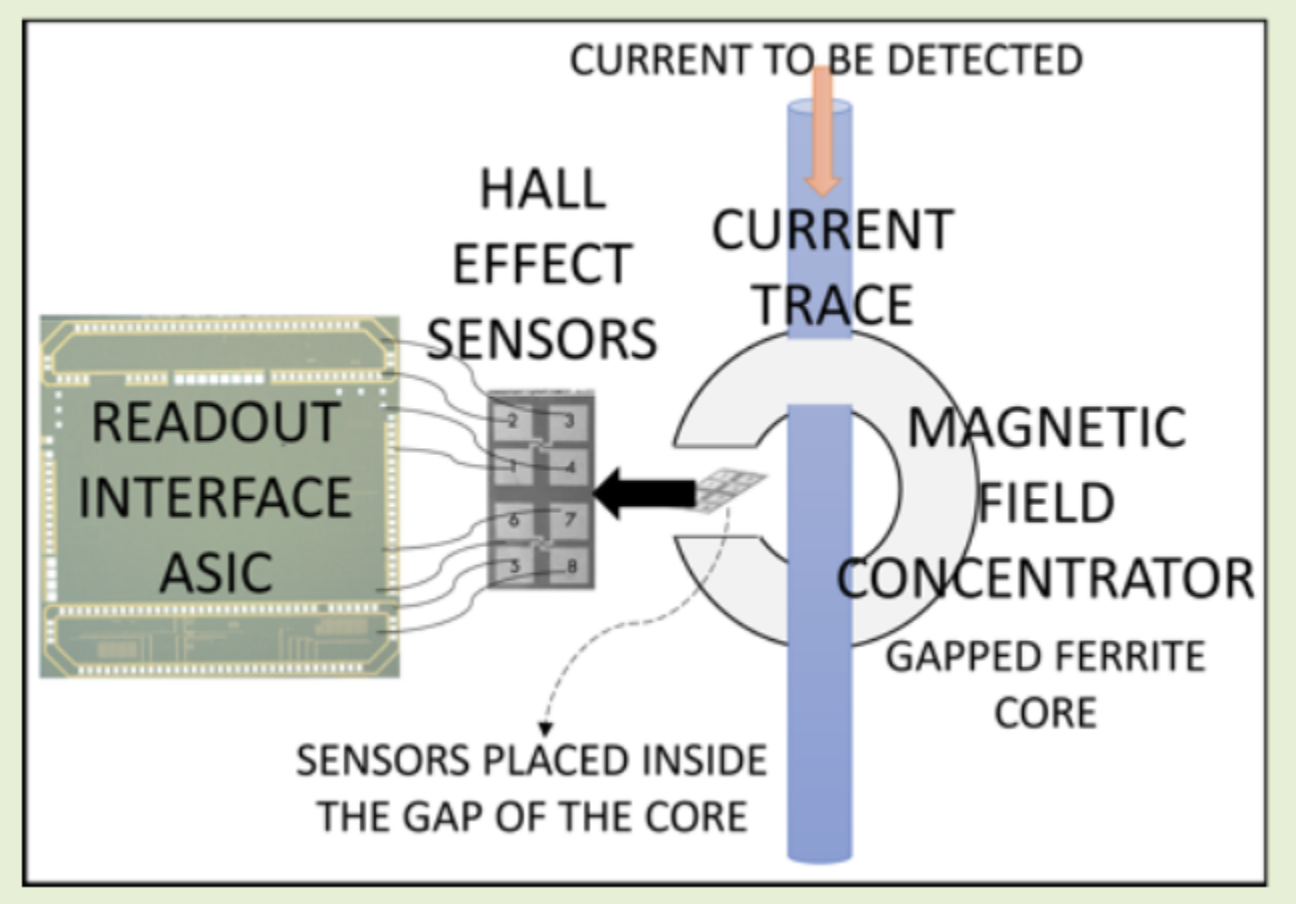
Docket #: S23-203

A DC to 25 MHz Current Sensing Interface using Hall-effect Sensor

Researchers in Stanford University's EXtreme Environment Microsystems Laboratory (XLab) working in collaboration with the University of Arkansas' Mixed-Signal Computer-Aided Design (MSCAD) Laboratory developed a Hall-effect sensor design that detects ultra fast changes in the magnetic field, and provides a non-invasive fast current detection solution that can operate from DC to 25 MHz and beyond. The current sensing system uses high-bandwidth gallium nitride (GaN) Hall-effect sensors and a fast readout interface. A 2-way current spinning technique minimizes offset at DC levels, while a high pass filter eliminates sensor offset at high frequencies. Two sensors and signal paths make it possible to take advantage of the full sensor bandwidth and detect fast changes in the magnetic field. The XLab/MSCAD non-invasive fast current detection solution is ideal for turbines, motors, converters, inverters, and engine systems that operate at DC / low frequency to high frequency in the 10s of MHz and beyond.



Proof of concept readout interface design test set up for Hall-effect sensors

Image courtesy the EXtreme Environment Microsystems Laboratory (XLab) and the Mixed-Signal Computer-Aided Design (MSCAD) Laboratory

Stage of Development - Proof of concept prototype

XLab/MSCAD prototype detected DC to 25MHz (significantly higher than anything on the market). The group continues refining the circuits to build a single chip with sensor and developing machine learning algorithms to detect faults in motor systems.

Applications

- Predictive maintenance and diagnosing health of electronics motor systems used in automotive, aerospace, etc.
- Current sensing in electric/power grid, turbines, motors, DC-DC converters, inverters, engines, etc.

Advantages

- Ultra-wide frequency range (DC to GHz) that simultaneously measures low frequency and high frequency magnetic fields.
- Highest frequency detection (compared to other Hall-effect sensor-based designs). Demonstrated prototype to 25 MHz with upper frequency range expected to be as high as 100-200 MHz.
- Non-Invasive, fast detecting.

Publications

- Hassan, A., Mahar, A., Shetty, S., Lalwani, A. V., Faruque, K. A., Paul, R., R., Senesky, D.G., Salamo, G.J. & Mantooth, H. A. (2024). A DC to 25 MHz Current Sensing Interface for Hall-effect Sensor. *IEEE Sensors Journal*. doi: 10.1109/JSEN.2024.3360462

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