

1 *Application-specific frontend board.*

2 *Xilinx Virtex-6 FPGA on mainboard.*

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ULTRASOUND BEAMFORMER PLATFORM

System Description

Diagnostic imaging quality of ultrasound systems is defined by beamforming characteristics of the ultrasound device. Modern plane wave imaging, dynamic focusing, steering and pulse coding are techniques which are used to form the acoustic beam. Especially for research and development it is needed to have complete control possibilities over the parameters that determine the geometry, the direction and the acoustical properties of the sound beams. The ultrasound research platform "DiPhAS", which is in its ninth generation of development, provides full control over all beamforming and imaging parameters.

System Characteristics

The system is set up based on a modular platform concept with mainboard, power supply, integrated PC and 16 application-specific frontends including up to 16 channels on each PCB.

Each frontend is able to generate user defined transmit waveforms with a resolution of up to 2ns for each channel individually. The output stages of the transmit pulse generators are designed to provide waveforms with adjustable amplitudes of up to +/-75V.

The system digitizes at sampling rates between 20 and 80MSPS. The received data will be pre-processed in FPGAs and stored in DDR3 memories. Using this buffer allows to realize ultrafast imaging at high pulse repetition rates of several kHz without the need of transferring data to PC in between.

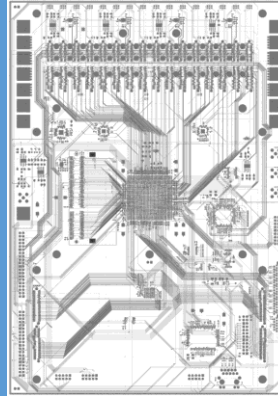
Signal processing and beamforming is completely done on parallel computing graphic processors (GPUs). The interface between beamformer and PC is realized by using PCIe providing up to 25Gbit/s of DMA transfer speed.

DiPhAS allows full access to the high frequency signals coming from each single receiving element of the array probe.

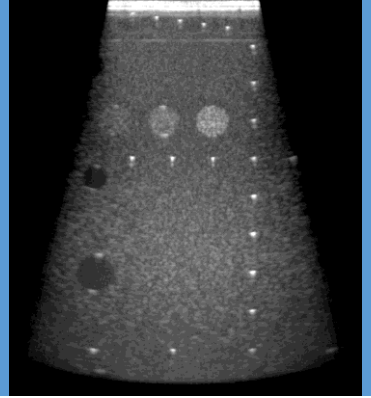
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Low-frequency Beamformer

Example applications

Sonar imaging, transducer characterization

Transmitter

TX voltage:

150 V_{pp}

TX signals:

Transmit coding with arbitrary tri-state waveform for each channel individually

TX resolution:

8 ns (up to 1 ms coded transmit signal length)

Receiver

Digitalization:

12 bit / 20 MSPS

Maximum gain / Variable gain range (TGC):

52 dB / 42 dB

Local memory (channel data acquisition):

8 Msamples / channel

System

Channels:

128

Frequency range:

500 kHz - 3 MHz

Power input voltage:

230 V AC

Data interface:

PCIe 2.0 x8 up to 25Gbit/s

PC:

included

Synchronization (trigger output):

included

Transducer connectors:

up to 4x ITT Cannon DLM6-360

Multiplexer:

1:8 option available (128 ch system)

Size:

312 mm x 449 mm x 436 mm

Weight:

20 kg (including PC)

Special characteristics:

medical certification possible

MR compatible option

passive cooling possible

PC integrated

Mid-frequency Beamformer

Medical imaging, optoacoustic imaging, ultrafast imaging

150 V_{pp}

Transmit coding with arbitrary tri-state waveform for each channel individually

2 ns (up to 4 μs coded transmit signal length)
8 ns (up to 1 ms coded transmit signal length)

12 bit / 80 MSPS

52 dB / 42 dB

8 Msamples / channel (128 ch system)
4 Msamples / channel (256 ch system)

128 / 256

1 MHz - 20 MHz

230 V AC

PCIe 2.0 x8 up to 25Gbit/s

included

included

up to 4x ITT Cannon DLM6-360

1:8 option available (128 ch system)
1:4 option available (256 ch system)
T/R switch option available (256 ch system)

312 mm x 449 mm x 436 mm

20 kg (including PC)

medical certification possible

MR compatible option

passive cooling possible

PC integrated

High-frequency Beamformer

Material characterization, skin imaging, small animal imaging

20 V_{pp}

Transmit coding with arbitrary tri-state waveform for each channel individually

2 ns (up to 4 μs coded transmit signal length)

12 bit / 480 MSPS

56 dB / 48 dB

8 Msamples / channel

128

1 MHz – 80 MHz

230 V AC

PCIe 2.0 x8 up to 25Gbit/s

included

included

1x Samtec SEAF

none

312 mm x 449 mm x 436 mm

20 kg (including PC)

PC integrated

3 Beamformer platform „DiPhAS“.

4 Layout of mainboard .

5 Ultrasound phantom measurement.