Short Course Proposal

Course title: Application of Deep Learning Techniques in Computational Electromagnetics

Abstract:

In recent years, research in deep learning techniques has attracted wide attention. With the help of big data technology, massive parallel computing, and fast optimization algorithms, deep learning has greatly improved the performance of many problems in the speech and image research. In this short tutorial, the presenter hopes to share some of his learnings in deep learning techniques, and discuss the feasibility of applying deep learning in the field of computational electromagnetics.

The study of computational electromagnetics has always focused on the high-precision interpretation of physical laws by numerical methods. Therefore, the laws of physics have always dominated the research. With the development of deep learning technology, the increasing learning ability makes it possible for the machine to "learn" and "master" the laws of physics from a large amount of physical data, so that the physical laws can be better interpreted under some controllable boundary conditions. In the long run, the hybridization of fundamental physical laws and "knowledge" from big data may provide us with a new way of thinking about some engineering problems used to be limited by information processing and computing power. The presenter hopes to explore the characteristics, feasibility, and challenges of deep learning methods in the field of computational electromagnetics through some preliminary research on solving Poisson's equation, array antenna synthesis, electromagnetic imaging, etc.

Course Objective:

The objective of this short course is to discuss some fundamentals in deep learning techniques and their preliminary applications in computational electromagnetics. Hope this short tutorial could bring more interest to deep learning techniques in our community.

Outline:

1. Introduction to deep learning techniques
2. A fast solver for Poisson’s Equations based on deep learning techniques
3. Application in array antenna synthesis
4. Applications in electromagnetic inverse problems

Estimated length: 1.5 – 2 hours

Short-bio:

Maokun Li received the B.S. degree in electronic engineering from Tsinghua University, Beijing, China, in 2002, and the M.S. and Ph.D. degrees in electrical engineering from University of Illinois at Urbana-Champaign in 2004 and 2007, respectively. After graduation, he worked as a senior research scientist at Schlumberger-Doll Research, Cambridge, MA, USA. Since 2014, he joined the department of electronic engineering, Tsinghua University, Beijing, China. His research interests include fast algorithms in computational electromagnetics and their applications in antenna modeling, electromagnetic compatibility analysis, inverse problems, etc. He has published 1 book chapter, 50 journal papers, 120 conference proceedings, and 3 patent applications. He also serves as the associate editor for IEEE Journal on Multiscale and Multiphysics Computational Techniques, Applied Computational Electromagnetic Society Journal, and the guest editor for the special issue on "Electromagnetic Inverse Problems for Sensing and Imaging" in IEEE Antennas and Propagation Magazine. He was also among the recipients of China National 1000 Plan in 2014, and 2017 IEEE Ulrich L. Rohde Innovative Conference Paper Award.