universität innsbruck

Department of Mathematics

Mathematics Colloquium

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Unlimited Sampling: from Theory to Practice

Shannon's sampling theorem is one of the cornerstone topics that is well understood and explored, both mathematically and algorithmically. That said, practical realization of this theorem still suffers from a severe bottleneck due to the fundamental assumption that the samples can span an arbitrary range of amplitudes. In practice, the theorem is realized using so-called analog-to-digital converters (ADCs) which clip or saturate whenever the signal amplitude exceeds the maximum recordable ADC voltage thus leading to a significant information loss. In contrast, the Unlimited Sampling Framework, an alternative paradigm for sensing and recovery recently developed by the speaker jointly with Bhandari and Raskar, is based on the observation that when a signal is mapped to an appropriate bounded interval via a modulo operation before entering the ADC, the saturation problem no longer exists, but one rather encounters a different type of information loss due to the modulo operation. Such an alternative setup can be implemented, for example, via so-called folding or self-reset ADCs, as they have been proposed in various contexts in the circuit design literature. The key task that one needs to accomplish in order to cope with this new type of information loss is to recover a bandlimited signal from its modulo samples. In this talk we will review different approaches to this problem with a particular focus on a Fourier domain approach that is robust to non-idealities in the circuit implementation, as we observe them in experiments with a hardware prototype that we constructed for this purpose.

This is joint work with Ayush Bhandari and Thomas Poskitt, Imperial College London.

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