

Modular Piezoelectric Sensor Array with Beamforming Channels for Ultrasound Imaging

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ABSTRACT

Researchers at the University of California, Davis have developed a large area sensor array for ultrasound imaging systems that utilizes high-bandwidth piezoelectric sensors and modular design elements.

FULL DESCRIPTION

Ultrasound sensing is utilized in a number of industries and applications, but it is most well-known for its role in medical imaging. Ultrasound is one of the safest medical imaging techniques currently available, since it doesn't emit radiation and is typically non-invasive. However, compared to other imaging techniques, ultrasound lacks in resolution and fine detail. Recent advancements have been made in beamforming algorithms, signal processing, and other associated ASICs for ultrasound imaging systems; thus, the new difficulty of creating high fidelity ultrasound systems involves connecting capable high-resolution sensors to these advanced circuits. There are many manufacturing challenges with designing dense arrays of sensors and integrating them with ASICs without compromises. Existing approaches are generally difficult and costly to manufacture, rely on flexible circuit boards that cause undesirable parasitic capacitance, feature poor acoustic performance, force restrictions of available ASIC sizes, or require dedicated fabrication lines for certain components. There is a need to integrate new ultrasound processing electronics with capable sensing arrays using a new, feasible manufacturing technique to make widespread adoption possible.

Researchers at the University of California Davis have developed a method of integrating modular arrays of piezoelectric ultrasound sensors with high-bandwidth ASICs for beamforming and signal processing. Multiple independent sub-array modules, consisting of piezoelectric sensors and associated interface electronics, are combined to form a unified large area array, thereby improving the production yield and manufacturing costs while solving other existing issues of ultrasound imaging systems. This design allows for high-bandwidth, large-resolution sensors to integrate seamlessly with advanced ASICs and other electronics in a convenient form factor. Bandwidth limitations are solved with the number of raw data channels available for advanced beamforming algorithms, which also allows for a large dynamic range. The modular design approach makes the physical layout of the system highly versatile, with the possibility of both flat and curved array options. Ultimately, the versatility of this system - in both in the design and manufacturing stages - may contribute to sophisticated ultrasound imaging systems. Researchers at the University of California Davis have developed a method of integrating modular arrays of piezoelectric ultrasound sensors with high-bandwidth ASICs for beamforming and signal processing. Multiple independent sub-array modules, consisting of piezoelectric sensors and associated interface electronics, are combined to form a unified large area array, thereby improving the production yield and manufacturing costs while solving other existing issues of ultrasound imaging systems. This design allows for high-bandwidth, large-resolution sensors to integrate seamlessly with advanced ASICs and other electronics in a convenient form factor. Bandwidth limitations are solved with the number of raw data channels available for advanced beamforming algorithms, which also allows for a large dynamic range. The modular design approach makes the physical layout of the system highly versatile, with the possibility of both flat and curved array options. Ultimately, the versatility of this system - in both in the design and manufacturing stages - may contribute to sophisticated ultrasound imaging systems.

APPLICATIONS

- ▶ Medical imaging and non-destructive evaluation (NDT/NDE) using ultrasound

FEATURES/BENEFITS

- ▶ Improved manufacturing yield and production costs compared to existing large area sensor arrays
- ▶ Many operating modes and aperture configurations
- ▶ Improved image resolution and channel bandwidth

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,134,918	10/05/2021	2017-373
United States Of America	Published Application	200214603	07/09/2020	2017-373
Patent Cooperation Treaty	Published Application	WO 2017/143307	08/24/2017	2017-373

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OTHER INFORMATION

KEYWORDS

ultrasound imaging,
medical imaging,
piezoelectric, sensor array,
beamforming, modular

CATEGORIZED AS

- ▶ **Engineering**
 - ▶ Engineering
 - ▶ Other
- ▶ **Imaging**
 - ▶ Medical
 - ▶ Other
- ▶ **Medical**
 - ▶ Diagnostics
 - ▶ Imaging
- ▶ **Sensors & Instrumentation**
 - ▶ Medical

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