages

- Proficient in Fortran
- Conversant with Matlab, Mathematica

Application : T_EX, L^AT_EX, B_IB_TE_X, Microsoft Office, and other common productivity packages for Windows, and Linux platforms

Operating Systems : Microsoft Windows XP/2000 and Linux

Other Information

• Personal Details

- Date of Birth : May 16, 1977
- Marital Status : Married
- Sex : Male
- Accommodation : Dr. Goutam Dutta, C/O Mr. Sunil Bhagchandani, Flat : 401, Koushalaya Homes, Behind Civil Line Police Station, Jabalpur : 482 001, State : Madhya Pradesh, Country : India
- Permanent Address : Dr. Goutam Dutta, S/O Mr. Gopal Chandra Dutta, Flat : 07, Vijoy Apartment, 300 Canal Street, Sreebhumi (Near Lake Town), Kolkata : 700 048, State : West Bengal, Country : India, Phone : +91 33 2521 7024, Mobile : +91 98306 15296

• Languages

- English : Proficient in conversation, reading and writing
- Hindi : Read, write and speaking knowledge
- Bengali : Mother tongue

• Extracurricular Activities

- Sports and Games : Play football, cricket and cards
- Interests : Listening music

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