Satyam Kumar

Curriculum Vitae

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Research Interests

Brain-Computer Interfaces (BCI), Machine Learning, Riemannian Geometry for BCI , Signal Processing, Time-Series Analysis

Education

2019–ongoing **University of Texas at Austin**, *Electrical and Computer Engineering, Ph.D.* .
GPA 4.0/4.0 | **Supervisor: Prof. Josè del R Millàn**

2013–2018 **Indian Institute of Technology Kanpur**, *Integrated BTech - MTech Electrical Engineering MTech GPA 8.7/10.*

Publications

1. **Kumar S.**, Yger F., Lotte F. *"Towards Adaptive Classification using Riemannian Geometry approaches in Brain-Computer Interfaces"*. 7th IEEE **International Winter Conference On Brain-Computer Interface, 2019**
2. **Kumar S.**, Reddy TK., Arora V., Behera L.*" Formulating Divergence Framework For Multi-class Motor Imagery Brain Computer Interface"*. 45th IEEE **International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2020**
3. **Kumar S.**, Reddy T., Behera L., *"EEG based motor imagery classification using instantaneous phase difference sequence"*, oral presentation at IEEE conference on **Systems, Man and Cybernetics, 2018**
4. Reddy T., Arora V., **Kumar S.**, Behera L., Wang Y. K. , Lin CT, *"Electroencephalogram based reaction time prediction with Differential Phase Synchrony representations using co-operative multitask learning Deep Neural Networks"* IEEE **Transactions on Emerging topics in Computational Intelligence**

Awards and Honors

Aug'18 **Travel Grant** winner, IEEE conference on Systems, Man and Cybernetics

Aug'17 **Teaching assistant fellowship**, awarded by Ministry of Human Resource Development, India on the basis of academic performance during graduate studies.

Apr'16 **Charpak research scholarship**, one of the 25 recipients from India.

Jun'13 **JEE Advanced** All India Rank 679, *(top 99.993 percentile)*

Jun'13 **Youngest ever Indian to clear JEE exam** (cleared the entrance exam for college at the age of 13 years)

Work Experience

Sep'19 – ongoing **Graduate research assistant**, *Supervisor: Prof. Jose Millan*, *University of Texas at Austin* .

- Formulating computational machine learning approaches to promote learning of motor imagery.

Sep'18 – Oct'18 **Visiting Researcher**, *Supervisor: Dr. Fabien Lotte & Prof. Florian Yger*, *Inria Bordeaux, Sud Ouest* .

- Implemented state of the art Riemannian geometry algorithms for classification of motor imagery BCIs

- Implemented the classical adaptive algorithms based on CSP for supervised and unsupervised adaptation
- Proposed different frameworks for doing adaptation using Riemannian geometry classifiers.

Oct'17 – Dec'17 **Scientific Assistant**, *Supervisor: Mr. Oliver Bichsel, Prof. Laxmidhar Behera & Prof. Roger Gassert* , *RELab ETH Zurich* .

- Analyzed different phase synchrony statistics during motor imagery
- Implemented and compared common spatial pattern (**CSP**) algorithm and its variants with **Lasso** regularized sparse filter bank approach (**SFBCSP**) on BCI competition datasets
- Proposed novel approach based on instantaneous phase difference sequences to extract phase synchrony information

Selected Projects

Dec'18 – May'19 **Memory evoked ERP classification** .
Prof. Vipul Arora (*IIT Kanpur*)

- Hands on experience with acquistion and processing of raw EEG data using openBCI, Cognionics and custom BCI headset
- Built different modules (Data recording, Preprocessing, feature extraction) from scratch in python for classification of ERPs

Mar'18 – Jul'18 **Subspace analysis in Motor Imagery Brain-Computer Interface**.
Prof. Laxmidhar Behera (*IIT Kanpur*)

- Implemented stationary subspace analysis and divergence based framework of common spatial pattern algorithm for binary class
- Proposed a novel framework for optimization of stationarity in multiclass motor imagery BCI using an information theoretic interpretation of Joint Approximate Diagonalization

May'16 – July'16 **Optimization of electrode positions in Brain-Computer Interfaces**.
Prof. Francesco P. Andriulli (*Telecom Bretagne, France*)

- Studied different forward and inverse methods deployed for EEG source localization in the human brain model
- Proposed and implemented the **Genetic algorithm** to simultaneously optimize channel selection and classification performance of Motor imagery BCI using source localisation .

Teaching and Mentorship Experience

Jan-April'18 **Microelectronics Laboratory, EE381A**

Aug-Oct'17 **Control System Laboratory, EE380A**

Aug-Nov'18 **Shreeshail Hingane***(Junior year undergrad, Electrical Engineering)* on P300 BCI speller together with **Prof. Laxmidhar Behera**

Aug-Nov'18 **Nihir gulati***(Junior year undergrad, Electrical Engineering)* on Motor Imagery BCI together with **Prof. Laxmidhar Behera**

Technical Skills

Advanced	MATLAB
Intermediate	Python | LaTeX| AutoDesk Inventor| Lab Streaming Layer | LINUX
Basic	C| Tensorflow| Arduino| Android Studio| Shell scripting
Devices Used	openBCI| Hasomed FES| ANTNeuro EEG| Cognionics EEG

Relevant Courses

Electrical Engineering	Neural networks | Control systems | Basic of modern control systems | Signal systems & networks | Digital signal processing

Mathematics	Fundamental of computing | Probability & statistics | Linear algebra | Numerical methods in engineering | Machine Learning
Biomedical	Biomedical Signal and Systems | Neurobiology | Human cognitive processes

Outreach and Presentations

Feb'20	Demo of Brain Computer Interface and Functional Electric Stimulation at TEDx Youth Austin
Nov'19	Poster Presentation in Austin, at Texas Wireless Summit 2019 on brain computer interface
Feb'19	Oral Conference Presentation in South Korea, on brain computer interfaces

References

Dr. Jose del R. Millan
University of Texas at Austin
Electrical and Computer Engineering
Department of Neurology
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Dr. Fabien Lotte
Inria Boredaux Research Director (DR2)
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