

# Modeling Spin Transfer Torque Magnetoresistive Memory

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## Abstract

As scaling of electronic semiconductor devices saturates, the focus of research in microelectronics is shifting towards reducing the energy consumption and boosting the performance of electronic circuits. The electron spin offers additional functionalities to charge-based digital electronics. Emerging spin-based nonvolatile magnetoresistive random access memories (MRAM) are electrically addressable, possess a simple structure, and offer endurance and speed superior to those of flash memory. Having nonvolatile memory close to CMOS eases the data exchange bottleneck and also enables data processing in the nonvolatile segment opening perspectives for new low power computing paradigms.

To facilitate the development of emerging MRAM devices, we are devising a high performance finite element-method (FEM) based simulation approach. In particular, we are developing and implementing a three-dimensional self-consistent simulation tool to evaluate the spin accumulation, torques, and magnetization dynamics in magnetic structures including tunnel junctions. Efficient methods for calculating (i) the demagnetization field, (ii) coupled three-dimensional charge and spin transport through a textured magnetic structure to evaluate (iii) spin-transfer torques driving (iv) the magnetization dynamics and switching are demonstrated.

## Bio

Viktor Sverdlov is currently heading the Christian Doppler Laboratory for Nonvolatile Magnetoresistive Memory and Logic at the Institute for Microelectronics, TU Wien, Austria. His research interests include device simulations, computational physics, solid-state physics, spintronics and nanoelectronics. Viktor holds his Master's and PhD degrees in Theoretical Physics from the State University of Leningrad/St.Petersburg, and his Habilitation in Microelectronics from TU Wien. Viktor worked as a staff research scientist at the V.A.Fock Institute of Physics, State University of St.Petersburg, Université de Genève, University of Oulu, Helsinki (Aalto) University of Technology, Freie Universität Berlin, and State University of New York at Stony Brook before he joined the Institute for Microelectronics, Technische Universität Wien, in 2004.