Chalmers Workshop on 5G Wireless and Vehicular Communications

Tuesday, May 03, 2016

Gothenburg, Sweden

IEEE VTS/ComSoc/ITSoc Chapters in Sweden are co-organizing and sponsoring a one-day technical workshop on next-generation 5G wireless networks with applications to mobile and vehicular communications. The Keynote Speaker will be **Prof. Martin Haenggi** (Univ. of Notre Dame, Indiana, USA). Researchers from academia and industry will also discuss their latest work in 5G communications. The event will occur on May 03, 2016 in Gothenburg, Sweden at Chalmers University of Technology from 10am until 5pm CET. Attendance to the event is free-of-charge, including refreshments and lunch!

- Registration: http://doodle.com/poll/c3g4tpuw3ptpnec2 (please add dietary constraints in the comment section of the doodle page)
- Organizers:
  Mouhamed Abdulla, PhD, Chalmers Univ. of Technology
  Tommy Svensson, PhD, Chalmers Univ. of Technology
  Henk Wymeersch, PhD, Chalmers Univ. of Technology
- Venue: Chalmers Univ. of Tech., Johanneberg Campus, EDIT Building, 6th Floor, Room: EC
- Questions: ma14@ieee.org

Program:

- **10:00** – Welcome Message (Tommy Svensson, IEEE Sweden)
- **10:05** – Keynote Speaker (Prof. Martin Haenggi, Univ. of Notre Dame)
- **11:30** – Coffee Break
- **12:00** – Using Stochastic Geometry to Model Packet Reception Probabilities in Vehicular Networks (Erik Steinmetz, SP Technical Research)
- **12:30** – On the Performance of Amplifier-Aware Dense Networks: Finite Block-Length Analysis (Behrooz Makki, Chalmers)
- **13:00** – Lunch/Networking

- **14:00** – Urban Traffic Control for Future Intelligent Transportation Systems (Henk Wymeersch, Chalmers)
- **14:30** – Moving Networks (Tommy Svensson, Chalmers)
- **15:00** – Coverage Analysis and Blockage Effects in Cellular Networks (Chao Fang, Chalmers)
- **15:30** – Coffee Break
- **16:00** – V2V Communications Reliability over Urban Intersections (Mouhamed Abdulla, Chalmers)
- **16:30** – What Role Does Vehicle-to-Vehicle Communication Play for the Automated Vehicle? (Katrin Sjöberg, Volvo Trucks)

10:05 ***Keynote:***
An Introduction to Stochastic Geometry and Applications in Vehicular Networking

Prof. Martin Haenggi, Univ. of Notre Dame

Bio: Martin Haenggi is a Professor of Electrical Engineering and a Concurrent Professor of Applied and Computational Mathematics and Statistics at the University of Notre Dame, Indiana, USA. He received the Dipl.Ing. (M.Sc.) and Dr.sc.techn. (Ph.D.) degrees in electrical engineering from the Swiss Federal Institute of Technology in Zurich (ETH) in 1995 and 1999, respectively. He served on the Editorial Boards of the Journal of Ad Hoc Networks, the IEEE Transactions on Mobile Computing, the IEEE Journal on Selected Areas in Communications, the IEEE Trans. on Vehicular Technology, and the ACM Trans. on Sensor Networks. Currently he is the chair of the Executive Editorial Committee of the IEEE Trans. on Wireless Communications. He is the author of the monograph "Interference in Large Wireless Networks" (NOW Publishers, 2008) and the textbook "Stochastic Geometry for Wireless Networks" (Cambridge, 2012), and more than 200 articles in international journals and conferences. He is a Fellow of the IEEE, and he received the ETH Medal for both his M.Sc. and Ph.D. theses, a CAREER award from the U.S. National Science Foundation in 2005, and the 2010 IEEE Communications Society Best Tutorial Paper award.

12:00 ***Using Stochastic Geometry to Model Packet Reception Probabilities in Vehicular Net.***
Future intelligent transportation systems, where vehicular communication systems play a key role, are envisioned to alleviate many of the problems related to safety and efficiency in the current road transport system. However, before vehicular communication systems can be used in safety critical applications we need to quantify the performance in different scenarios. Measurements campaigns and simulations to evaluate the reliability of packet transmission are slow and scenario-specific. Thus it is desirable to complement these with analytical key performance metrics that can give quick insights about performance and scalability. In this talk I will give an overview of how tools from stochastic geometry can be used to analyze the impact of interference in vehicular network, and to analytically characterize the packet reception probability in an intersection scenario.

Erik Steinmetz, SP Technical Research

Bio: Erik Steinmetz is a PhD Candidate in the Communication systems research group and a Research and Development Engineer with SP Technical Research Institute of Sweden, Borås, Sweden. His research interests are sensor fusion, modeling of Global Positioning System signals, and naturalistic field tests, with focus on active safety.

