EE Department Seminar

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Yorgo Istefanopulos Meeting Lounge

Artificial Photonic Media with Different Symmetries: Optical Filters, Cloaking and Slow Light

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Great attention has been given for photonic applications based on wavelength order periodic, quasi-periodic and random media due to the novelties arising for manipulation of light propagation. The talk will first review some of our research efforts that highlight the benefits of symmetry reduction in highly symmetric periodic photonic media.

***Optical Filters*:** Two dimensional periodic structures known as photonic crystals (PCs) are highly symmetric in terms of structural pattern due to the lattice types and shape of the elements occupying the PC unit cell. We propose the idea of intentionally introduced reduced-symmetry to search for anomalous optical characteristics so that one can implement such type of PCs in the design of novel optical devices. Breaking either translational or rotational symmetries of PCs provide enhanced and additional optical characteristics such as creation of complete photonic band gap, wavelength demultiplexing, super-collimation, tilted self-collimation, and beam deflecting/routing properties.

***Cloaking*:** In the second part of the talk, broadband two-dimensional cloaking designs based on isotropic and all dielectric lossless materials will be presented. The photonic structures are created by implementing graded index idea. The desired refractive index distribution is achieved with effective medium theory. Directional graded index cloaking structure shows unique characteristics such as low-loss, large bandwidth and scalable to other frequency regions. It is demonstrated that hiding arbitrary shaped large objects from the incident light is feasible.

***Slow Light*:** The last part of the talk covers slow light studies. Brief introduction to the slow light concept will be given. The two main approaches in terms of underlying fundamentals will be discussed. The first approach utilizes the material dispersion while the second category belongs to the structural dispersion of specially designed photonic devices. I will present how to design and characterize waveguide and cavity type of structures that can reduce the speed of light more than two orders of magnitude. The trade-off relation between bandwidth and group index will be highlighted. This part of the talk will end up with a forecast of future research directions on the field of slow light.

On the basis of the these considerations, it is expected that novel photonic media can be considered as a potential structure in photonic device applications due to the rich inherent optical properties.

Dr. Hamza Kurt received the B.S. degree from Middle East Technical University, Ankara, Turkey, in 2000, the M.S. degree from the University of Southern California, Los Angeles, CA, USA, in 2002, and the Ph.D. degree from the Georgia Institute of Technology (Georgia Tech), Atlanta, GA, USA, in 2006, all in electrical and electronics engineering. He was a Research Fellow with the Cedars-Sinai Medical Center, Bio-photonics Research Lab, Los Angeles, from 2001 to 2002. He was a Post-Doctoral Research Fellow with Georgia Tech for a short period and then he has spent a year with the Institut d'Optique Graduate School, Paris, France, as a Post-Doctoral Scientist. Since December 2007, he has been with the TOBB University of Economics and Technology, Ankara, as an Associate Professor with the Electrical and Electronics Engineering Department. He has authored more than 50 research papers in refereed international journals.

His current research interests include nanophotonics including the design and analysis of nanophotonic materials and media for the realization of wavelength-scale optical elements, slow light structures, graded index optics, high-resolution imaging, polarization insensitive devices, optical cavities/waveguides, and optical biosensors. Dr. Kurt is a member of the Optical Society of America and IEEE Photonics Society.