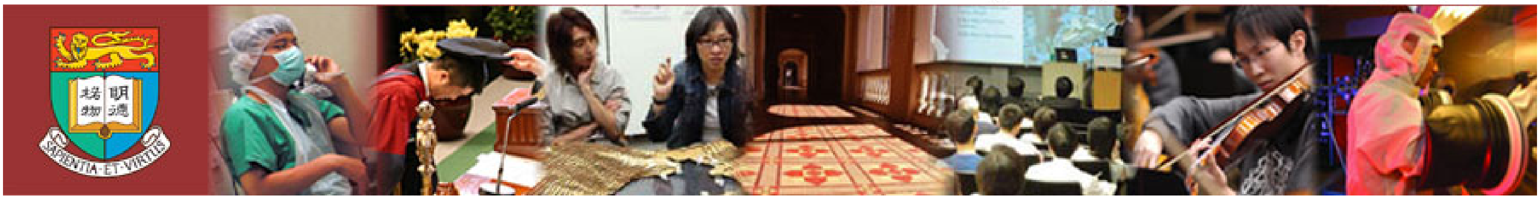

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Digital Wireless Transmission for MRI

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Introduction: In recent years, several proposals of using wireless transmission for MRI have been reported to avoid the interference between array channels [1, 2]. Amplitude modulation (AM) and single sideband (SSB) analog wireless techniques have been applied to design transponders for RF coils [3]. Compared to analog transmission, digital transmission is noise immunity, stable, and flexible. In this work, we construct a transmission system based on WLAN 802.11 digital wireless standards, which reaches the speed of 54Mbps with 2.4G or 5GHz band.

Methods: The digital wireless MRI transmission system based on the standard 802.11b is shown in Fig.1. The MR signal firstly is amplified and digitized, then sent to the digital signal processor (DSP), where the signal is processed according to the IEEE 802.11b standard definition. The baseband controller tunes the transmitted signal to the ultra high frequency (2.4GHz) or makes the received signal down converted to a lower frequency (several hundreds of KHz). The antenna transmits the power amplified high frequency signal or receives the signal ready to be demodulated.

In our system, the module WiPort™, which is a wireless embedded server produced by Lantronix, is used as wireless transceiver. The module includes 802.11b transceiver, a 10/100 Ethernet transceiver, and dual high-speed serial ports. Our signal processing circuit is connected to this module by Ethernet interface for high speed digital transmission.

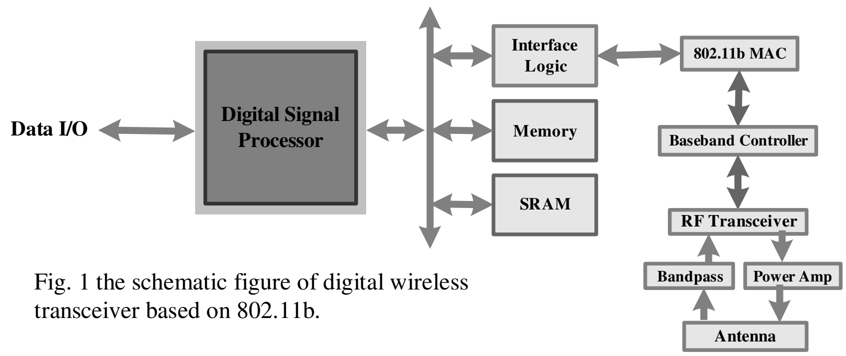

Fig. 1 the schematic figure of digital wireless transceiver based on 802.11b.

For a sampled signal to be reproduced accurately at the receiver, each cycle of the analog input signal must be sampled at least twice. And consider both of sampling speed of commercial A/D converter (up to about 100MSPS) and cost; we would like firstly to down convert the amplified MR signal to lower frequency like several hundreds of kHz. The harmonic waves aroused by A/D sampling should be filtered out once the digitized signals are input into the DSP. The parallel digital format from A/D converter should be transformed to the Ethernet configuration of 802.11b module before wireless transmission. Some kind of memories, such as FIFO and SRAM are added into the transmitting and receiving circuit as a buffer.

Results and discussion: A digital wireless transmission link for MRI application has been set up. The input analog signal is amplified, down converted, and then digitized by A/D converter. The digital signal is transmitted by the wireless module. The wireless module is connected with signal processing board by Ethernet interface. This wireless transmission is applied just in a limited area as in MRI operation room, so the transmitting power could be lower, which can be realized by B1 coupled power supply.

Based on 802.11b standard, the maximum data rate is 11Mbps and only limited number of MRI coils can simultaneously transmit MRI signals in this stage. Therefore, it is necessary to make use of frequency division multiplexing (FDM) technique for multi-channel coil array transmission, which sets signals from different channels to divided frequency bands and realizes parallel transmission.

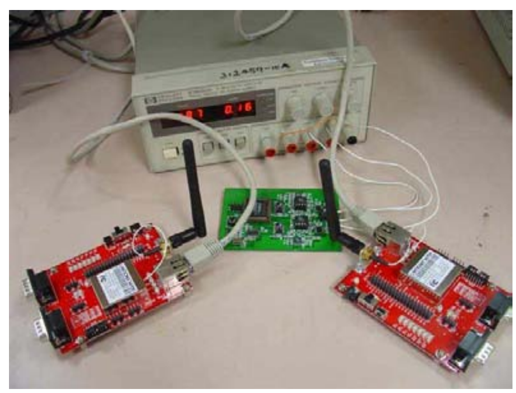

Fig. 2 Digital wireless transceiver PCB prototype

Conclusion: Digital wireless transmission based on 802.11 standards for MRI gives the opportunity to eliminate the cable coupling among multiple channels. The use of division multiplexing techniques significantly expands the usable bandwidth defined by transmission standards. This could be a promising method for using arrays with a larger number of channels, but no cables.

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