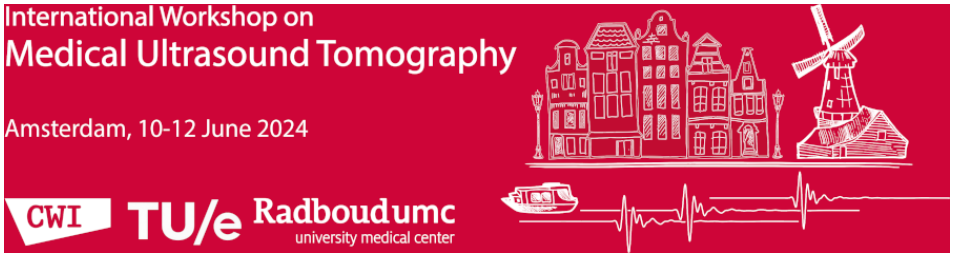

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A serially scalable emission and acquisition system architecture for ultrasound computed tomography

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Background:
Most emission and acquisition systems for research and applications in ultrasound computed tomography (USCT) are custom-built and lack scalability in the number of emitting and receiving channels. To address this problem, we proposed a serially scalable emission and acquisition system architecture that is available to build emission and acquisition systems with different channel numbers based on serial control and connections.
Method:
In this architecture, a serially scalable emission and acquisition module (SSEAM) is the core component, which is designed with N channels, consisting of a power board, an emission board, and an acquisition board. Each SSEAM provides a serial clock interface and a serial control interface where clock signals and control signals are serially transmitted and synchronized by the FPGA. By cascading multiple SSEAMs, it is available to construct emission and acquisition systems with a channel number that is an integral multiple of N. Moreover, SSEAM provides a 10-Gigabit Ethernet interface to transfer the acquired data, which can be connected to network cards or high-performance computing cards to complete data post-processing at high speed.
Results:
We constructed emission and acquisition systems with 512, 768, and 1024 channels by cascading 2, 3, and 4 SSEAMs, respectively. Each SSEAM contains 64 emitting channels and 256 receiving channels. All constructed systems can sequentially emit pulses and acquire ultrasound signals. The maximum error of synchronous clock signals is less than 200 ps. The maximum current of each SSEAM is less than 3 A. The maximum rate of 10-Gigabit Ethernet interfaces is 9.8 Gbps.
Conclusion:
The characterization and results indicate that the serially scalable emission and acquisition system architecture based on SSEAMs contributes to constructing an accurate emission and acquisition system with scalability in channel numbers. The constructed emission and acquisition systems are more flexible and can control multiple probes with different element numbers.

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