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Miniature magnetic resonance system for robust and portable diagnostics[1] CHANGWOOK MIN, DAVID ISSADORE, JAEHOON CHUNG, HUILIN SHAO, MONTY LIONG, Massachusetts General Hospital, RALPH WEISSLEDER, Massachusetts General Hospital/Harvard Medical School, HAKHO LEE, Massachusetts General Hospital — We have recently developed a new diagnostic platform, microNMR(μNMR), specifically designed for clinical applications This new μNMR system performs rapid, accurate, and robust measurements of cells, proteins and small molecules in point-of-care settings. The system utilizes magnetic nanoparticles (MNPs) to amplify the analytical signals in NMR detection. When molecularly-specific MNPs identify their targets, the particles induce large, amplified changes in the transverse relaxation of water protons by producing local magnetic fields. A major challenge in achieving reliable NMR detection is the fluctuation of NMR frequency ($f0$) with temperature, which originates from the the temperature-dependent drift of the magnetic field. To overcome the challenge, we have implemented a new, automated feedback controller that keeps track of $f0$ and reconfigures measurement settings. The mechanism enables robust μNMR measurements in realistic clinical environments (4-50 °C). Moreover, the μNMR interfaces with mobile devices for its operation, maximizing the portability of μNMR. The clinical utility of the new μNMR system is demonstrated by detecting and molecularly profiling cancer cells from patient samples.

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