Fast Auto-adaptive Gain Adaption for Improved Signal Dynamics

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Abstract

In our 3D Ultrasound Computer Tomography system (USCT), the 12 bit ADC and factor 10 VGA are insufficient to resolve the smallest interesting signals. An adaptive front-end gain can solve this by object specific adaptions during the measurement.

The 3D USCT II of the KIT device contains 157 Transmitter Array System (TAS). Each TAS has 13 piezoelectric transducers, corresponding analog signal front end (AFE) and an MSP430FG66xx series microcontroller (MCU). All TAS are connected to a control board through a two-wire serial bus system.

Direct Memory Access (DMA) was used in the hardware to control the interrupt of the Universal Serial Communication Interfaces module (USCI). To complete the data transfer without occupying the MCUs of the TAS. A location-based general call was developed in the control system. The host transmits one frame long message to all TAS in a general call mode. This message contains the configurations of all TAS for the next measurement step. The address of each TAS corresponds to the location of each configuration in the long message. Thus, in the broadcast mode, each TAS only obtains the configuration information required by itself. With these two improvements, to configure all of the TAS can be reduced to less than 3 ms, which is the shortest measurement interval.

The here proposed solution allows a fast dynamic control of the front-end electronics during measurement without extending the measurement time significantly.

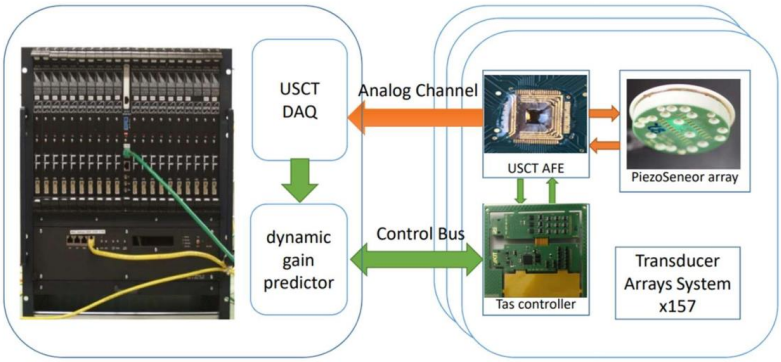

Figure 1: The figure shows the basic architecture of our system: combined with the USCT AFE, which is custom designed for USCT devices, the dynamic gain system can amplify the input signal in the range from 12 dB to 69 dB. Every channel has at least 5 MHz bandwidth.