General Lecture 1 (11:00–12:00, Tuesday, May 28, 2019)

A VIEWPOINT ON RECENT PROGRESS IN COMPUTATIONAL ELECTROMAGNETICS

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Chair: Shinichiro Ohnuki, *Nihon University, Tokyo, Japan*

Abstract

In this lecture, we will discuss our recent progress in computational electromagnetics (CEM). This includes new methods to solve multi-scale problems, as well as methods to include multi-physics effects including quantum effects. We will also present new methods to accelerate the solutions to Maxwell's equations.

We will discuss the equivalence principle algorithm (EPA) that allows one to tackle multi-scale problems quite effectively. Next, we will discuss the vector and scalar potential formulation of electromagnetics. This formulation precludes the low-frequency catastrophe that is commonly encountered in classical electromagnetics. We will also show the time-domain formulation of the vector-scalar potential formulation, which gives rise to broadband low frequency stability.

We will also discuss some of our recent progress in the fast multipole algorithm that can work from DC to optics. This is an acceleration method that will be instrumental in rapid solution to future multi-scale problems. This will be illustrated with the augmented electric field integral equation approach so solve a multi-scale problem.

The numerical Green's function concept has enabled the modular programming paradigm of computational electromagnetics, as well as object oriented programming paradigm. It is a good marriage between computer science concept and CEM concept. This will be discussed in this lecture.

Our recent progress in the use of massively parallel computer to solve wave physics and inverse scattering problems will also be illustrated.

We will also present some of our recent foray into quantum electromagnetics, which is a challenging area in computational electromagnetics. Our work in the use of discrete exterior calculus in solving electromagnetic problems will also be reported.

Profile

W. C. Chew received all his degrees from MIT. His research interests are in wave physics, specializing in fast algorithms for multiple scattering imaging and computational electromagnetics in the last 30 years. His recent research interest is in combining quantum theory with electromagnetics, and differential geometry with computational electromagnetics. After MIT, he joined Schlumberger-Doll Research in 1981. In 1985, he joined U Illinois Urbana-Champaign, was then the director of the Electromagnetics Lab from 1995-2007. During 2000-2005, he was the Founder Professor, 2005-2009 the Y T Lo Chair Professor, and 2013-2017 the Fisher Distinguished Professor. During 2007-2011, he was the Dean of Engineering at The University of Hong Kong. He joined Purdue U in August 2017 as a Distinguished Professor. He has co-authored three books, many lecture notes, over 400 journal papers, and over 600 conference papers. He is a fellow of various societies, and an ISI highly cited author. In 2000, he received the IEEE Graduate Teaching Award, in 2008, he received the IEEE AP-S CT Tai Distinguished Educator Award, in 2013, elected to the National Academy of Engineering, and in 2015 received the ACES Computational Electromagnetics Award. He received the 2017 IEEE Electromagnetics Award. In 2018, he served as the IEEE AP-S President.