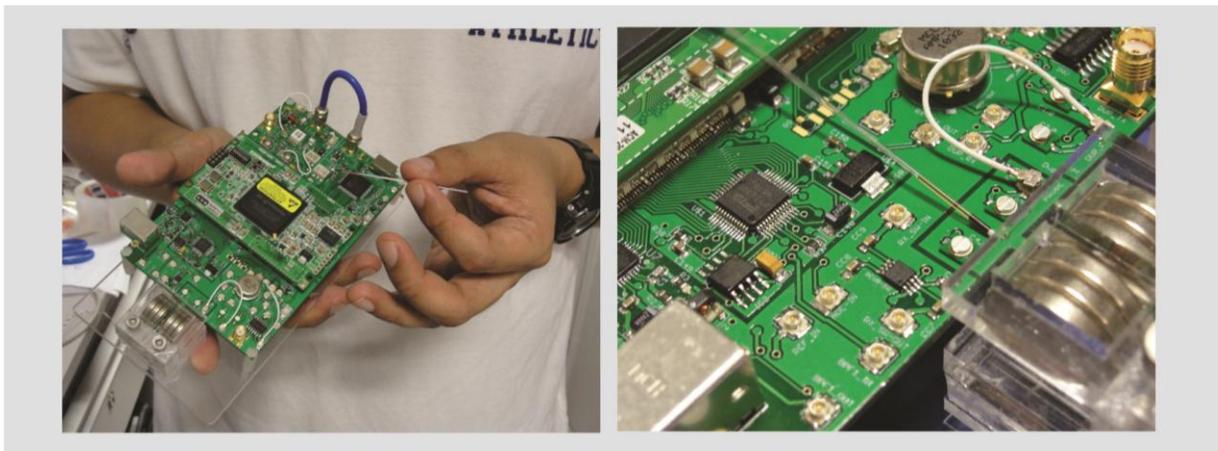


Development of miniaturized, portable Magnetic Resonance Relaxometry System for Point-of-Care Medical Diagnosis

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With advances in microelectronics technology, Magnetic Resonance (MR) community sees the emergence of much more compact MR spectrometers (pulse programmer, transmitter, receiver, and digital signal processing) on a highly integrated circuit platform such as field programmable gate array (FPGA)¹, and complementary-metal oxide semiconductor (CMOS)². Recently, Weissleder's group shown that small "ping-pong sized" magnet can be packed together with a CMOS-based transceiver into a palm-sized, NMR-based biosensor². Here, in MIT, SMART Centre (in Singapore) a novel, compact-sized (16cm x 9cm) and portable (250g) Magnetic Resonance Relaxometry system is designed and developed³⁻⁵. We overcame several key engineering barriers so that magnetic resonance technology can be potentially used for disease diagnosis-monitoring in point-of-care settings, directly on biological cells and tissues. The whole system consists of a coin-sized permanent magnet (0.76 Tesla), miniaturized radio-frequency microcoil probe⁶, compact lumped-circuit duplexer, and single board 4-Watt power amplifier, in which a FPGA-based spectrometer is used for pulse excitation, signal acquisition and data processing. We show that by measuring the proton transverse relaxation rates from a large pool of natural abundance proton-nuclei presence in less than 1 μL of red blood cells, one can indirectly deduce the relative magnetic susceptibility of the bulk cells within a few minutes of signal acquisition time. Such rapid and sensitive blood screening system can be used to monitor the fluctuation of the bulk magnetic susceptibility of the biological cells (e.g. human red blood cells), where unusual state of the bulk magnetic susceptibility is related to a number of diseases (e.g. malaria^{3,7}, dengue, enzyme deficiency, inflammation, sepsis, etc.). We are looking for interested party for collaborations as well as to license this technology⁸.



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