Dr. Hrishitosh Bisht

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OBJECTIVE

Inquisitive, hard-working and consistent. Looking forward to work with an organization where I can use my skill for the betterment of the society.

AREAS OF INTEREST

Computational Electromagnetics, Inverse Scattering problems in Electromagnetics, Machine learning, Convolution Neural Networks, Multiresolution approaches to Machine Learning, Modelling of Hysteresis curve, Communication and Signal Processing, Image Processing, Digital Signal Processing, Multirate and Multiresolution signal Processing - Wavelets and filter Banks, Wavelet transforms.

EDUCATION

IIT Bombay, Mumbai
Ph.D., Electrical Engineering
(25^{th} January 2022) CGPA: 7.41

MNNIT Allahabad, Prayagraj (U.P.)
M.Tech., Power Electronics & ASIC design, Electrical Engineering
July 2012 CGPA: 7.1

University of Rajasthan, Jaipur (Raj.)
B.E., Electronics and Communication Engineering
July 2009 Percentage: 69.55 %

Kendriya Vidyalaya, Noida (U.P.)
Class 12^{th} exam, CBSE
may 2005 *Percentage: 73.33 %*

***Kendriya Vidyalaya**, Noida (U.P.)*
Class 10^{th} exam, CBSE
may 2003 *Percentage: 82 %*

TECHNICAL SKILLS

Languages :* Python** *(Scikit-learn, Pytorch, NumPy, SciPy, Matplotlib),* ***Matlab, Octave, Scilab *(Familiarity with all the toolboxes required to solve any problem related to Statistics, Linear algebra, & convex and non-convex optimization Problems),* ***Pspice***, ***Xilinx***.
Software Tools: *LaTeX, MS-Office*

EXPERIENCE

College of Technology (CoT), GBPUAT, Pantnagar, Uttarakhand: Assistant Professor (TEQIP) ***Sept 2018 - Present***
Teaching and conducting Labs for Undergraduate and Postgraduate students

IIT Bombay, Mumbai, India: Research Associate Jan 2014 - Sept 2018.

Galgotia's College of Engineering and Technology, Greater Noida: Assistant Professor ***Jan 2013 - Dec 2013***
Teaching and conducting Labs for Undergraduate and Postgraduate students

Dehradun Institute of Technology (DIT), Dehradun, Uttarakhand : Assistant Professor Aug 2012 - Jan 2013
Teaching and conducting Labs for Undergraduate and Postgraduate students

PROJECTS (See Appendix A for details)

Ph.D.: Novel Approaches to Selected Electromagnetic Problems using Multi-resolution Representation, Iterative Techniques & Machine Learning

M.Tech.: Comparison of Modified hill climbing based fuzzy-logic control method for MPPT with P&O and basic FLC methods in a grid connected PV system.

B.E.: Wireless speed position control of stepper motor

Publications

Conferences:

- **H. Bisht** and R. K. Singh, "A novel simulation method using Stateflow for DC-DC converters," Power, Control and Embedded Systems (ICPCES), 2012 2nd International Conference on, Allahabad, 2012, pp. 1-6. doi: 10.1109/ICPCES.2012.6508101

Journals:

- **Bisht H**, Gadre VM, Kulkarni SV, Ram BS. "A Wavelet descriptor model of hysteresis loop phenomena". IET Electric Power Applications. 2020 Jul 17.
- Yash Sanghvi, **Hrishitosh Bisht**, Uday K. Khankhoje, V. M. Gadre, and S. V. Kulkarni, "Iteratively reweighted $\ell_1 - \ell_2$ norm minimization using wavelets in inverse scattering," J. Opt. Soc. Am. A 37, 680-687 (2020)

Book Chapters:

- Modulation AM and FM (Transmission and Reception), Uttarakhand Open University. **(Under Publication)**

Talk/Expert Lectures Given:

- Expert lecture on "Fused Floating-Point Arithmetic for DSP Applications", Latest trends in VLSI Design and hands-on Implementation using EDA tools, College of Technology, G.B.P.U.A.T., Pantnagar, 2019

Membership to Professional societies:

- IEEE, Grade- Member (Membership No.: 96692661)
- Life Member of Institution of Engineers (India) (IEI), , Grade- Member (Membership No.: M-1685109)

Awards:

- Awarded certificate of merit for outstanding academic performance & for being among top 0.1 of successful candidates of all India secondary school examination 2003 in mathematics
- Secured 152^{nd} state rank in 6^{th} NATIONAL SCIENCE OLYMPIAD.

