Mohit Agarwal

PhD Student

Electrical and Computer Engineering

Georgia Institute of Technology

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Research Interests	Brain-Computer Interfaces, Signal Processing, Machine Learning, Deep Learning, Artificial Intelligence and Wireless Communications

Education

Georgia Institute of Technology Aug'14 - Present
PhD in Electrical and Computer Engineering
Advisor: Prof. Raghupathy Sivakumar
GPA: 4.0/4.0 (Expected Graduation: May 2019)

Georgia Institute of Technology Aug'14 - May'17
MS in Electrical and Computer Engineering
Minor in Computer Science
GPA: 4.0/4.0

Indian Institute of Technology Kanpur July'10 - May'14
B.Tech in Electrical Engineering
GPA: 8.7/10.0

Publications

Mohit Agarwal and Raghupathy Sivakumar, "Characters vs. Words - Observations on Command Design for Brain-Computer Interfaces", Poster, International Conference on Mobile Systems, Applications and Services (MobiSys), Niagra Falls, NY, USA, June 2017

Mohit Agarwal and Raghupathy Sivakumar, "THINK: Toward Practical General-Purpose Brain-Computer Communication", 2nd ACM Workshop on Hot Topics in Wireless (HotWireless), 2015

Atul Kumar Sinha, **Mohit Agarwal** and Ajit K. Chaturvedi,"Multi-Level SINR Thresholding for Reduced Complexity MIMO Detection" in National Conference on Communications, 2013

Onur Ozdemir, Lakshmi N. Theagarajan, **Mohit Agarwal**, Thakshila Wimalajeewa and Pramod K. Varshney, "An MCMC Approach to Multisensor Linear Modulation Classification", WCNC 2017

Jun Zou, **Mohit Agarwal**, Yashas Malur Saidutta, Faramarz Fekri, Raghupathy Sivakumar, and Steven W. McLaughlin, "EEG Sequence Recognition using Deep Learning and Hidden Markov Models for Brain-Computer Communication" to be submitted

Awards and Achievements

- Ranked in the **Top 0.1%** (amongst 475,000 students) in IIT-JEE 2010
- Selected in the **Top 1%** (amongst 40,000 students) in National Physics Olympiad 2010
- Recipient of **MCM Scholarship** for continued excellent academic performance (2010-2014)
- Ranked **2nd** in worldwide Melanoma Detection Challenge (2016) organized by ISBI

Technical Skills

C/C++, Java, Python, MATLAB, R, Android Development, Web (HTML/CSS), LaTeX
Network Simulation Tools: ns2, Netlogo, iperf and Wireshark
Deep Learning Frameworks: Tensorflow, Caffe, Torch and Keras

Internships	**High Dimensional Spectral Sampling Methods**	Summer'17

Internships

High Dimensional Spectral Sampling Methods Summer'17
Machine Learning and Data Analysis Research Project
Under J. J. Thiagarajan at Lawrence Livermore National Labs (USA)

- In progress

Video Action Classification using Deep Stateful Networks Summer'16
Deep Learning Research Project
Under the guidance of Rob Liston and Dan Tan at Cisco Systems, Inc. (USA)

- Designed deep neural nets using LSTMs in Tensorflow, for action recognition in video clips
- Performed experiments to leverage temporal coherence in sequence of video frames
- Quantified the comparison between stateful and stateless models in UCF-101 dataset

Automatic Modulation Classification in WSNs Summer'13
Wireless Communication Research Project
Under the guidance of Prof. Pramod Varshney at Syracuse University (USA)

- Developed algorithm for automatic identification of digital modulation in wireless communication in the presence of noisy environment having unknown channel parameters using Bayesian model
- Proposed *Collapsed Gibbs sampling* based approach for channel parameter estimation
- Performs well even in higher-order QAMs and reduces the local minima effect in high SNR regime

Research Experience

Democratizing Brain-Computer Communication Aug'16 - Present
BCI Research Project under Prof. Sivakumar as a part of Doctoral Research Work

- Research, design and develop an automatic learning framework that application developers can leverage to build applications effectively without any explicit knowledge in many related domains
- Framework learns the statistical pattern of brain waves and their correlation with mental thoughts using Deep-Neural Networks (e.g. CNNs, RNNs) and hybrid HMM models for sequence detection
- Exploring the practical challenges including usability, computational and communication aspects, from both user and developer standpoint

