 Proceedings of ICCES'08, pp.1013-1013

Efficient Modelling of Light Propagation and Light-Matter Interaction in Nano-Photonic Systems

Kurt Busch[1], Jan Gieseler[1], Michael König[1], Jens Niegemann[1]
Kai Stannigel[1], and Lasha Tkeshelashvili[1]

Summary

Time-domain simulations play a very prominent role in the investigation and design of micro- and nano-photonic structures. In many cases, these strongly scattering systems need to be modelled on long time-scales with high precision. Such high accuracy, combined with unconditional stability and efficient performance, can be achieved via an operator-exponential method based on Krylov-subspace techniques [1].

This approach is capable of handling optically anisotropic, lossy and dispersive materials as well as CFS-PML boundary conditions. Furthermore, the use of discontinuous Galerkin methods on unstructured grids allows to realize high-order spatial discretization schemes which ideally complement the time-stepping capabilities of the Krylov-subspace approach [2]. It is straightforward to extend the scheme to handle nonlinear wave propagation and wave mixing phenomena as well as to treat the dynamics of coupled systems [3].

Thus, this approach is very well suited to study most experimentally relevant photonic nano-structures and we present results of strongly non-Markovian dynamics associated with spontaneous emission in Photonic Crystals [4] as well as cross sections and field enhancements in certain nano-plasmonic systems [5,6].

References

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[1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe, 76128 Karlsruhe, Germany