Magnonic studies of ferromagnetic nanostructures

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Magnetization dynamics are widely studied and used both from a fundamental study and from an application point of view. The possibility of microwave nanoscale devices such as couplers, multiplexers and processors is a great motivation for such studies. In this context, we study spin waves (SWs) in a variety of structures. We first consider a ferromagnetic waveguide and study the SW dispersion and profiles in it. This was proposed as a standard problem, which can be used to compare different micromagnetic packages. We explain a mechanism to excite a single mode in the waveguide, which is more suitable for a device. The problem of wave reflections in simulations is quite common and we propose absorbing boundary conditions in the context of SWs. We find that a parabolic increase in damping performs better than other commonly used damping profile for different angles of incidence in different materials. We study the SW dynamics in rings and show that the SW coupling efficiency between structure ends can be enhanced by changing bias field configurations. SW modes are more efficiently excited when bias fields follow the ring curvature. This is confirmed by looking at the SW energy density in the receiving pad. We also consider a ring shaped defect in an antidot magnonic crystal of permalloy and show that SWs get preferentially guided through the defect. The modes allowed through the defect lie in the band gap of the magnonic crystal and thus a filtering action was obtained. We finally analyze the static and dynamic magnetization in ferrite films. The hysteresis characterization is studied using an in house magnetometer and domain images were obtained. Brillouin light scattering was employed to study SW dynamics. The trend in the variation of SW frequency with applied magnetic field was corroborated with micromagnetic simulation predictions.

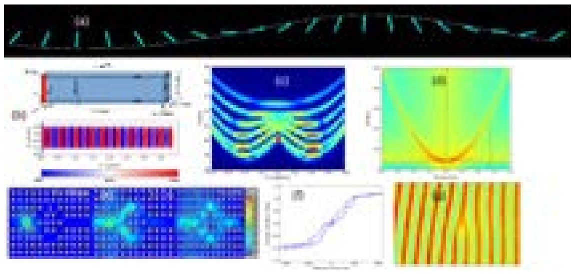

Figure 1: (a) A schematic of a spin wave. (b) A magnonic waveguide and a snapshot of the fundamental SW mode in it. (c) Backward volume dispersion of SWs and (d) excitation of the fundamental backward volume SW mode. (e) SW guiding in a ring defect showing filtering action. (f) shows the in-plane hysteresis curve and (g) shows fork patterns in the magnetic domain images of a ferrite film.

Biography

Guru Venkat completed his Bachelors of Technology from the National Institute of Technology Durgapur in Electronics & Communications Engineering with first class distinction. Since then he has been pursuing a MS and PhD in the Dept. of Electrical Engineering, Indian Institute of Technology Madras and has submitted his PhD thesis. He has published 5 articles in peer reviewed journals and has presented his work in national and international conferences. He has been studying magnetization dynamics using simulations and experiments and hopes to continue his work in this field so that the learning keeps continuing.

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