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**Field-modulated spin torque ferromagnetic resonance: Characterization of spin wave eigenmodes in magnetic tunnel junctions** YU-JIN CHEN, Univ of California - Irvine, ALEXANDRE GONCALVES, Centro Brasileiro de Pesquisas Fisicas, RJ, Brazil, IGOR BARSUKOV, LIU YANG, Univ of California - Irvine, JORDAN KATINE, HGST Research Center, San Jose, CA, USA, ILYA KRIVOROTOV, Univ of California - Irvine — A common technique for measurements of magnetic parameters in nanoscale magnetic tunnel junctions (MTJs) is spin torque-driven ferromagnetic resonance (ST-FMR) based on an amplitude-modulated microwave drive [1,2]. We demonstrate a technique of broadband ST-FMR based on magnetic field modulation for measurements of spin wave properties in magnetic nanostructures [3]. Application of the field-modulated ST-FMR technique to MTJs gives reliable information on magnetization dynamics for arbitrary magnetic state of the MTJ, including the case of collinear magnetizations. This configuration is difficult to measure in conventional ST-FMR due to the weak spin torque drive. The improved signal-to-noise ratio and improved sensitivity of field-modulated ST-FMR allow us to measure the entire spectrum of low-frequency standing spin waves. We find the magnetic field dependence of the measured spin wave eigenmodes to be in good agreement with micromagnetic simulation results, which allow us to identify the observed modes as the free layer eigenmodes and to determine their spatial profiles [3].

1. A. A. Tulapurkar et al., Nature 438, 339-342 (2005)
2. J. C. Sankey et al., Phys. Rev. Lett. 96, 227601 (2006)
3. A. M. Goncalves et al., Appl. Phys. Lett. 103, 172406 (2013)

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