SPEAKER
OF SHORT COURSE

Professor LAU Pak-tao Alan
B.A.Sc., M.A.Sc., Ph.D., Optica Fellow
The Hong Kong Polytechnic University, Hong Kong SAR, China

Alan Pak Tao Lau received the B.A.Sc. degree in engineering science (electrical option) and the M.A.Sc. degree in electrical and computer engineering from the University of Toronto, Toronto, ON, Canada, in 2003 and 2004, respectively, and the Ph.D. degree in Electrical Engineering from Stanford University, Stanford, CA, USA, in 2008. He then joined The Hong Kong Polytechnic University as an Assistant Professor and he is currently Professor and Associate Head (Promotions and Global Relations) of the Department of Electrical and Electronic Engineering(EEE), The Hong Kong Polytechnic University. He was also a Visiting Professor of Stanford University in 2019.

Professor Lau's research includes analytical modelling, digital signal processing techniques and Machine Learning applications to long-haul and short-reach optical communications, optical performance monitoring, physical-aware optical networking and optical fiber sensing with numerous World-record experimental demonstrations in transmission speed. He collaborates extensively with industry such as Huawei, Alibaba, Corning, NEC Labs etc and contributed to the development of algorithms that have been integrated into commercial networks. He also helped open sourced the first comprehensive large-scale physical-layer dataset for deployed optical network for Machine Learning and related research for the optical networking community.

Professor Lau is a fellow of OPTICA for "developing digital signal processing techniques for optical communication systems" and is very active in serving the community. Most notably, he is the Program Chair of Optical Fiber Communications (OFC) 2027, served as the Associate Editor for Journal of Lightwave Technology(JLT) and currently serves as member of the Publication Council of IEEE Photonics Society. He co-edited 2 books and contribute to a few book chapters in optical communications and related areas.

SHORT COURSE

Machine Learning Fundamentals and Their Applications in Optical Communications and Networks

Machine Learning (ML) has disrupted a wide range of science and engineering disciplines in recent years. ML applications in optical communications and networking are also gaining more attention, particularly in the areas of nonlinear transmission systems, optical performance monitoring (OPM) and network monitoring and adaptation for flexible and dynamic optical networks with reduced margin and improved throughput. However, the extent to which ML techniques can benefit optical communications and networking is not clear at this point as there is an insufficient understanding of the nature of ML concepts. This short course aims to describe the mathematical foundations of basic ML techniques from communication theory and signal processing perspectives. This will be followed by an overview of ongoing ML research in optical communications, networking as well as emerging area of optical fiber sensing including the latest developments in digital twins and generative AI applications.

CONTENT

- ◎ Overview of Machine Learning(ML) developments in recent years
- ◎ Basic machine learning techniques - artificial neural networks (ANN),support vector machine(SVM), K-means clustering, EM algorithm, principal component analysis(PCA)
- ◎ Deep learning techniques - convolutional neural networks(CNN),recurrent neural networks (RNN), Transformers
- ◎ ML for nonlinear optical transmission systems
- ◎ ML for optical performance monitoring
- ◎ ML for quality of transmission estimation and dynamic optical networks
- ◎ ML for soft-fault prediction
- ◎ Data set for ML/AI in optical communications and networks
- ◎ ML for optical fiber sensing
- ◎ Upcoming trends and challenges including digital twin and generative AI applications

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