Ottawa-Carleton Institute for Electrical and Computer Engineering

ELEC5404 / ELG6344

Neural Networks for High-Speed/High-Frequency Circuit Design

Professor Q.J. Zhang
Department of Electronics
Carleton University

Neural Networks, also called Artificial Neural Networks (ANN) are information processing systems inspired by the ability of human brain to learn from observations and to generalize by abstraction. The fact that neural networks can be trained for totally different applications, has resulted in their use in diverse fields such as pattern recognition, speech processing, control, medical applications and more. The application of ANN to computer-aided design of high-speed/high-frequency circuits and systems has opened the door for new advances in design automation of high-frequency electronic circuits. ANN can learn and generalize from data allowing model development even when component formulas are unavailable. ANN models are easier to update as technology changes. ANNs are universal approximators allowing re-use of the same modeling technology for both linear and nonlinear problems and at both device or circuit levels. Yet, ANN models are simple and model evaluation is very fast. Recent works have led to the use of ANNs for modeling 2D and 3D electromagnetic structures, in signal integrity analysis and modeling of high-speed VLSI interconnects, in modeling semiconductor devices, in modeling components and circuits in wireless systems such as microstrip lines/CPW discontinuities, printed antennas, amplifiers/mixers, and for simulation and optimization of linear and nonlinear circuits and systems.

This course introduces the fundamentals of using ANN for high-speed/high-frequency circuit design. The course will also bring the audience to the forefront of this emerging field with state-of-the-art research results. The course will cover:

Introduction
Neural network Structures
Neural network training
Neural models for passive components
Neural models for nonlinear components
Neural network based circuit simulation and optimization
Knowledge Based Neural Networks and other advanced structures
Advanced training algorithms

Course Material:

Text Book: Q.J. Zhang and K.C. Gupta, Neural Networks for RF and Microwave Design, Boston, MA: Artech House, 2000.

References: S. Haykin, Neural Networks and Learning Machines, Upper Saddle River, New Jersey, 2009.

Additional reference materials including overview papers in PDF to be provided.

Course Marks:

Final Exam	50%
2 Assignments	30%
Mini-Project	20%
Total	100%

Important Notice:

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols.

Masks: Carleton has paused the COVID-19 Mask Policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the University's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.