MAGNETIC BIOSENSORS

Cancelling the drift

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Magnetic biosensing is a potentially low-cost technique that could provide point-of-use diagnostic devices. One approach is to use magnetic beads attached to biological elements that interact with specific analytes, inducing shifts in their frequency response that can be detected as changes in the inductance of the driving coil. These sensing systems, however, are often limited by poor signal-to-noise performance, high power consumption, and thermal sensor frequency drift. Constantine Sideris and colleagues at the California Institute of Technology have now designed a self-referencing magnetic sensor system that achieves significantly improved drift and noise-suppression performance.

The researchers developed a resonant circuit based on a fourth-order transformer configuration to implement a drift-cancellation scheme. This circuit configuration has two resonant frequencies: a low frequency at which the magnetic beads are in the sensing mode and a high frequency at which the beads are transparent and no sensing takes place. Switching between the two frequencies, the high-frequency state acts as a reference to the low-frequency state and can be used to compensate for the drift in the sensing signal. A proof of concept, 2×2 cell array prototype was fabricated using a 65 nm complementary metal–oxide–semiconductor (CMOS) process, and achieved 0.3 ppm sensitivity and two-orders-of-magnitude improvement in drift cancellation over prior methods. Furthermore, a DNA biodetection experiment was performed in order to demonstrate the feasibility of the approach for in vitro diagnostics.

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