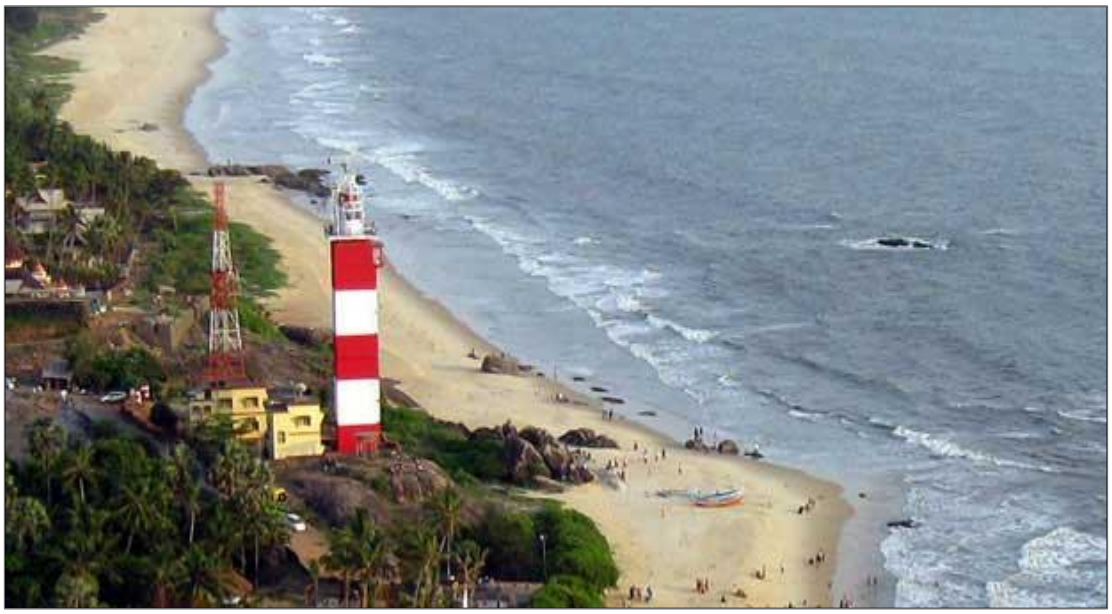
GLOBAL INITIATIVE OF ACADEMIC NETWORKS
(GIAN)

Government of India
Ministry of Human
Resource Development

GIAN COURSE
ON
Approaches and Tools for Sensitivity Analysis of Earth and Environmental Systems Models
(November 19 to 23, 2018)



COURSE COORDINATOR: Dr. AMAI MAHESHA

Organized by

DEPARTMENT OF APPLIED MECHANICS & HYDRAULICS

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA

SURATHKAL, MANGALORE 575025 KARNATAKA

APPROACHES AND TOOLS FOR SENSITIVITY ANALYSIS OF EARTH AND ENVIRONMENTAL SYSTEMS MODELS

Course Overview

Sensitivity analysis (SA) is an important paradigm in the context of model development and application. There exist a variety of approaches toward SA that formally describe different "intuitive" understandings of the sensitivity of one or more model responses to different factors such as model parameters or forcings. The significance of SA and the associated challenges in the context of Earth and Environmental Systems modelling cannot be understated. Such models are rapidly becoming increasingly more complex and computationally intensive, growing in dimensionality (both process and parameter), as they progressively and more rigorously reflect our growing understanding (or hypotheses) about the underlying real-world systems they are constructed to represent. This course provides a comprehensive overview of SA from its fundamentals, history and origin to the most advanced techniques for global sensitivity analysis (GSA). Theory and numerical implementation of a wide range of GSA approaches, as applied in Earth and environmental modelling, are taught. Also, strategies for improving computational efficiency and model performance are presented. Software tools for the range of sensitivity analyses thought in this course will be available in the VARS-TOOL package developed by the instructor (to download visit http://vars-tool.com/). Applicants are advised to get familiarized with MATLAB programming language for the course.

