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SEMINAR

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304 Whitehead Hall
Refreshments: 3:30 p.m.
Seminar: 4:00 p.m.

DIOPHANTINE FREQUENCY SYNTHESIS:
The Invasion of Number Theory to Frequency Synthesis Systems

Abstract

Time-periodic electrical signals of accurately defined frequency are of fundamental importance in many electronic systems including positioning and navigation (GPS), time-keeping (atomic clocks), wireless communication, scientific instrumentation, medical instruments, and so on.

Frequency synthesis is the process of generating a time-periodic signal of a desired frequency using, as a reference, a primary periodic signal of a *fixed* and pre-defined frequency, e.g., the output of an atomic clock, a crystal oscillator, or other frequency-stable source. Typically, frequency synthesizers must be able to generate every one frequency out of a pre-decided set of uniformly-spaced frequencies (by simply programming their parameters). The "step" and the "range" of a synthesizer are defined in the obvious way.

Technical, cost, and complexity limitations imply certain trade-offs between the quality of the synthesized signal, the frequency step, the frequency range, the time required to switch from one frequency to another (frequency hopping), and so on.

This talk introduces the "Diophantine Frequency Synthesis" (DFS), a new fine-step frequency synthesis that is based on mathematical properties of integer numbers to overcome the inherent and constraining relation between frequency step and phase-comparator frequency in Phase-Locked-Loop (PLL) based frequency synthesis architectures. This leads to fine frequency-step, fast hopping, modular structured synthesizers with potentially very low spurs (clean output signal), especially in the vicinity of the output frequency.

The talk focuses on the mathematical principles of the new approach and the related supporting algorithms.