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High Dynamic Range Magnetometry with a Single Spin in Diamond[1] N.M. NUSRAN, M. UMMAL MOMEEN, M.V. GURUDEV DUTT, University of Pittsburgh — Detection of the weak magnetic fields associated with nanometer sized volumes of spins could allow for non-invasive, element-specific probing of a variety of important physical and biological systems. Averaging out random noise which is the commonly used standard measurement strategy (SM) in most nanosensors, will at best lead to a field variance that is inversely proportional to the total averaging time. Further, there exists a trade-off between the field sensitivity and the dynamic range in the SM. In this work, we demonstrate an alternative approach for accurate magnetic sensing, using novel phase estimation algorithms (PEA), implemented on a single electronic spin associated with the nitrogen-vacancy (NV) defect center in diamond. The field variance in our approach scales down faster than the SM. The trade-off between the field sensitivity and the dynamic range no longer exists in this approach. Our results show an improvement of $\sim 6.25dB$ in the field sensitivity compared to the SM, over a large field sensing range ($\sim \pm 0.3mT$). Besides their direct impact on applications in demonstrated nanoscale magnetic sensing and imaging, this may also open the way for application of other quantum feedback and control techniques to magnetometry.

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