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Ultrasound Tomography: Technical Challenges and System Design

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A clinically applicable ultrasound tomography system should produce data that both provides optimal imaging results for diagnosis and is at the same time suitable for clinical use. Clinical applicability includes patient safety and comfort, high patient throughput, rapid image reconstruction, and low cost of acquisition and operation.

The technical challenges of building and operating such a device are due to the large size of a complex object being imaged, e.g. the female breast, compared to the wavelength of the ultrasound. A large number of ultrasound transducers is required to image the object, which need to be as identical as possible. In order to approximate spherical waves (3D systems) or cylindrical (2D systems), the individual transducers have to be very small, resulting in low sound level pressures and a low signal-to-noise ratio. The large number of ultrasound transducers that have to be recorded in parallel leads to a large number of parallel channels and a high data rate in order to avoid patient motions with the shortest possible data acquisition times. Due to the complex interaction of ultrasound with tissue, reconstruction algorithms for high image quality are complex and time consuming.

This paper discusses these challenges, presents the different available hardware setups and how they tackle these challenges, and provides an outlook on future developments.

Preferred Contribution Type

Presentation

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