IEEE Ottawa Section

Photonics Simulation Tools for Biophotonics: Finite-Difference Time-Domain Modeling of the Gold Nanoparticle Effect on Optical Phase Contrast Imaging of Single Biological Cells

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The application of photonics software simulation and modeling tools provides a deeper understanding of newly developed optical diagnostics and imaging techniques. The Finite-Difference Time-Domain (FDTD) approach has been proven as a powerful tool in studying the nature of the light scattering mechanisms from both normal and pathological cells.

The numerical modeling of light interaction with biological cells and tissues within the context of a particular optical imaging technique is of particular interest. We have recently applied the FDTD approach to numerically study how the optical immersion (OI) technique enhances the effect of cell membrane thickness and gold nanoparticles on the forward scattered light from single cancerous and non-cancerous cells. OI leads the so called "optical clearing" effect consisting in the increased light transmission through microbiological objects due to the matching of the refractive index of some of their morphological components to that of the extra-cellular medium. We have also applied the FDTD approach in combination with Fourier optics-based post processing techniques to validate a simulation model of the optical phase contrast microscope imaging of single biological cells. The model enables the study of the imaging effect of Gold nanoparticles on optical cellular and sub-cellular imaging. To the best of our knowledge, this is the first study using the FDTD approach to provide a 3D model of realistic size cells. It demonstrates the power and benefits of using photonics simulation tools in biomedical engineering optics problems.

Dr. Stoyan Tanev has a M.Sc. (1989, Sofia University, Bulgaria) and a Ph.D. (1995, by the University Pierre and Marie Curie, Paris, France) in Physics as well as a M.Eng. in Telecommunications Technology Management (2005, Carleton University, Ottawa, ON, Canada). After one-year post-doctoral research fellowship at the University of Quebec in Outaouais, he worked as a research scientist at Optiwave Corporation, Ottawa, ON, Canada (1997 to 2001). From 2001 to 2003, Dr. Tanev was part of the optical link design team at Innovance Networks, Ottawa, Canada. From 2003 to 2006 Dr. Tanev managed the photonics and biophotonics programs at Vitesse Re-Skilling™ Canada Inc. – a not-for-profit organization providing advanced learning solutions and technology commercialization opportunities for highly qualified professionals in new and emerging technology areas.

In July 2006 Dr. Tanev joined the Department of Systems and Computer Engineering at Carleton University, Ottawa, Canada. His main teaching and research activities are associated with the Technology Innovation Management Program. His current research interests are in two major areas: i) new and emerging applications of open source innovation principles, and ii) nanobiophotonics design and modeling.

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admission is free

Light refreshment will be served

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