Total variation regularized phase retrieval algorithm
for diffraction imaging analysis of magnetic domain patterns

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Understanding magnetic interactions, such as ferromagnetic interaction and anisotropy, is crucial for enhancing the performance of magnetic materials and devices. In addition to these intrinsic factors, extrinsic ones such as grain size and grain boundaries also play a significant role in permanent magnets and soft magnetic materials. To capture such information, a powerful approach is to monitor the temporal evolution of the ferromagnetic domain structure during the magnetization or demagnetization process and then to estimate the determinants of physical properties. Single-shot X-ray diffractive imaging is an effective measurement technique for measuring magnetic patterns with high spatio-temporal resolution. However, it is usually challenging to extract valid physical property information because the measurement data contains errors and missing information. A phase retrieval algorithm based on total variation and L2 regularizations has been proposed for reconstructing ferromagnetic domain images from the diffraction pattern [11]. The algorithm has been validated on emulated diffraction data and is expected to be a powerful analysis method for extracting physical property information from the single-shot diffraction data. The grain size is an extrinsic factor that affects the coercivity of permanent magnets.