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Increased Sensitivity of Magnetoelectric Sensors at Low Frequencies Using Magnetic Field Modulation JONATHAN PETRIE, Army Research Laboratory, DWIGHT VIEHLAND, DAVID GRAY, Virginia Tech University, SANJAY MANDAL, GOLLAPUDI SREENIVASULU, GOPALAN SRINIVASAN, ALAN EDELSTEIN, Oakland University — Magnetoelectric (ME) laminate sensors are vector magnetometers that can detect pT magnetic fields at 1 kHz, although sensitivity may be reduced at lower frequencies. These passive sensors consist of alternating layers of magnetostrictive and piezoelectric materials. A magnetic field causes the magnetostrictive layer to strain the piezoelectric material and create measurable charge. We have shown[1] that since the strain response is a nonlinear function of the bias field, sweeping the magnetic bias on the magnetostrictive layer can modulate the ME response and increase the operating frequency of the sensor. This upward shift lowers the $1/f$ noise and increases the signal amplitude if the new operating frequency is near a mechanical resonance mode of the sensor. Using this modulation technique, the low frequency sensitivity has been improved by more than an order of magnitude and we have achieved a detectivity of 7 pT/$\sqrt{\text{Hz}}$ at1 Hz. In addition to increasing the magnetic signal frequency, we can use magnetic modulation to increase the operating frequency of acoustic signals detected by these sensors. This occurs because the ME sensors are nonlinear devices. In these cases using magnetic field modulation, the signal appears as sidebands around the modulation frequency.

[1]To be published in Journal of Applied Physics.

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