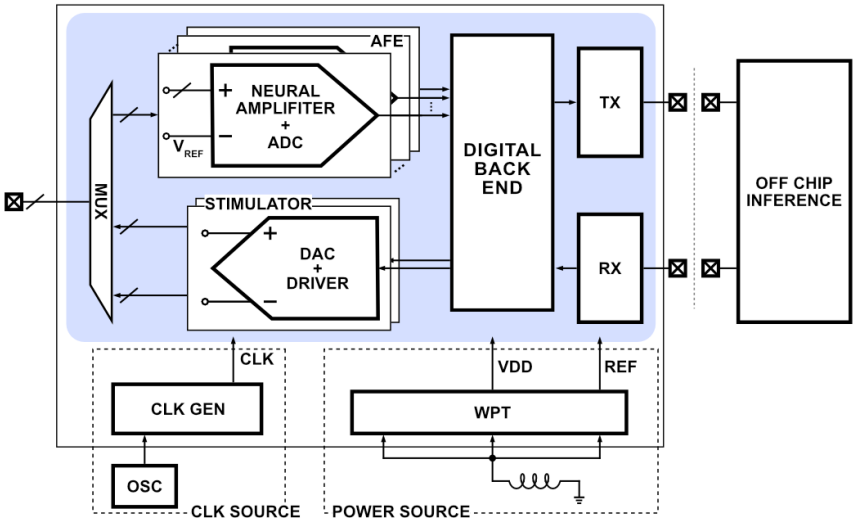
Project Title	**Chronically Implantable Biomedical Interface IC**
Supervisor	Prof. Roman Genov Department of Electrical and Computer Engineering (ECE)
Laboratory	Integrated Sensory Microsystems Laboratory (ISML), ECE, UofT
Project Description	 Figure: Envisioned chronically implantable interface IC. Professor Genov's team is building an artificially intelligent closed-loop peripheral neural-interfacing IC, which enables one to "listen in" and "modify" messages sent between the brain and various organs. Application examples include blocking chronic pain signals, restoring motor function in paralyzed patients and treating intractable disorders such as intractable epilepsy and autoimmune disease. The project features a fully implantable IC that supports simultaneous recording and stimulation, with on-chip machine learning algorithms, wireless powering and data transfer. As shown in the figure, we are designing a multi-channel analog front-end (AFE) with low-noise preamplifiers and high-resolution analog-to-digital converters (ADCs). For a closed-loop operation, this system also incorporates a neural stimulator. The IC is powered and configured through a wireless power delivery and data transfer system, enabling its the fully implantable functionality. Students will participate in analog/digital IC design, layout design, PCB design, and chip testing. This is a great opportunity to contribute to a chip design project where parts of your work may end up in fabrication.
Pre-requisite	Background/ affiliations in ECE/Eng.Sci./CS with experience/ interests in any points: • Analog/digital IC design, layout design • Machine learning and data processing • PCB-level circuit design and hardware testing • (Very important) Enthusiastic, independent learner, and strong soft skills.
Number of positions	3 (three) students
Contact	Junyu Ma (joshua.ma@mail.utoronto.ca) Hao You (hao.you@mail.utoronto.ca) [and copy to Prof. Roman Genov (roman@eecg.utoronto.ca)]

References	[1] Xu, Jianxiong, et al. "Fascicle-selective bidirectional peripheral nerve interface IC with 173dB FOM noise-shaping SAR ADCs and 1.38 pJ/b frequency-multiplying current-ripple radio transmitter." 2023 IEEE International Solid-State Circuits Conference (ISSCC). IEEE, 2023. [2] T.D. Albarran, "Optimization of Temporal Interference Stimulation for Invasive Neuromodulation of Motor Neurons Using an In-Silico Sciatic Nerve Model," *M.S. thesis*, ECE, UCLA, USA, 2023. [3] R.B. Budde, M.T. Williams, and P.P. Irazoqui, "Temporal interference current stimulation in peripheral nerves is not driven by envelope extraction," *IOP J. Neural Engg.*, vol. 20, no. 2, Apr. 2023.