Prof. Allen Taflove

Allen Taflove received the B.S., M.S., and Ph.D. degrees in electrical engineering from Northwestern University in 1971, 1972, and 1975, respectively. From 1975 to 1984, he was employed as a research engineer at IIT Research Institute in Chicago. In September 1984, he returned to Northwestern where, since 1988, he has been a tenured full professor in the Department of Electrical Engineering and Computer Science.

Since his graduate-student days at Northwestern in 1972, Allen has pioneered finite-difference time-domain (FDTD) computational solutions of the fundamental Maxwell's equations of classical electrodynamics [1]. FDTD solutions of Maxwell's equations have emerged as a primary means to solve the most complex scientific and engineering problems involving electromagnetic wave phenomena, devices, and systems across the spectrum.

Currently, FDTD is the "go-to" tool to attack problems involving all things electromagnetic from ultralow-frequency geophysical phenomena spanning the entirety of Planet Earth, to microwaves radiating from smartphones or scattering from airplanes and missiles, all the way to visible light interacting at nanometer length scales with complex man-made metamaterials or with biological media such as DNA strands folded inside the nuclei of potentially lethal human cancer cells.

In recognition of his pioneering research, Allen has received a number of significant external recognitions. In 1990, he was the first person to be named a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in the FDTD area. Subsequently, he was the recipient of the 2010 Chen-To Tai Distinguished Educator Award of the IEEE Antennas and Propagation Society, and the 2014 IEEE Electromagnetics Award [2].

In May 2010, *Nature Milestones | Photons* identified Allen as one of the two principal pioneers of numerical solutions of Maxwell's equations [3]. In Sept. 2012, the University of Rochester's Institute of Optics ranked Allen's book, *Computational Electrodynamics: The Finite-Difference Time-Domain Method*, as the 7th most-cited book in all of physics [4], with more reference citations than books by three Nobel prize winners in physics.

In January 2015, in a Special Issue marking the 150th anniversary of the publication of Maxwell's equations, *Nature Photonics* prominently featured an interview with Allen dealing with how solutions of these fundamental equations have evolved over the past century, and especially how FDTD has become so fundamental to the development of contemporary electromagnetic technologies in science and engineering [5].

The latter is exemplified by the Optical Society's (OSA's) elevation of Allen to Fellow rank in 2018 with the citation: "For creating the finite-difference time-domain method for the numerical solution of Maxwell's equations, with crucial application to the growth and current state of the field of photonics."

At Northwestern, Allen has been the adviser or co-adviser of 24 Ph.D. recipients and 5 postdoctoral fellows who have completed their residencies. Six of his advisees (four women and two men) currently hold tenured faculty positions in university electrical engineering departments.

Continuing a collaboration that began in 2003, Allen is working with Prof. Vadim Backman of Northwestern University's Biomedical Engineering Department to develop novel biophotonics techniques aimed at the minimally invasive detection of deeply seated, early-stage human cancers [6]. This research could lead to a new paradigm in cancer screening where, for example, early-stage lung cancer could be reliably detected by analyzing a few cells brushed from the interior surface of a person's cheek, and early-stage ovarian cancer could be reliably detected by the same Pap smear that's been used for decades to detect cervical cancer.

[1] https://www.mccormick.northwestern.edu/news/articles/2013/05/allen-taflove-40-years-solving-maxwells-equations.html

[2] http://www.ieee.org/about/awards/bios/electromag_recipients.html

[3] http://www.nature.com/milestones/milephotons/full/milephotons02.html

[4] http://www.ece.northwestern.edu/ecefaculty/taflove/Most-cited_physics_books.png

[5] http://www.eecs.northwestern.edu/images/nphoton.2014.305.pdf

[6] https://magazine.northwestern.edu/features/the-far-side-of-violet-where-cancer-lurks/