THINK: Turning Thoughts into Action Jan'15 - July'15
BCI Research Project under Prof. Sivakumar as a part of Master's Thesis

- Developed THINK, a general purpose platform to communicate by mere imagination
- Explored signal processing and detection of *mu-waves*, specifically in non-invasive domain (EEG)
- Achieved counter-intuitive results for system accuracy (81.2%), think rate and form-factor

Academic Projects

Modelling the Rehearsal Effect of Humans Oct'16 - Nov'16
Neuroscience and Machine Learning Project (Computation and Brain: Prof. Santosh Vempala)

- Demonstrated the notion of forgetting and rehearsal in humans in the realm of neural networks
- Successfully simulated Ebbinghaus forgetting curve and learning curve, and explored various rehearsal properties by building a Recurrent Neural Net in Tensorflow

Multi-Level SINR Thresholding for Reduced Complexity MIMO May'12 - June'12
Wireless Communication Research Project under Prof. Ajit K. Chaturvedi, IIT Kanpur

- Investigated the post-processing SINR distribution in MMSE, a MIMO detection Algorithm
- Proposed a new algorithm of reduced complexity by pruning search space of sphere decoder
- Achieved 55% complexity reduction as compared to state-of-the-art, keeping the error rate same

Skin Lesion Analysis towards Melanoma Detection — Mar'16 - Apr'16
Deep Learning Project (Deep Learning: Prof. Zsolt Kira)

- Automated skin cancer detection by proposing Deep Learning architectures based on CNNs for skin lesion segmentation, feature extraction and classification
- Won 2nd prize for the classification (81.3%) and feature extraction in ISBI 2016 Challenge

OCR based Mathematical Equation Recovery — Mar'15 - Apr'15
Machine Learning Project (Statistical Signal Processing: Prof. Mark Davenport)

- Developed a mathematical equation recognition system, capable of converting scanned mathematical equations to machine readable format along with its LaTeX code and solution
- Implemented character segmentation and equation recovery algorithms for complex mathematical equations involving 2-D information (ex. superscript, summation, fraction etc.)
- Achieved 98.92% accuracy in case of 60 symbols including operators and greek characters

General Game Playing Agent — Jan'13 - Apr'13
Artificial Intelligence Project (Artificial Intelligence: Prof. Amitabha Bhattacharaya)

- Developed an artificial gaming agent, capable of playing any game without human intervention
- Implemented state-of-the-art work published by CadiaPlayer (3 times winner in General Game Playing (GGP) competition in AAAI conference) which involves putting Upper Confidence Bound (UCB) in Monte-Carlo Tree Search (MCTS)
- Selected amongst top 5 projects, to compete on a global scale in GGP competition in AAAI

NDroidPad: Android Application — Dec'12 - Jan'13
Smartphone Application Development (Electronics Club, IIT Kanpur)

- Developed an Android application to use smartphone as wireless controller/joypad for Laptop
- Implemented motion-sensor and multi-touch features, providing Xbox Interface to application
- Won 1st Prize in Techfest12; The app crossed 1000+ downloads within a week on Google Play

Graphic Driver on ATMEGA Microcontroller Platform — May'11 - June'11
Hardware Development Project (Electronics Club, IIT Kanpur)

- Developed Graphic Driver features on ATMEGA16, to project on external CRT/LCD monitor
- Programmed VGA protocol using SRAM (as buffer memory) and SPI for high data rate
- Created VGA library for text/image display, designed ping-pong demonstrating library usage

Academic Courses		
	Computer Science	Machine learning, Deep Learning, Artificial Intelligence, Computation and Brain, Applied Cryptography, Mobile Computing, Advanced Programming Techniques, Android Application Development, Data Structure and Algorithms
	Mathematics	Probability and Statistics, Linear Algebra, R Programming
	Telecom/SP	Information and Coding Theory, Random Processes, Digital Communication Networks, Communication Systems, Digital Signal Processing, Statistical Signal Processing, Advanced Digital Communications, Wireless Communications and Networks, Convex Optimization in SP/COM

References

Prof. Sivakumar Raghupathy

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