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Finite-element mesh generation and simulation of magnetization dynamics in a three-dimensional artificial spin structure

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Magnetic three-dimensional structures on the nanoscale possess static and dynamic properties not found in their 'flat'counterparts. The recent development of three-dimensional lithography and probing techniques (such as X-ray tomography) has enabled the experimental investigation of such structures. Concurrently, simulations need to be developed to gain detailed understanding of the magnetization dynamics. We have developed a finite-element meshing technique involving Eikonal equations, which has allowed us to produce high-quality efficient meshes for to describe a mesoscopic 'Buckyball'made of hollow beams, exemplifying a complex network with tree-fold junctions. Our micromagnetic simulations based on tetrahedral meshes reveal reversal avalanches mediated by the nucleation and propagation of domain walls during the field-driven magnetization reversal in the cylindrical tubes making up the Buckyball.

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