Course objectives

Upon completion of the course, participants will be able to:

- Demonstrate an understanding of how different sensitivity analysis approaches work
- Set up different sensitivity analysis techniques for a range of models
- Analyse model input-state-output data in the context of sensitivity analysis
- Carry out a range of sensitivity analysis experiments
- Apply a range of performance metrics and multi-criteria sensitivity analysis

COURSE SCHEDULE

Day 1

-- Lecture 1 (1 hour): What is sensitivity analysis?

-- Lecture 2 (2 hours): Parameter sensitivity versus parameter identifiability

Day 2

--Lecture 3 (2 hours): Local sensitivity analysis

--Tutorial 1 (2 hours): Local sensitivity analysis

Day 3

--Lecture 4(1 hour): Sensitivity analysis in groundwater/rainfall-runoff modelling

--Lecture 5(1 hour): Introduction to Global sensitivity analysis

--Tutorial 2 (2 hours): Hands-on global sensitivity analysis

Day 4

--Lecture 5 (1 hour): Regional sensitivity analysis (heuristic approach)

--Lecture 6 (1 hour): Derivative-based approach – Morris'es method

--Tutorial 3 (2 hour): Hands-on Regional sensitivity analysis

Day 5

--Lecture 7 (1 hour): Variance-based approach - Sobol's method

--Lecture 8 (1 hour): Variogram-based approach – VARS method

--Tutorial 4(2 hour): Hands-on Variogram-based approach

--Lecture 9 (1 hour): Theoretical relationships between the methods of VARS, Sobol, and Morris

Registration Process

Step 1 - Web Portal Registration:

Please visit GIAN Website at the link: **http://www.gian.iitkgp.ac.in/GREGN/index** and create login, User ID and Password. Fill up the GIAN registration form and do web registration by paying Rs. 500/- online through Net banking/Debit/ Credit Card as per instructions given there in. This provides the user with life time registration to enrol in any number of GIAN courses offered (skip this step if already registered with GIAN portal).

Step 2 – Course Registration:

Login to the GIAN portal again with the user ID and Password already created in Step- 1. Click on **Course Registration** option at the top of registration form. Select the course titled "***Approach and Tools for Sensitivity Analysis of Earth and Environmental System Models***" from the list and click on the '**Save**' option. Confirm your registration by clicking on the "**Confirm Course**" option. Shortlisted participants will be intimated by email for further registration and payment of course registration fees.

Registration fees

- Student/Research Scholar/Postdoc : Rs. 2500
- Faculty/Research scientist : Rs. 5000
- Employees of Government Organisation : Rs. 7000
- Industry Participants : Rs. 8000
- Participants from Abroad : US$ 200

The registration fee includes instructional materials and refreshments between sessions. Accommodation will be provided to outstation participants on payment basis subject to availability. No TA/DA will be provided to participants.

About GIAN Course

MHRD, Govt. of India has launched an innovative program titled Global Initiative of Academic Net -work (GIAN) in Higher Education, in order to garner the best international experience. As part of this, internationally renowned academics and scientists are invited to augment the country's academic resources, accelerate the place of quality reforms and elevate India's scientific and technology capacity to global excellence.

About NITK Surathkal

National Institute of Technology Karnataka (NITK), formerly known as Karnataka Regional Engineering College (KREC), also known as NITK Surathkal, is a public engineering university at Surathkal, Mangalore. It was founded in 1960 as KREC while today, it is one of the 31 National Institutes of Technology in India and is recognised as an Institute of National Importance by the Government of India. It has a suburban campus, in close proximity to the Arabian Sea. National Highway 66 runs adjacent to the campus and serves as a major mode of access. It is easily accessible by air, train and bus.

