Yadhu M Kartha

B.Tech, IIT(ISM) DHANBAD (2018-2022)

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Education

Educational Qualification	Institute	Grade
PhD in ML (Incoming)	**Georgia Institute of Technology**	-
BTech in MechE (2018-2022)	**IIT Dhanbad**	7.50/10

Research Experience

- ***Project*** **- Residual Point Sampling in Physics Informed Neural Networks.**
  Supervisor: **Dr. Lu Lu , Assistant, Professor, Department of Chemical & Bio-Molecular Engineering, University of Pennsylvania**.
  Method Research. This project was based on improving the solving capability of PINNs and making it more efficient by selecting a suitable sampling. The main research question was to understand the reason why PDEs require certain sampling method. By solving this and adding the methods to Deepxde, a library that solves PDEs by approximating the solution using neural networks, the accuracy of the solution obtained could be improved. Sampling here denotes the process of selecting training points in the defined domain of the PDE. These training points are essentially the ordinate, abscissa and the field value which will be used to train the neural network. This work will be communicated to Journal of Computational Physics later this year.

- ***Project*** **– Determination of Finite Difference Coefficients for Coarser Grid Wave Fields using image processing and CNN.**
  Supervisor: **Professor Felix Herrmann, Professor School of Earth and Atmospheric Sciences, Computational Sciences, Georgia Institute of Technology.**
  Method Research. The aim of this work is to create a high fidelity, dynamic estimator of finite difference stencils for accurate solution of a coarser wave field using Machine Learning. This neural network will be able to solve a coarse wave field instantly and dynamically. The solution will be comparable to a fine grid solution which otherwise takes a lot of computational resources to solve. The study involves determination of finite difference coefficients to solve coarser grid wave equations and attain a fine grid solution level of accuracy using neural networks. The model will be able to dynamically predict the stencil.

- ***Project*** **- Development of Physics Informed Model Based Reinforcement Learning.**
  Supervisor: **Professor Guang Lin, Associate Professor Mechanical Engineering, Purdue University**

  Method Research. In this project the aim was to develop a physics informed reinforcement learning model. The final objective was to address the issue of complex dynamics and large number of variables of the environment when it comes to model based reinforcement learning and to lessen the data required to train the dynamic controller. This project involved using Physics Informed Neural Networks (PINN) in learning the environment better and in a short time using model based reinforcement learning. I will be presenting this in the form of a journal paper.

- ***Project*** **- Development of Surrogate Classifier using Machine Learning for Energy Traces.**
  Supervisor: **Professor Yale E Goldman, Professor of Physiology, University of Pennsylvania**
  Method Research. The study involves the development of surrogate model for differentiating good photobleaching effects from the bad ones. The aim of this work is to make an efficient classifier for differentiating energy traces using limited data and compare its performance with existing software which takes a lot more computational time and resources. The classifier is being tested rigorously against a large amount of data to ensure that the classifier performs accurately.

- ***Project*** **- Physics Informed Neural Networks for Conjugate Heat Transfer in Heat Sinks**.
  Supervisor: **Graduate Research Assistant (PhD student) Arunkumar Seshadri, Massachusetts Institute of Technology**.
  Method Research. The study involves the development of Physics Informed Neural Networks (PINN) and surrogate models for conjugate heat transfer in heat sinks. The aim of this work is to make a PINN capable of producing results as accurate as CFD tools with less computational time. The data is generated using ANSYS FLUENT, input parameters are the boundary conditions and dimensions of the heat sink and the output is the contour of temperature and pressure developed in the heat sink. The loss function used in PINN is developed with a residual constraint of the NS equations and Energy equation. The paper has been submitted for review in International Communication of Heat and Mass Transfer.

- ***Project*** **- Development of Inverse Machine Learning Model and Modeling of different Porous Materials**
  Supervisor: **Prof. B Gurumoorthy, Center for Product Design and Manufacturing (CPDM) , Indian Institute of Science (IISc).**
  Method Research. The study included developing an inverse machine learning framework for predicting dimensions of different porous media of given porosity, permeability and thermal conductivity. The study involved preparation of 3D models of various Porous Media using Grasshopper software and determination of various key characteristics of the Porous media using COMSOL software. The findings and data were used to create a machine learning framework that would predict the dimensional quantities using the physical parameters such as porosity and permeability.

- ***Project*** **- Case Study on Volvo Single Drum Vibratory Compactor**
  Supervisor**: Mr. Dimitrov Krishna, Managing Director and Mr. Sanjay Raina, Production Manager, Volvo Construction Equipment Limited, Bengaluru.**
  Engineering Research. During the course of Internship, undertook a "Case Study to Analyze and Provide Solutions for the causes attributable for Pre-Mature Failure of Vibratory Drum of Volvo, SD110BA Single Drum Compactor". The study presented the reasons for premature failure of the single drum vibratory compactor. The reasons were identified to be high amplitude and frequency of the drum, which leads to more stress on the oil seals and bearings thus resulting in pre-mature failure.

Relevant Computer Skills/Courses

Geometry Modeling: Solidworks, Auto Cad, Fusion 360, Grasshopper

Structural Mechanics and CFD solvers: ANSYS CFD, Abaqus CE, COMSOL

Programming Languages: Python, C, MATLAB , C++ , DSA

Machine Learning: Tensorflow, Keras ,Pytorch ,Reinforcement learning (Gym), Computer Vision, Open CV , Image Processing , Object detection , basics of NLP, Video processing, ROS Basics

Ethical Hacking: Kali Linux, Social Engineering, Basics of Website and Network Hacking

Publications

- **Yadhu M Kartha**, Arunkumar Seshadri. *Physics Informed Neural Networks for Conjugate Heat Transfer in Heat Sinks*, Submitted to International Communication of Heat and Mass Transfer.
- Lu Lu **,Yadhu M Kartha**, Qinyang Yang. *Rethinking Residual Point Sampling in PINNs* , under preparation for Journal of Computational Physics.
- **Yadhu M Kartha** , Guang Lin. Physics informed Model Based Reinforcement Learning ,under preparation

Extra-Curricular Activities

- **Sports**:
  - ✓ *Bronze Medal in Inter House Boxing Championship*
  - ✓ *Third place in Inter Hostel Basketball Championship*
- **Leadership**:
  - ✓ *Organizer of Inter House Badminton Championship*
  - ✓ *Event Manager at Student Council at IIT(ISM)Dhanbad*
  - ✓ *Sports Head of House-1 of IIT(ISM)Dhanbad*
- **Writing**:
  - ✓ *Content Writer of the Core Team which organized CONCETTO (Annual Techno-Management Fest) 2019 at IIT(ISM) Dhanbad*
- **Social and Voluntary Work**:
  - ✓ *Hud-Hud cyclone restoration work at School and Residential Areas in 2014*
  - ✓ *Took part in clean ship drive during Environment Day organized by Indian Navy in 2016-17*
  - ✓ *Took tuitions and career guidance for children of economically weak families*
  - ✓ *Provided internship guidance to Juniors in College*