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## Ultrasensitive Magnetoresistive Sensors

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The design of an ultrasensitive magnetoresistive sensor is a compromise between detectivity, sensitivity, linearity, hysteresis, device footprint, and power consumption. This work focuses on exploring MTJs, which provide a scalable and low-cost solution for magnetic sensing at room temperature, with strong potential for high spatial resolution and applications where proximity to the field is important. Analyzing how design choices impact the final performance and feasibility of the end device showed that improving detectivity can be achieved either by increasing sensitivity (e.g., through flux concentrators) or by reducing noise (e.g., parallel sensor architectures), but these approaches also introduce disadvantages, such as larger device footprints and fabrication complexity. The results indicate that meeting the target specification is most realistically approached through a combination of 3D arrays of small junctions, carefully chosen biasing, and magnetic flux concentrators to boost detectivity while maintaining a linear, non-hysteretic response.

### Field of Research/Work

Condensed Matter and Materials

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