About the Department of Applied Mechanics & Hydraulics

The Department of Applied Mechanics & Hydraulics was established in 1960. It has earned a good reputation as a centre for academic, research and industrial consulting activities. Academic programmes leading to M.Tech Degrees in (i) Marine Structures (MS), (ii) Water Resources Engineering and Management (WREM) and (iii) Remote Sensing are offered. Also Ph.D. Degree in the broad areas of Hydraulics and Water Resources Engineering, Coastal Engineering and Remote Sensing and GIS Applications are offered. In addition to regular students, candidates sponsored under the Quality Improvement Program (QIP) are admitted to these programs. The Department also contributes significantly to the academic content of the B.Tech programme in Civil Engineering and offers basic Engineering Science and Elective courses to all under-graduate programmes. The Laboratories with state-of-art equipment, highly qualified faculty and dedicated staff provide an ideal environment for academic and research pursuits.

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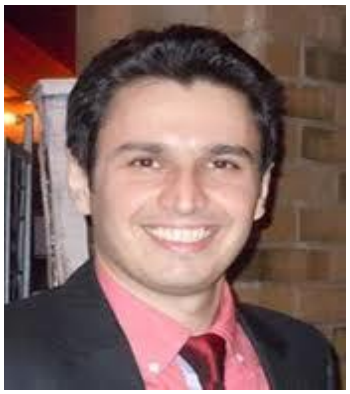
COURSE FACULTY

Foreign Faculty:



Dr. Razavi leads Watershed Systems Analysis and Modelling Lab, at the University of Saskatchewan. He is an assistant professor with School of Environment and Sustainability and Department of Civil and Geological Engineering at the University of Saskatchewan, Canada. He received the PhD degree (2013) in civil engineering from the University of Waterloo, Ontario, and the MSc (2004) and BSc (2002) degrees in civil engineering from Amirkabir University and Iran University of Science and Technology in Iran, respectively.

He has (co-)authored 28 peer-reviewed journal papers (24 published and 4 submitted), 7 of which published in Water Resources Research (the top journal in the field), 1 book chapter, and 5 technical reports. He has 1 patent pending and released 2 software packages for environmental modelling. Since 2009, he has given 5 invited and 52 contributed presentations (with 33 as the presenter) at conferences. His total citation count is 567 with an h-index of 11 according to Google Scholar. Dr. Razavi is the lead of Integrated Modelling Program for Canada (http://gwf.usask.ca/impc/), and has secured $1,795,000 of research funding as Principal Investigator and more than $5,072,000 as Co-Investigator. Dr. Razavi is Deputy Chair of AGU Committee on Hydrologic Uncertainty (2017-present), leading to Committee Chair in 2 years. He is an Associate Editor of Journal of Hydrology (2016-present) and an Editorial Board Member of Environmental Modelling & Software (2015-present). He is a member of Surface Water Hydrology Technical Committee of American Society of Civil Engineers (2016-present). Since 2014, He has been the (co-)convener and chair of 9 sessions at AGU, EGU, and CGU meetings on range of topics from Hydrological Modelling to Food-Energy-Water Nexus. He has 4 years of work experience in water industry and consulting companies in Canada and Iran and contributed to International Upper Great Lakes Study. Dr. Razavi has trained 6 PDFs, and 5 PhD and 3 MSc students. Full details are available at http://homepage.usask.ca/~ser134/. His notable achievements are 2018 Water Security Research Excellence Award, 2013 Water Resources Research Editors' Choice Award; 2013 AGU Research Spotlight; 2015 Outstanding Reviewer Award of ASCE Journal of Water Resources Planning and Management; 2014 Outstanding Reviewer Award of Environmental Modelling & Software; 2012 Ontario Graduate Scholarship; 2012 University of Waterloo President's Scholarship; 2011 Queen Elizabeth II Graduate Scholarships in Science and Technology; 2011 Dr. T.E. Unny Memorial Award; 2012 Mitacs-Accelerate Internship; 2011 University of Waterloo Special Graduate Scholarship; 2009-2012 University of Waterloo Graduate Merit Scholarships (eight times); 2006 Best Thesis Award of the national (Haseb) festival of distinguished students of Civil Engineering in Iran.