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Ultrasound speckle reduction and image reconstruction using deep learning techniques

Stanford researchers at the Dahl Lab have developed a method to reduce artifacts in ultrasound image reconstruction using a trained convolutional neural network (CNN). The CNN applies machine-learned filters to the pre-beamformed ultrasound channel signals to suppress artifacts, improving overall image quality.
Beamforming with neural networks represents a fundamentally different paradigm for speckle reduction as compared to traditional techniques such as DAS, spatial compounding, and nonlocal means. These beamforming speckle filters operate on the original radiofrequency channel signals, rather than on images that have previously been beamformed with DAS, which are subject to DAS artifacts such as clutter. In addition, unlike existing clutter filters, these filters are capable of reducing clutter and speckle simultaneously.
To the inventors' knowledge, this is the first method to use an artificial neural network to remove speckle and clutter all in one step from raw signals to final image.

Working Prototype

A working prototype of the method that performs real-time imaging at 30 frames per second.

Stage of Research

- Demonstrated feasibility of ultrasound B-mode image reconstruction using machine-learned neural networks
- Simulation results showed that trained networks outperformed spatial compounding in speckle reduction and preserved better details than OBNLM
- Demonstrated a real-time implementation of the method on a research scanner

- Ultrasound image reconstruction

Applications

- Ultrasound imaging reconstructon

Advantages

- Improved image quality
- Can reduce clutter and speckle simultaneously
- Uses machine learning techniques
- Believed to be the first use of artificial neural network to remove speckle and clutter all in one step from raw signals to final image

Patents

- Published Application: 20190295295
- Issued: 11,030,780 (USA)

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