Approximate-DFT: Theory and Applications in Digital Multi-Beam Antenna Arrays

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Fast Fourier Transforms (FFTs) are $N \times N$ linear transform factorizations that split a set of N-samples to their frequency components. What if one could design an *even faster-FFT* to approximate discrete Fourier transforms? The complexity lower bounds of FFTs have been found by M. T. Heideman. These bounds do not apply to approximate-FFTs. This talk explores fast, small, and power-efficient digital implementations of FFT-like transforms for demanding applications requiring massive real-time throughput. The proposed algorithms achieve faster-than-FFT performance trading accuracy for low-complexity via approximation and matrix factorization, allowing FFT-like performance at several billion N-point transforms per second, for extremely throughput intensive applications in radio-frequency multi-beam forming spanning military radar, wireless communications and radio telescope systems.