IEEE Ottawa Section

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Talk 1: Machine Learning in Digital Medicine
Talk 2: Cellular and Device-to-Device Networks Coexistence

by

Professor Giorgio Quer

Sr. Research Scientist and Director of Artificial Intelligence, Scripps Research Institute in San Diego, California

DATE: Wednesday May 9, 2018
TIME: Refreshments, Registration and Networking: 06:00 p.m.; Seminar: 06:30 p.m. – 07:30 p.m.
PLACE: Ciena-Optophotonics Lab (Room T129), T-Building, School of Advanced Technology, Algonquin College, 1385 Woodroffe Ave., Ottawa, ON Canada K2G 1V8
PARKING: after 5:00 p.m. at the Visitors' Parking Lots 8 & 9. Please respect restricted areas.
Admission: Free Registration. To ensure a seat, please register by e-mail contacting: Wahab Almuhtadi

Abstract

Talk organization: In the following, two possible topics for a DL talk. It would be possible to do two shorter talks (30 minutes) in the same institution.

Talk 1: Machine Learning in Digital Medicine (30 minutes):

Digitalize human beings using biosensors to track our complex physiologic system, process the large amount of data generated with artificial intelligence (AI) and change clinical practice towards individualized medicine: these are the goals of digital medicine. At Scripps, we promote a strong collaboration between computer scientist, engineers, and clinical researchers, as well as a direct partnership with health industry leaders. We propose new solutions to analyze large longitudinal data using statistical learning and deep convolutional neural networks to address different cardiovascular health issues. Among them, one of the greatest contributors to premature morbidity and mortality worldwide is hypertension. It is known that lowering blood pressure (BP) by just a few mmHg can bring substantial clinical benefits, but the assessment of the "true" BP for an individual is non-trivial, as the individual BP can fluctuate significantly. We analyze a large dataset of more than 16 million BP measurements taken at home with commercial BP monitoring devices, in order to unveil the BP patterns and provide insights on the clinical relevance of these changes.
Another prevalent health issue we investigated is atrial fibrillation (AFib), one of the most common sustained cardiac arrhythmia, which is associated with stroke, hospitalization, heart failure and coronary artery disease. AFib detection from single-lead electrocardiography (ECG) recordings is still an open problem, as AFib events may be episodic and the signal noisy. We conduct a thoughtful analysis of recent deep network architectures developed in the computer vision field, redesigned to be suitable for a one-dimensional signal, and we evaluate their performance for the AFib detection problem using 200 thousand seconds of ECG recording, highlighting the potential of this technology.

Looking to the future, we are investigating new applications of existing wearable devices, requiring advanced processing and clinical validation, and we are participating to the All of Us research program, an unprecedented research effort to gather data from one million people in the USA to accelerate the advent of precision medicine.

Talk 2: Cellular and Device-to-Device Networks Coexistence (30 minutes):

The coexistence of device-to-device (D2D) and cellular communications in the same band is a promising solution to the dramatic increase of wireless networks traffic load. Mobile nodes may communicate in a semi-autonomous way (D2D mode), with minimal or no control by the base station (BS), but they will create a harmful interference to the cellular communications.

To control this interference, we propose a distributed approach that allows the mobile nodes to acquire local information in real time, infer the impact on other surrounding communications towards the BS, and optimize mode and power selection performed with a network wide perspective. In a single-cell scenario, we develop a rigorous theoretical analysis to quantify the balance between the gain offered by a D2D transmission and its impact on the cellular network communications, while in a multi-cell scenario, we exploit a probabilistic approach with Bayesian networks.
As a practical application, we envision a network with one macro BS, multiple small cell BSs, and several mobile D2D users, where proactive caching can be used to take full advantage of this heterogeneity. In this scenario, we propose a robust optimization framework to derive a proactive caching policy that exploits all these communication opportunities and reduces congestion on the backhaul link.

The adoption of D2D technologies may save precious resources like spectrum and energy for future 5G networks by exploiting physical proximity between terminals, helping to counteract the increasing traffic demand in cellular networks.

Speaker’s Bio

Giorgio Quer is a Sr. Research Scientist at the Scripps Research Institute in San Diego, California, and he is the Director of Artificial Intelligence at the Scripps Translational Science Institute.
He received the B.Sc. degree, the M.Sc. degree (with honors) in Telecommunications Engineering and the Ph.D. degree (2011) in Information Engineering from University of Padova, Italy. In 2007 he was a visiting researcher at the Centre for Wireless Communication at the University of Oulu, Finland. During his Ph.D., he proposed a solution for the distributed compression of wireless sensor networks signals, based on the joint exploitation of Compressive Sensing and Principal Component Analysis. From 2010 to 2017 he was a visiting scholar at the California Institute for Telecommunications and Information Technology and then a postdoc at the Qualcomm Institute, University of California San Diego (UCSD), working on cognitive networks protocols and implementation.
He is a Senior Member of the IEEE, a member of the American Heart Association (AHA), and a Distinguished Lecturer for the IEEE Communications society. His research interests include wireless sensor networks, network optimization, compressive sensing, probabilistic models, deep convolutional networks, wearable sensors, physiological signal processing, and digital medicine.