THE UNIVERSITY OF CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

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Wide-band Butterfly Network: Sub-wavelength Imaging via Multi-frequency Neural Networks

THURSDAY, February 27, 2020, at 4:00 PM
Jones 226, 5747 South Ellis Avenue

ABSTRACT

For wave-based inverse problems the resolution is usually limited by the so-called diffraction limit, i.e., the smallest features to be reconstructed cannot be smaller than the smallest wavelength of available data.

In this talk we aim to surpass the diffraction limit using deep learning coupled with computational harmonic analysis tools. In particular, I will introduce a new a neural network architecture for inverting wide-band data to recover acoustic scatterers at resolutions finer than the classical limit.

The architecture incorporates insights from the butterfly factorization and the Cooley-Tukey algorithm to explicitly account for the physics of wave propagation. The dimensions of the network seamlessly adapt to the desired image resolution, resulting in a number of trainable weights that scale quasi linearly with the image resolution and the data bandwidth. In addition, the data is optimally assimilated across frequencies thus enhancing the stability of the training stage.

I will provide the rationale for such construction and showcase its properties for several classes of scatterers with sub-Nyquist features embedded in a known background media.

Joint work with Matthew Li and Laurent Demanet

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