Chiranjib Saha

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Research Interests

Wireless communications; 5G networks; Heterogeneous cellular networks (HetNEts); LTE/LTE-A, WiFi; Internet of Things (IoT); Device-to-device (D2D) communications; Integrated access and backhaul design; Spectrum sharing; Machine learning; Signal processing; Stochastic geometry.

Education

Virginia Tech., USA. Pursuing Ph.D. in Electrical and Computer Engineering **Aug. 2015- Dec. 2019**

- Advisor: Harpreet S. Dhillon
- Current Research Project: Joint Backhaul and Radio Access Design for Heterogeneous Wireless Networks
- Current GPA: 3.87

Jadavpur University, India. B.E. in Electronics and Telecommunication Engineering **2011-2015**

- Final year Project Topic: Gesture driven control of an Arduino based robot using Kinect
- Advisor: Amit Konar
- CGPA: 9.22

Journal Publications

[J10] **C. Saha** and H. S. Dhillon, "Load Balancing in 5G HetNets with Millimeter Wave Integrated Access and Backhaul", submitted to *IEEE Trans. on Wireless Commun.*

[J9] **C. Saha**, H. S. Dhillon, N. Miyoshi, and J. G. Andrews, "Unified Analysis of HetNets using Poisson Cluster Process under Max-Power Association", submitted to *IEEE Trans. on Wireless Commun.*. Available online: arxiv.org/abs/1812.01830.

[J8] **C. Saha**, M. Afshang and H. S. Dhillon, "Bandwidth Partitioning and Downlink Analysis in Millimeter Wave Integrated Access and Backhaul for 5G," in IEEE Trans on Wireless Commun., Dec. 2018.

[J7] M. Afshang, **C. Saha**, and H. S. Dhillon "Equi-coverage Contours in Cellular Networks", in *IEEE Wireless Commun. Letters*, Oct. 2018.

[J6] **C. Saha**, M. Afshang, H. S. Dhillon, "3GPP-inspired HetNet model using Poisson cluster process: sum-product functionals and downlink coverage", in *IEEE Trans. on Commun.*, May 2018.

[J5] M. Afshang, **C. Saha**, and H. S. Dhillon, "Nearest-neighbor and contact distance distributions for Matérn cluster process", in *IEEE Commun. Letters*, Dec. 2017.

[J4] M. Afshang, **C. Saha**, H. S. Dhillon, "Nearest-neighbor and contact distance distributions for Thomas cluster process", in *IEEE Wireless Commun. Letters*, Dec. 2016.

[J3] **C. Saha**, M. Afshang, and H. S. Dhillon, "Enriched K-tier HetNet model to enable the analysis of user-centric small cell deployments", in *IEEE Trans. on Wireless Commun.*, Mar. 2016.

[J2] **C. Saha**, K. Pal, S. Mukherjee, S. Das, "A fuzzy rule based penalty function approach for solving constrained optimization", in *IEEE Trans. on Cybern.*, Dec. 2016.

[J1] A. Trivedi, D. Srinivasan, K. Pal, **C. Saha** and T. Reindl, "Enhanced multiobjective evolutionary algorithm based on decomposition for solving the unit commitment problem", in *IEEE Trans. on Ind. Informat.*, Dec. 2015.

Selected Conference Publications

[C5] **C. Saha**, M. Afshang, and H. S. Dhillon, "Integrated mmWave access and backhaul in 5G: Bandwidth partitioning and downlink analysis", in Proc. IEEE ICC, Kansas city, KS, 2018.

[C4] **C. Saha**, M. Afshang, and H. S. Dhillon, "Poisson cluster process: Bridging the gap between PPP and 3GPP HetNet models", in Proc., ITA, San Diego, CA, 2017.

[C3] **C. Saha** and H. S. Dhillon, "D2D underlaid cellular networks with user clusters: Load balancing and downlink rate analysis", in Proc., IEEE WCNC, San Fransisco, CA, Mar. 2017.

