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Chapter 1 : Nonlinear Magnetization Dynamics in Nanosystems - Knovel

This chapter provides novel techniques for numerical integration of Landau-Lifshitz-Gilbert (LLG) and Landau-Lifshitz (LL) equations. The main emphasis is on the derivation of finite.

FastMag can handle complex structures meshed over tetrahedral meshes as large as million elements. It allows modeling a host of magnetic systems, such as magnetic recording heads, media, and arrays of magnetic nanoparticles. The efficiency of FastMag derives from fast computational methods for effective field calculation and time integration as well as their efficient implementations on massively parallel computing systems. Learn more and download Study of magnetization dynamics in magnetic nanostructures We use our codes to study magnetization dynamics mechanisms in magnetic nanostructured materials. These mechanisms include dynamics of magnetization reversal in composite and patterned media for ultra-high density magnetic recording, composite media for microwave assisted magnetic recording, heat-assisted magnetic recording, as well as magnetic random access memory elements. Our interests also are in the study of spin transfer torque phenomena and spin waves. This research is conducted in collaboration with the research groups in the Center for Memory and Recording Research at UCSD as well as our industrial partners. Journal of Applied Physics. Lomakin, and Eric E. Analytic and computational methods in Electromagnetics The investigation of the photonic and magnetic nanostructures is based on the development of sophisticated analytical models and efficient numerical. Many of these methods are based on integral formulation methodology. Our study of electromagnetic, optical, and magnetic fields in complex structures relies on the developments of efficient analytic and computational methods. In terms of computational methods, we are currently most interested in integral equation type approaches. These approaches are developed for computing electromagnetic field in systems comprising finite and infinite periodic distributions of scatterers in free space or in layered medium backgrounds. More Details Field representations in complex structures: The goal is to obtain rapidly convergence representations for a wide range of parameters for frequency and time domain fields. Fast iterative integral equation methods: The fast methods are being developed for free-space, layered medium, and periodic backgrounds. One goal is to introduce kernel independent methods that seamlessly work for low-, high-, and mixed frequency problems in various complex background types. Parallelization on new hardware architectures: We are developing highly efficient codes for evaluating static and dynamic electromagnetic fields in large scale configurations on GPUs. Out codes running on a desktop computer with a single GPU can solve the N-body problem of computing electromagnetic fields with N being as large as million for static and low-frequency problems and several tens of millions for high-frequency problems. The obtained GPU-CPU speed-ups are in the range from 70 to depending on the particular problem type, problem size, and accuracy. The study is geared towards identifying novel applications of the investigated structures and phenomena including subwavelength lasers as well as wave guiding and focusing structures for surface microscopy. Time evolution of the electric field supported by a straight chain of gold nano-bumps of size nmxnm residing directly on a gold surface [6]. The field is shown in the horizontal plane at 50 nm from the top edge of the nano-bumps. The structure is excited by a dipole source relatively far from the chain. This source excited a surface plasmon polariton on the gold surface, which is scattered from the chain. Time evolution of the electric field supported by a chain of gold nano-bumps of size nmxnm residing directly on a gold surface and having a 90 degree bend [6]. The structure is excited by a dipole placed near the left bottom end of the chain. This source excites a surface plasmon polariton on the gold surface as well as a traveling wave along the chain. The surface plasmon polariton is scattered from the chain. The traveling wave propagates without radiation loss along the chain and it also propagates through the sharp edge. More Details Nano-sized metal-dielectric composite elements have a number of interesting properties that can lead to important applications. Many metals in the optical e. Due to this property nano-sized metal particles can support resonances at wavelength much greater than their size, which can be used in various novel applications. One of our projects is to design and fabricate a laser of size smaller than the wavelength in all three dimensions. An important component of this study is to reduce the inherent radiation and dissipation losses in subwavelength resonators [3]. Nano-scale elements coupled with metal-dielectric surfaces can support an even richer variety of optical phenomena, many of which are only possible due to the interaction between the arrays and surfaces see an example in Fig. Twisted arrays of nanoparticles. Shvets, "Doubly negative metamaterials in the near infrared and visible regimes based on thin films," Optics Express, vol. Shvets, "Optical metamaterials based on thin metal films: Fainman, "Low threshold gain metal coated laser nanoresonators," Optics Letters, vol. Diffractive focusing of in-plane surface plasmon polariton waves", Applied Physics Letters, vol. Michielssen, "Optical wave properties of nano-particle chains coupled with a metal surface," Optics Express, vol. Michielssen, "Enhanced transmission through metallic plates perforated by arrays of subwavelength holes and sandwiched in between dielectric slabs," Physical Review B, vol. Michielssen, "Plane wave transmission through metal plates perforated by periodic arrays of through-holes of subwavelength coaxial cross-section," Microwave and Optical Technology Letters, vol. Michielssen, "Transmission of transient plane waves through perfect electrically conducting plates perforated by periodic arrays of subwavelength holes," IEEE Transactions on Antennas and Propagation, vol.