12:30 ***On the Performance of Amplifier-Aware Dense Networks: Finite Block-Length Analysis***
We investigate the performance of dense Poisson-point-process-based cellular networks using finite length codewords. Taking the properties of the power amplifiers (PAs) into account, we derive the outage probability, the per-user throughput and the area spectral efficiency in different conditions. Our analysis is based on some recent results on the achievable rates of finite-length codes and we investigate the effect of the codeword length/PAs properties on the system performance. Our numerical and analytical results indicate that the inefficiency of the PAs affects the performance of dense networks substantially. Also, for a given number of information nats per codeword, there is an optimal finite codeword length maximizing the throughput.

Behrooz Makki, Chalmers Univ. of Technology

Bio: Behrooz Makki was born in Tehran, Iran. He received the B.Sc. degree in Electrical Engineering from Sharif University of Technology, Tehran, Iran, and the M.Sc. degree in Bioelectric Engineering from Amirkabir University of Technology, Tehran, Iran, respectively. Behrooz received his PhD degree in Communication Engineering from Chalmers University of Technology, Gothenburg, Sweden. Since 2013, he is working as a Postdoc at Chalmers University. Behrooz is the recipient of VR

Research Link grant, Sweden, 2014, and the Ericsson's Research grant, Sweden, 2013, 2014 and 2015. Also, he is a member of European Commission 5G project ``mm-Wave based Mobile Radio Access Network for 5G Integrated Communications.'' His current research interests include partial channel state information (CSI) feedback, hybrid automatic repeat request, Green communication, millimeter wave communication, free-space optical communication and finite block-length analysis.

14:00 ***Urban Traffic Control for Future Intelligent Transportation Systems***

Traffic congestion is an important cause of pollution and economic loss. If unchecked, these problems are expected to increase, especially in dense cities. Urban traffic control and coordination can address this challenge and improve efficiency, fuel consumption, and safety. In this talk, after a brief digression into microscopic traffic control, the problem of controlling traffic lights under fixed and adaptive routing of vehicles in urban road networks is considered. Based on multi-commodity back-pressure, originally developed for routing and scheduling in communication networks, we develop algorithms to road networks to control traffic lights and adaptively reroute vehicles in a decentralized manner.

Henk Wymeersch, Chalmers Univ. of Technology

Bio: Henk Wymeersch is an Associate Professor with the Department of Signals and Systems at Chalmers University of Technology, Sweden. He is also affiliated with the FORCE research center on fiber-optic communication, and is the PI of COOPNET, an ERC project on cooperative networks. Prior to joining Chalmers, he was a postdoctoral researcher from 2005 until 2009 with the Laboratory for Information and Decision Systems at the Massachusetts Institute of Technology. Henk Wymeersch obtained the Ph.D. degree in Electrical Engineering/Applied sciences in 2005 from Ghent University, Belgium. He served as Associate Editor for IEEE Communication Letters (2009-2013), IEEE Transactions on Wireless Communications (since 2013), and IEEE Transactions on Communications (since 2016).

14:30 ***Moving Networks***

The usage of broadband services via mobile devices is becoming increasingly important. With 5G, users will expect the connected society to be available with no limitations, and users will make use of bandwidth-demanding services like augmented reality and virtual office applications, also when on the move. In this context, future vehicles and transportation systems may play an important role in wireless networks by providing additional communications capabilities and becoming an integrated part of the communications infrastructure to improve capacity and coverage of the operator driven mobile networks. That is, in order to serve vehicular users effectively, one promising solution is to deploy moving base stations on the vehicles to form moving networks (MNs). Such moving network nodes can also be used to realize reliable communication links between vehicles and mobile devices of other traffic participants in order to enable new V2X services based on cellular communications, which has the potential to improve traffic safety and efficiency. We show that by using MNs, the quality of service for the vehicular users can be significantly improved with no obvious impact on the performance of regular outdoor users. We also present a promising enabling technology to boost the spectral efficiency of the moving base station backhaul link and to fully integrate moving base stations in cooperative heterogeneous networks - the predictor antenna concept.

