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Magnetic microscopic imaging with atomic magnetometers and flux guides for magnetic biomarker applications

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Magnetic nano-particle detection is an alternative method to optical bio-imaging based on bio-markers. For example, it can be used to detect circulating tumor cells to diagnose the metastatic stage of the cancer. One important advantage of the magnetic modality is the possibility of imaging in turbid media, such as blood samples and tissues. In addition, naturally magnetic nano-particles can be manipulated with magnets to concentrate the samples for improving sensitivity, to deliver the samples to target areas in tissues, and to treat the diseased areas. Apart from medical, the magnetic nano-particle imaging can be used in biosecurity applications. While an atomic magnetometer has sufficient sensitivity to detect a small number of nano-particles, the large sensor size does not allow imaging with high resolution. Recently, we proposed and tested a method of magnetic imaging that can provide high resolution and sensitivity. The approach is based on augmenting the performance of an atomic magnetometer with magnetic flux guides. As optical fibers direct light from a source to the detector, the flux guides similarly send the magnetic flux from the microscopic source to the much larger magnetometer, substantially improving magnetic source localization and imaging resolution. We not only experimentally tested the operation of a single pair of flux guides with the atomic magnetometer, but also used simulations to show the possibility of simultaneous multi-channel imaging. Many applications are anticipated from the detection of the field of a single neuron to the detection of nano-particles and imaging.

Biography

Igor Savukov has completed his PhD at University of Notre Dame, USA and Post-doctoral studies at Princeton University. He is a R&D Scientist at Los Alamos National Laboratory. He has published more than 77 papers in reputed journals and has been working over 15 years in the field of Sensitivity Magnetic Measurements.

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