Positions of responsibility during Ph.D.

Teaching Assistant (TA): Wavelets (EE678), IIT Bombay, Applied Linear Algebra (EE-635), IIT Bombay, Electrical and Electronic Circuits (EE101), IIT Dharwad, Network Analysis (EE225), IIT Dharwad.

NPTEL MOOC:

- Massive Open Online Course on "Foundations of Wavelets and Multirate Digital Signal Processing" (5-week online course) instructed by Prof. V. M. Gadre, IITB on NPTEL MOOC.
- Massive Open Online Course on "Fundamentals of Wavelets, Filter Banks and Time Frequency Analysis" (8-week online course) instructed by Prof. V. M. Gadre, IITB on NPTEL MOOC

Workshop Conducted: Participated in and conducted a 3-day workshop as a Teaching Assistant with Prof. V.M.Gadre at IIT Bombay on the theme "TEQIP-III Preparation and Collaborative Faculty-Student Pedagogical Initiatives," conducted in collabo-

ration with the Continuing Education Programme (CEP) and Department of Electrical Engineering IIT Bombay

Conference/ Training and Workshops attended:

Training Attended:

- Short-term course under TEQIP-III on Advanced Pedagogies: Active Learning & Digital Tools, IIT Delhi, 24-28 June 2019.
- Two-week course on Digital Transformation in Teaching Learning Process, IIT Bombay on SWAYAM (Online mode), 14 Feb-6 March 2020.
- Two-week course on Digital Transformation in Teaching Learning Process, 6 April-22 April 2020.
- Training on Python 3.4.3, K.N. Modi University in association with IIT Bombay (Online mode), 22-27 Jan 2020.
- Training on "Using Open Educational Resources (OER) for creating courses" held on 1-2 June 2020, organized by e-governance cell & IDP-NAHEP of GBPUAT Pantnagar.

Workshops Attended:

- "The growing role of IOT in Latest Technological Trends", School of Information Technology, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (In association with Wiley India Pvt. Ltd.), 22-26 June 2020
- "The growing role of IOT in Covid-19 and Health Care", School of Information Technology, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (In association with Wiley India Pvt. Ltd.), 8-10 June 2020.

Conference Attended:

- IEEE MTT-S International Microwave and RF Conference (IMaRC) 2019, IIT Bombay, 2019.

Certification Courses:

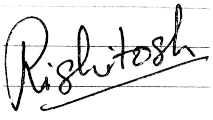
- "Machine Learning"- STANFORD University (Coursera), 10 Nov 2020.
- "Using Python to Access Web Data"- University of MICHIGAN (Coursera), 18 June 2020.
- "Python Data Structures"- University of MICHIGAN (Coursera), 12 June 2020.
- "Programming with Everybody (Getting Started with Python)"- University of MICHIGAN (Coursera), 30 May 2020.
- "Data Analytics"- SimpliLearn, 20 April 2020

Declaration

I hereby agree for my personal data, included in my job application, to be processed in line with the needs of recruitment, in accordance with the Law on Personal Data Protection of 29th August 1997 (Law Gazette from 2002, No.101, heading 926, as amended).

References

1. Prof. V.M. Gadre- Department of Electrical Engineering, IIT-B, Email: vmgadre@ee.iitb.ac.in, Phone number: 02225767426
2. Prof. S. V. Kulkarni- Department of Electrical Engineering, IITB, Email: svk@ee.iitb.ac.in, Phone number: 02225767430
3. Prof. Sanjay Mathur- Department of Electronics & Communication Engineering, CoT Pantnagar, Email: sanjaymathur.ece@gbpuat-tech.ac.in, Phone number: 08938006010
4. Dr. Amit More, AI Researcher at Honda R&D Co. Ltd, Email- amitmore17@gmail.com, Phone number: 09967885809
5. Prof. Ravindra K. Singh- Department of Electrical Engineering, MNNIT Allahabad, Email- rksingh@mnnit.ac.in, Phone number: 05322271404



