Variational methods for an elliptic singular SPDE describing the magnetization ripple

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The magnetization ripple is a microstructure formed by the magnetization in a thin-film ferromagnet due to the random orientation of the grains in the polycrystalline material.

In an approximation of the micromagnetic model the ripple can be described by a strongly anisotropic elliptic PDE driven by white noise in two dimensions. However, the noise is too rough to make sense of the nonlinearities appearing in the equation.

We develop a global well-posedness theory for this singular SPDE based on a renormalization of the corresponding energy functional, and prove optimal regularity results for minimizers of the renormalized energy. More precisely, we show that the renormalized energy functional can be obtained as a Γ–limit from regularizing the noise, independent of the regularization.

This complements the well-posedness theory for small data which was developed in [1], based on a renormalization of the ill-defined nonlinear terms à la Da Prato–Debussche.

References

[1] R. Ignat and F. Otto, The magnetization ripple: A nonlocal stochastic PDE perspective, *J. Math, Pures Appl. (2019)*, https://doi.org/10.1016/j.matpur.2019.01.010.