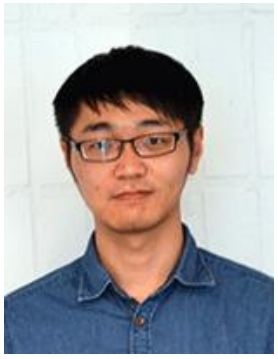
Tommy Svensson, Chalmers Univ. of Technology

Bio: Tommy Svensson (S'98--M'03--SM'10) is Associate Professor in Communication Systems at Chalmers University of Technology, where he is leading the research on air interface and wireless backhaul networking technologies for future wireless systems. He received a Ph.D. in Information theory from Chalmers in 2003, and he has worked at Ericsson AB with core networks, radio access networks, and microwave transmission products. He was involved in the European WINNER and ARTIST4G projects that made important contributions to the 3GPP LTE standards, the recently finished EU FP7 METIS project and he is active in the recently started EU H2020 5GPPP mmMAGIC project targeting mm-wave solutions for 5G. His main research interests are in design and analysis of physical layer algorithms, multiple access, resource allocation, cooperative systems, moving networks and satellite networks. He has co-authored two books and more than 120 journal and conference papers. He is Chairman of the IEEE Sweden joint Vehicular Technology, Communications, Information Theory Societies chapter, and coordinator of the Communication Engineering Master's Program at Chalmers.

15:00 ***Coverage Analysis and Blockage Effects in Cellular Networks***

Cellular networks in a dense urban environment are prone to blockages. The blockage effects can result in a significant difference in received power between line-of-sight (LOS) and non-line-of-sight (NLOS) links, especially for millimeter-wave communications. In this talk, we study the coverage probability of a network where transmitters are distributed according to a Poisson point process. We distinguish between LOS and NLOS links using a distance-dependent LOS probability function, and give the coverage performance for a partial-zero-forcing receiver (PZF). The results demonstrate the decrease of interference due to blockages and the coverage improvement using PZF.

Chao Fang, Chalmers Univ. of Technology



Bio: Chao Fang is a PhD student in the Communication Systems Group. His research interests include the design and analysis of the future wireless networks considering high carrier frequencies with massive bandwidths and extreme base station and device densities.

16:00 ***V2V Communications Reliability over Urban Intersections***

Vehicle-to-vehicle (V2V) communication can improve road safety and traffic efficiency, particularly around critical areas such as intersections. We analytically derive V2V success probability near an urban intersection, based on empirically supported line-of-sight (LOS), weak-line-of-sight (WLOS), and non-line-of-sight (NLOS) channel models. The analysis can serve as a preliminary design tool for performance assessment over different system parameters and target performance requirements.

Mouhamed Abdulla, Chalmers Univ. of Technology

Bio: Mouhamed Abdulla received, respectively in 2003, 2006, and 2012, a B.Eng. degree (with Distinction) in Electrical Engineering, an M.Eng. degree in Aerospace Engineering, and a Ph.D. degree in Electrical Engineering all at Concordia University in Montréal, Québec, Canada. Since the fall-2015, his research is funded by the European Commission as a Marie Skłodowska-Curie Fellow (MSCA-IF) which he is pursuing with the Department of Signals and Systems at Chalmers University of Technology in Gothenburg, Sweden. Until 2015, he was an NSERC Postdoctoral Research Fellow with the Department of Electrical Engineering of the University of Québec in Montréal working on Satcom; and previously he was a Systems Engineering Researcher in the Wireless Design Laboratory of the Department of Electrical and

Computer Engineering of Concordia University. Moreover, for nearly 7 years since 2003, he worked at IBM Canada Ltd. as a Senior Technical Specialist. Dr. Abdulla holds several awards, honors and recognition from international organizations, government, academia, and industry. He is professionally affiliated with IEEE, IEEE ComSoc, IEEE YP (S'02-GSM'09-M'12), ACM, AIAA, and OIQ. He was a member of the IEEE Executive Committee of the Montréal Section, where he was the Secretary in 2013, and the Treasurer of the Section in 2014 and 2015. In addition, he was the Secretary and Treasurer of IEEE ComSoc and ITSoc societies.

16:30 ***What role does vehicle-to-vehicle communication play for the automated vehicle?***

Several car manufacturers have showcased their automated vehicles that are not relying upon wirelessly received information in real-time from other vehicles in the vicinity (vehicle-to-vehicle communication). What would the gains be for the automated vehicle by adding the V2V functionality? This talk will elaborate on the challenges and opportunities with adding V2V to the automated vehicle.

Katrin Sjöberg, Volvo Trucks

Bio: Katrin Sjöberg works a connected vehicle technology specialist at Volvo Group Trucks Technology in Göteborg. She is working with wireless access to the vehicle both short-range (e.g., IEEE 802.11p, WiFi) as well as long-range wireless technologies (i.e., 3G/4G). Her research interests ranges from channel modeling to applications within connected automation (e.g., CACC and platooning). She is actively contributing to V2V standardization in Europe within ETSI TC ITS (where she is holding a vice chairmanship of WG4) and C2C-CC, and in the US within SAE DSCR Tech Cmte. She defended her PhD thesis “Medium Access Control for Vehicular Ad Hoc Networks” in April 2013.