Appendix A: Details of Projects Done

Ph.D.: Novel Approaches to Selected Electromagnetic Problems using Multi-resolution Representation, Iterative Techniques & Machine Learning

- **Multiresolution based approaches in solving Inverse Scattering Problems:** An inverse scattering problem is to estimate the shape of an object by measuring samples of the scattered field. In microwave imaging, this is achieved by retrieving the unknown contrast or permittivity profile of the scattering object by processing the measured electromagnetic field data. The electromagnetic inverse problem is modelled by reducing the Maxwell's system to a new Fredholm integral equation of the second kind. The equation in general is non-linear and hence can not be used directly to obtain the unknown contrast profile of the target. In this work, we proposed an iterative reweighted ℓ_1-ℓ_2 norm minimization algorithm integrated to Born Iterative Method for solving Inverse Scattering Problems. The proposed method is an expansion to the well-known joint ℓ_1-ℓ_2 norm minimization. Regularization schemes have been used in the past in the context of wavelet coefficients. It was observed that none of them take into account the fact that in wavelet domain we obtain coefficients corresponding to coarse and detail parts. Such regularization schemes are inefficient, in the sense, that they fail to make use of this important information. The proposed method makes use of the wavelet based joint ℓ_1-ℓ_2 norm minimization in an iterative manner within the BIM framework. In this work, we first present the idea of weights as a free parameter in the regularization scheme, associated with each wavelet coefficient and showed their robust performance even under noisy conditions. This algorithm called as "weighted ℓ_1 norm minimization" was observed to greatly depend on the choice of initial weights and thus a need to choose them carefully was required. To improve the algorithm, we then propose an iterative scheme of estimating the weights based on the previous estimate of the profile in the context of BIM. This method is called as "Iteratively reweighted ℓ_1 minimization". The advantage of this algorithm is that it is independent of the choice of initial weights. This "Iteratively reweighted ℓ_1 minimization" method is then used along with ℓ_2 norm minimization in order to achieve solutions that are not over smoothened at the discontinuities.
- **Wavelet Encoder-Decoder based Deep Neural Network for Non-linear Inverse Scattering Problems:** The inverse scattering problem as described above, in general, suffers from the curse of non-linearity and ill-posedness. The non-linearity in the problem is a manifestation of the nonlinear relationship between the unknown model parameters and the scattered field data, whereas, the ill-posedness comes from the fact that unknown parameters/variables do not depend on the measured data in a stable way and hence a small error in the measured scattered field data could lead to very large errors in the solution. To resolve this problem of ill-posedness, generally a regularization scheme is adopted (as the one proposed above) along with the iterative methods such as Born Iterative Method (BIM), Contrast Source Inversion Method (CSI), Subspace based Optimization method (SOM) ect. In this, the model parameters of the unknown scatterers are reconstructed by minimizing the objective function that quantifies the mismatch between calculated and measured scattered field iteratively. However, the major drawback of these iterative methods is that they are time-consuming and thus not suitable for the real-time reconstruction. These methods are also not capable of reconstructing the objects that will usually occur in real world situations (i.e. objects of large dimensions compared to the wavelength and having high contrasts/permittivity values) eg. tumor detection, behind-wall object detection, detection of arms, detection of land mines etc. For such situations, we propose a wavelet-based encoder-decoder DNN to solve the ISP. The

proposed model is a physics-aided learning approach. In general, the sparsity of the features computed by convolutional layers in DNN models is exploited by a max-pooling operation that reduces the feature's spatial size. We replace the max-pooling operation with a wavelet decomposition operation, which reduces the spatial resolution and decomposes the features into low frequency and high-frequency components separately. We first use a backpropagation (BP) algorithm to obtain a low-resolution estimate of the object from the given scattered field data. The proposed model takes this initial estimate as an input to produce an accurate and high-quality reconstructed image of the unknown scattering object. Another important point to note about the proposed architecture is that it uses CNN which is not based on the U-Net architecture. A CNN based on U-Net architecture is used in almost all the deep learning-based approaches to solve an ISP. The reason for using U-Net architecture is that it can predict the missing high-frequency components from the low-resolution image instead of learning the complete mapping from the low-resolution to the high-resolution image. However, this complicates the network and makes it slow to train. The proposed approach is validated with the help of several experiments and it is shown that the proposed model can reconstruct scatterer's with complex shapes and strong permittivity values with reasonable accuracy in real-time.

