Seminar Announcement

Leveraging Advances in Computational Electrodynamics to Enable New Kinds of Nanophotonic Devices

Speaker: **Ardavan Oskooi**, Founder & CEO of Simpetus
Homer Reid, Lecturer, Department of Mathematics, MIT

Venue: Room 121B1, 12F, Eng. 2nd Bldg. 工学部2号館12Fセミナー室121B1

Date: January 10th, Tuesday, 2017

Time: 11:00 a.m. – 12:00 p.m.

Abstract:
Advances in computational electrodynamics have the potential to enable fundamentally new kinds of nanophotonic devices principally based on complex, non-analytical wave-interference effects. Powerful, flexible, open-source software tools have now been made available for use in large-scale, parallel computations to model the interaction of light with practically any kind of material in any arbitrary geometry. These recent developments in computational capability make possible the investigation of various emergent structures, materials, and physical phenomena that were previously beyond the reach of theoretical analysis -- including not only pencil-and-paper calculation but even commercial software tools, which tend to be less versatile and even less readily available to academic researchers. Modern open-source tools for computational electromagnetism may be broadly divided into two categories -- differential-equation solvers and integral-equation solvers -- and this seminar will cover both. We will first demonstrate how advances in finite-difference time-domain (FDTD) methods for computational electromagnetics, as implemented by the open-source package MEEP, can lead to entirely new designs for light trapping in nanostructured thin-film silicon solar cells and light extraction from nanostructured organic light-emitting diodes (OLEDs). Then we will discuss two applications of surface-integral-equation algorithms as implemented by the open-source package SCUFF-EM: **(1)** designing antennas defined by periodic and aperiodic nanopatterning with polarization-sensitive frequency response, and **(2)** optimizing the shapes and material content of asymmetric nanoparticles to maximize radiative heat transfer, Casimir forces, and other phenomena induced by thermal and quantum-mechanical fluctuations. Finally, we will describe efforts by Simpetus -- our startup venture -- to leverage scalable, high-performance computing (HPC) in the public cloud for large-scale device design.

Ardavan Oskooi

He is the founder and CEO of Simpetus, a startup aiming at propelling computational simulations to the forefront of research and development in electromagnetics. Ardavan received his Sc.D. from MIT, where he worked with Prof. Steven G. Johnson and John D. Joannopoulos to develop MEEP. He has published 13 first-author articles in peer-reviewed journals and the book "Advances in FDTD Computational Electrodynamics: Photonics and Nanotechnology".

Homer Reid

He is a lecturer in Applied Mathematics at MIT, and focuses on computational quantum field theory and chemistry in addition to computational electromagnetism. Homer completed his Ph.D. in physics at MIT, where he created the fluctuating-surface-current approach to fluctuational electrodynamics, and developed the open-source SCUFF-EM package for surface-integral modeling of deterministic and fluctuational electromagnetism problems. Homer lived in Japan for 6 years and is fluent in Japanese.

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