Unlimited Sensing: From Theory to Practice

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Abstract. In SampTA 2017, the Unlimited Sensing Framework (USF) was introduced as part of a new sampling theory, demonstrating that bandlimited signals can be recovered from their fractional-part or modulo-folded samples. The mathematical insight underlying the USF is that, for smooth functions, their fractional-parts encode their integer-parts. This insight shows that, instead of directly quantizing a signal, sampling the "quantization noise" alleviates bottlenecks in conventional digital sensing.

This novel insight led to the creation of the modulo ADC, confirming that the USF can practically achieve both high dynamic range and high digital resolution—limitations that fundamentally constrain conventional sampling methods.

Bridging theory, algorithms, hardware, and experiments, this talk aims to provide the sampling theory community and Special Session attendees with an interdisciplinary overview of the USF. Topics covered include the interplay of the USF with: (i) different signal classes (bandlimited, sparse, splines, exponentials), (ii) various sensing architectures (one-bit, time-encoding, sub-Nyquist), (iii) recovery approaches (time, frequency, and time-frequency domains), (iv) diverse application areas (radars, tomography), and (v) hardware capabilities (a brief overview).

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