[C2] **C. Saha** and H. S. Dhillon, "Downlink coverage probability of K-tier HetNets with general non-uniform user distributions", in Proc., IEEE ICC, Kuala Lumpur, 2016.

[C1] **C. Saha**, D. Goswami, S. Saha, A. Konar, A. Lekova and A. K. Nagar, "A novel gesture driven fuzzy interface system for car racing game", in Proc., FUZZ-IEEE, Istanbul, 2015.

PhD Research Experience

- **mmWave Integrated access and backhaul (IAB)** **May 2017-Present**
  - Proposed new stochastic geometry-based model for mmWave IAB-enabled HetNet
  - Load modeling, coverage and data-rate analysis, studying resource partition strategies in IAB.
- **3GPP-inspired stochastic geometry models for HetNets** **Sep. 2015-May 2017**
  - Proposed new stochastic geometry-based models closely resembling 3GPP HetNet models, coverage analysis and model comparisons.
- **Performance analysis of D2D-enabled cellular networks** **Jan. 2016-May 2016**
  - Proposed new spatial models for D2D communication in user hotspots, analyzed downlink coverage and rate trends.

Industrial Research Internships

- **Beamforming and beam tracking in 3GPP new radio** **Summer 2018**
  Research internship *Nokia Bell Labs, Naperville, IL*
  - Mentors: Amitava Ghosh, Fredrik Vook, Anil Rao.
  - Studied beam tracking when a mmWave receiver is moving along a trajectory in an urban environment. Integrated spatially correlated channels from a ray tracer to the link and system level simulator of 5G NR. *Selected for distinguished Bell Labs Summer Internship Project.*

Graduate Level Projects

- **Fitting point processes to cellular network topology** **Fall 2016**
  - Fitted point processes from Gibbs process family to analyze the location patterns of base stations in different urban regions of UK for four major telecomm operators.
- **Software design of digital transmitter and receiver** **Spring 2016**
  - MATLAB implementation of fundamental building blocks of a digital trans-receiver, e.g. modulation-coding schemes, pulse-shaping, OFDM and BER analysis for AWGN and fading channels.
- **Comparative study and analysis of MIMO techniques** **Fall 2015**
  - Coded SU-MIMO receivers based on pre-coding, zero-forcing (ZF), successive interference cancellation (SIC) algorithms to compare performances of multiplexing schemes.
  - Analyzed antenna diversity techniques and DOA algorithms such as MUSIC, ESPRIT.
- **OFDM Channel Estimation and Receiver Algorithms** **Fall 2015**
  - Performed OFDM channel estimation using LS and MMSE approaches and implemented receiver algorithms including ZF, MMSE and SIC.
  - Simulated OFDM in frequency selective channels to capture performance.

Other positions of responsibility

Currently reviewer of *IEEE Transactions on Wireless Communications*, *IEEE Transactions on Communications*, *IEEE Wireless Communications Letters*, *IEEE Communication Letters*.

Undergrad Research Experience

- **Multi-objective optimization for day-ahead thermal scheduling** **May 2014-Jul. 2014**
  Summer internship *National University of Singapore*
- **Application of perceptron networks in biometric systems** **Dec. 2013-Jan. 2014**
  Internship *Indian Institute of Technology, Delhi*

Graduate Courses Undertaken

Multichannel communications, Stochastic signals and systems, Information theory, Advanced digital communication, Measure and probability, Spatial statistics, Error control coding, Graph theory, Bayesian statistics.

Awards

Wireless@VT Fellowship, 2015.

Computer Skills

- **Programming Languages:** C, C++, R, MATLAB, Mathematica, Python
- **Scripting Languages:** HTML5, LaTeX

Teaching Experience

Course Instructor of Electronic Circuits Laboratory at Viginia Tech Fall 2015-Spring-2016.

Reference

Harpreet S. Dhillon	Assistant Professor Virginia Tech	hdhillon@vt.edu
Amitava Ghosh	Head, Radio Interface Group at Nokia Bell Labs	amitava.ghosh@nokia-bell-labs.com