IEEE Ottawa Section

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Time Domain Adjoint Sensitivities and their Applications: State of the Art

by

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DATE: Friday, September 16, 2011.
TIME: Refreshments, Registration and Networking: 10:30 a.m. – 11:00 a.m.; Seminar: 11:00 a.m. – 12:00 p.m.
PLACE: University of Ottawa, School of Electrical Engineering and Computer Science, SITE Building, Room 5084 (Boarding Room), 800 King Edward Avenue, Ottawa, Ontario, Canada.
Admission: Free. Registration required. To ensure a seat, please register by e-mail contacting: Qingsheng Zeng (qingsheng.zeng@crc.gc.ca) or Wahab Almuhtadi (almuhtadi@ieee.org).

Abstract

The design process of high frequency structures is usually carried out using Electromagnetic (EM) simulators. A model of the structure under consideration is constructed and a number of key variables controlling its response are chosen. An optimization algorithm (optimizer) drives the simulator to determine the optimal set of values of the designable parameters that satisfies the design specifications. Gradient-based optimizers are robust with well-established convergence proofs. They, however, require sensitivity information which may require large number of extra simulations for each design step.

The adjoint variable methods (AVM), aim at efficiently estimating the response sensitivities. Using at most one extra EM simulation of an adjoint system, the response sensitivities with respect to all parameters are estimated regardless of the number of parameters. For the case of network parameters, this extra simulation can be eliminated. The same simulations supplying the network parameters supply their sensitivities as well. This makes gradient-based optimization more efficient.

In this talk we review the state of the art of the time-domain AVMs and their applications. We discuss recent techniques that make this approach more efficient in terms of speed and memory storage. We show a number of interesting applications in microwave imaging, antenna design, and design of photonic devices. Open points for research are also addressed.

Speaker's Bio

Mohamed H. Bakr received a B.Sc. and M.Sc. degrees in Electronics and Communications Engineering and Engineering Mathematics from Cairo University, Egypt, in 1992 and 1996, respectively with distinction (honors). He earned the Ph.D. degree in September 2000 from the Department of Electrical and Computer Engineering, McMaster University. In November 2000, he joined the Computational Electromagnetics Research Laboratory (CERL), University of Victoria, Victoria, Canada, as an NSERC Post-Doctoral Fellow. Between July 2008 and June 2009, he was with Research in Motion (RIM) as a senior researcher during his Sabbatical leave. His research areas of interest include computer-aided design and modeling of microwave and photonic circuits, neural network applications, efficient optimization using time/frequency domain methods, and bio-electromagnetism. He is a recipient of a Premier's Research Excellence Award (PREA) from the province of Ontario in 2003, and a Discovery Accelerator Award (DAS) in 2011. He is currently an associate professor with the Department of Electrical and Computer Engineering, McMaster University.