



# 学术报告

## ACADEMIC LECTURE

**Topic:** Impact of CSI Knowledge on the Codebook-Based Hybrid Beamforming in Massive MIMO

**Time:** 2016年4月25日 (周一) 上午10:00-11:30

**Venue:** 信电大楼, 215学术会议室

**Speaker:** An Liu, Research Assistant Professor,  
Department of ECE,  
Hong Kong University of Science and Technology



## Biography

An Liu received the Ph.D. and the B.S. degree (Distinguished Graduate in Beijing City) in Electrical Engineering from Peking University, China, in 2011 and 2004 respectively. From 2008 to 2010, he was a visiting scholar at the Department of ECEE, University of Colorado at Boulder, USA. From 2011 to 2013, he was a Postdoctoral Research Fellow with the Department of ECE, Hong Kong University of Science and Technology, and he is currently a Research Assistant Professor. His research interests include Wireless Communications (focusing on 5G wireless networks), Stochastic Optimization, Advanced RRM and Interference Mitigation, and Compressive Sensing. His industry experience includes one year's internship at Intel China Research Center Beijing, and 2 years' R&D experience as a Chief Technician and one of the Founders in D-rate Corporation, Beijing. He has contributed to 8 US/CN patents on wireless systems and signal processing. Academically, he has published 16 papers on IEEE Transactions on Signal Processing, 2 papers on IEEE Transactions on Wireless Communications, and many IEEE conference papers. He has served as Member of Technical Program Committees for several major IEEE conferences in wireless communications, such as IEEE Globecom and IEEE ICC.

## Abstract

Hybrid beamforming, which consists of an analog RF precoder and a digital baseband precoder, has been proposed to achieve first order gain in massive MIMO systems with a reduced number of RF chains and lower power consumption at the base station (BS). This talk will discuss the impact of channel state information (CSI) on the sum capacity of massive MIMO systems with codebook-based hybrid beamforming where the RF precoder is selected from a finite size codebook. Two types of CSI at the BS (CSIT) are commonly assumed: full instantaneous CSIT (full channel matrix between the BS and users) and hybrid CSIT (channel statistics plus the low dimensional effective channel matrix after RF precoding). With full instantaneous CSIT, both the RF and baseband precoders are adaptive to the full instantaneous CSI at the fast timescale. With hybrid CSIT, the RF precoder is adaptive to slow-timescale channel statistics only, and the baseband precoder is adaptive to the instantaneous effective channel, yielding lower implementation complexity by sacrificing some capacity. We derive asymptotic sum capacity expressions under these two types of CSIT. We find that, in codebook-based hybrid beamforming systems, exploiting the full instantaneous CSIT can only achieve a marginal SNR gain and hybrid CSIT is sufficient to achieve the first order gain provided by massive MIMO for most cases. We also propose practical fast and slow timescale RF precoding algorithms, which asymptotically achieve the capacity under full instantaneous CSIT and hybrid CSIT respectively.