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

Abstract: Advances in computational electrodynamics have the potential to enable fundamentally new kinds of nanophotonic devices which are based principally 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 pencil and paper analytical methods as well as less versatile and even less accessible commercial software tools. I will demonstrate how such advances in finite-difference time-domain (FDTD) methods for computational electromagnetism via an open-source software package known as MEEP can lead to entirely new designs for light trapping in nanostructured thin-film silicon solar cells as well as light extraction from nanostructured organic light-emitting diodes (OLEDs). I will then describe efforts by our startup to leverage scalable, high-performance computing (HPC) in the public cloud for large-scale device design.

Bio: Ardavan Oskooi (ab-initio.mit.edu/~oskooi) is the Founder and CEO of Simpetus (www.simpetuscloud.com), a San Francisco-based startup offering an on-demand photonics simulation platform with a mission to propel computational simulations to the forefront of photonics research and development. Ardavan received his Sc.D. from MIT where he worked with Professors Steven G. Johnson and John D. Joannopoulos (thesis: Computation & Design for Nanophotonics) to develop MEEP (ab-initio.mit.edu/meep). Ardavan has published 13 first-author articles in peer-reviewed journals and a book "Advances in FDTD Computational Electrodynamics: Photonics and Nanotechnology" with Professors Allen Taflove of Northwestern University and Steven G. Johnson. He has a master's in Computation for Design and Optimization from MIT and completed his undergraduate studies, with honors, in Engineering Science at the University of Toronto. Prior to launching Simpetus, Ardavan worked with Professors Susumu Noda at Kyoto University and Stephen R. Forrest at the University of Michigan on leveraging MEEP to push the frontier of optoelectronic device design.