THE CHINESE UNIVERSITY OF HONG KONG
Department of Electronic Engineering
Seminar

Unlimited Sensing Framework: Digitization Beyond the Shannon-Nyquist Philosophy

Dr. Ruiming Guo
Research Fellow
Department of Electrical and Electronic Engineering
Imperial College London, UK

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Abstract

Digital data acquisition serves as the cornerstone of almost all modern technologies and applications. Underpinning this digital acquisition pipeline is the well-known Shannon-Nyquist framework. Its practical implementation via the analog-to-digital converters, however, suffers from two fundamental bottlenecks, namely, (a) dynamic range limitation, and, (b) digital resolution due to lossy quantization. To overcome these bottlenecks, the Unlimited Sensing Framework (USF) has been recently proposed as an alternative solution to the conventional sampling paradigm. Radically different from the Shannon-Nyquist framework, the USF yields computationally encoded measurements via modulo operation in the analog domain. This fundamentally eliminates the dynamic range constraint. For a given bit budget, this strategy also allows for higher digital resolution. The advent of modulo ADCs and emerging applications of the USF necessitates the development of novel recovery algorithms so as to recover signals from folded samples. From the algorithmic standpoint, the key questions that guide recovery methods include, (1) for bandlimited inputs, how to design efficient and robust algorithms that can handle various types of hardware data? (2) Beyond bandlimited inputs, e.g. for sparse inputs, how to design sampling pipelines? Starting with an introduction to the USF, the main goal of this talk is to share recent advances linked with the above algorithmic questions. More concretely, we show how Iter-SIS or iterative signal sieving algorithm offers robust recovery with hardware-based experiments. For sparse signals, we show that inter-channel redundancy allows for the recovery of inputs without any sampling rate criterion. The theoretical claims and associated recovery algorithms are comprehensively validated on various hardware data. We end this talk with a few examples and applications of the topic.

Biography

Ruiming Guo received a B.E. degree in Electronic Engineering from Sichuan University, Chengdu, China, in 2017. He received his Ph.D. degree in Electronic Engineering at the Chinese University of Hong Kong (CUHK), HKSAR, China, in 2021. He worked as a postdoctoral research fellow with Prof. Thierry Blu at EE Department at CUHK, from 2021 to 2022. He is currently a postdoctoral research associate at the EEE Department of Imperial College London (ICL), working with Prof. Ayush Bhandari on computational imaging and modulo sampling. He received the Postgraduate Student Research Excellence Awards from the Department of the Electronic Engineering of the Chinese University of Hong Kong in 2022. His research interests include sparse signal processing, sampling theory, inverse problems, modulo sampling, and computational sensing and imaging.

***** ALL ARE WELCOME *****

For enquiries: Prof BLU Thierry Albert Jean-Louis (tblu@ee.cuhk.edu.hk), Tel: 3943 8288