- **Wavelet Descriptor model for Hysteresis Loop phenomena:** An accurate hysteresis model is required to perform the transient analysis of electric machines. Mathematical modelling of the non-linear hysteresis curve is a classical problem and a variety of techniques have been proposed in the literature. In this work we have built upon the idea of using Fourier Descriptors (FD) which has shown some promising results in the past in describing the BH curve. It provided advantages such as (1) representation of the BH curve using only a few FD and (2) automated representation of the BH characteristics. FD were used in the past to describe a BH curve obtained using sinusoidal flux excitation and for excitations using third harmonics (this leads to minor loops in the BH curves). Through extensive simulations done on various BH loops, it was observed that the FDs fail to describe hysteresis curves as the number of minor loops increases. It is due to the fact that the Fourier basis are sinusoidal in nature and therefore have an infinite support. This does not help in capturing the local features of the signal. Therefore, we require a basis function which has a compact support, fast algorithms for its computation is available and whose coefficients have a fast decay rate. We proposed a Wavelet Descriptor based approach to model the BH curve owing all the three advantages offered by the wavelets. It is shown that proposed method can efficiently represent the complete BH curve with only a few data points and also allows for the automated measurement and representation of the hysteresis loop. The proposed method showed its strength even in modelling the BH curve obtained from the PWM excitation which results in a Hysteresis curve with a large number of minor loops.
- **Parameter Identification of Jiles-Atherton model using Wavelet and Fourier Descriptors-based Neural Networks:** The Jiles-Atherton (JA) model is commonly used for modeling hysteresis behaviour in magnetic circuits of electrical machines and transformers. The JA model consists of five parameters, each having a unique physical interpretation. Proper identification of these parameters is very crucial to estimate the losses accurately. The classical approaches to identify the JA model parameters are sensitive to the initial values and have convergence issues. All these methods solve a nonconvex optimization problem that in turn aims to solve a set of non-linear and first-order ordinary differential equations and is known to be highly computation-intensive. In this work we propose a novel approach for the estimation of the parameters of the JA model. We propose a wavelet and Fourier descriptor-based fully connected neural network (NN) to identify the JA model parameters. It is shown that the proposed fully connected NN, when trained with the BH curves of a magnetic material, can predict these parameters accurately. It is further shown that the

WDs or FDs, combined with the NN, can result in faster training convergence and improve parameter prediction accuracy. The proposed approach is validated by predicting hysteresis characteristics of ferromagnetic materials. The accurate and fast determination of the JA model parameters is at the core of solving the JA model equations, and therefore the proposed method can be seen as an excellent alternative to the conventional methods. A comparative performance analysis between the naive NN and FD and WD-based NN is shown at the end.

M.Tech.: Comparison of Modified hill climbing based fuzzy-logic control method for MPPT with P&O and basic FLC methods in a grid connected PV system.

In this a new fuzzy-logic controller for maximum power point tracking of photovoltaic (PV) systems was proposed. After exploring various PV models, a thorough investigation of conventional hill-climbing maximum power-point tracker structures and features were investigated. The new controller improved the hill-climbing search method by fuzzifying the rules of such techniques and eliminates their drawbacks. Fuzzy-logic based hill climbing offers fast and accurate converging to the maximum operating point during steady-state and varying weather conditions compared to conventional hill climbing. Simulation results are provided to demonstrate the validity of the proposed fuzzy-logic-based controller.

B.E.: Wireless speed position control of stepper motor

Position Control of brush-less Stepper motor using Atmel AT91SAM micro-controller. Also, RF-434 MHz modules were used to make the setup wireless in transmitter section, we use HT12E encoder and at receiver section, we use HT12D decoder.