

High-Precision, Low-Power ADC and PLL Design for Intelligent Sensing and Biomedical Systems

Project proposed by: Intelligent Sensory Microsystems Laboratory, ECE, U of T

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Project description:

Our research explores the next generation of **high-precision, low-power analog-to-digital converters (ADCs)** and **phase-locked loops (PLLs)** for intelligent sensing and communication systems. The goal is to push the limits of energy efficiency and signal fidelity through innovations in sampling, quantization, and clock generation. By integrating adaptive architectures and low-jitter timing control, the project seeks to achieve superior performance under tight power and area constraints—key to future biomedical, IoT, and edge-AI applications.

Your Mission:

As a key member of our team, you will collaborate with graduate researchers to characterize, test, and optimize the latest generation of our ADC and PLL subsystems. Your contributions may include:

- Designing and simulating some blocks for **low-power PLLs** for adaptive sampling clock generation and phase noise reduction.
- Implementing a **digital FIR filter**.
- Exploring **optimal companding and quantization strategies** based on brain signal energy distributions.

Why It Matters:

In biomedical applications—such as neural recording, brain-machine interfaces, and electrophysiological monitoring—ultra-low-power ADCs and stable PLLs are vital for achieving accurate, real-time signal capture without excessive heat dissipation or power consumption. The circuits developed in this project directly contribute to next-generation implantable and wearable healthcare devices capable of continuous, artifact-resilient monitoring.

Who We're Looking For:

- **Innovative Thinkers:** Self-motivated students passionate about circuit-level innovation and system-level impact.
- **Strong Foundations:** Familiarity with Fourier, Laplace, and Z-transforms, sampling theory, and mixed-signal circuit design principles.
- **Eager Learners:** A curiosity for exploring the intersection of analog/mixed-signal IC design and signal processing.

Join Us:

Become part of the **Intelligent Sensory Microsystems Lab**, where your skills in integrated circuit design, signal processing, and system architecture will help shape the future of biomedical sensing technologies. Work alongside experienced researchers and gain hands-on experience with leading-edge mixed-signal ICs that bridge silicon and neuroscience.

How to Apply:

Send your **resume, transcript and a brief cover letter** explaining why you are the perfect fit for this role to **Mr. Jianxiong Xu** (jianxiong.xu@mail.utoronto.ca), **Junyu Ma** (joshua.ma@mail.utoronto.ca), and copy to **Prof. Roman Genov** (roman@eecg.utoronto.ca). Let's innovate together for a better tomorrow.