A Software Prototype of Compressed Ultrasound imaging over WIFI
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Motivation and Contributions
- Ultrasound imaging is one of the most common medical imaging technique
- The commercially used US machines are relatively large, with limited image resolution and contrast
- Uncomfortable cable management
- Reducing sampling rate and data size while ensuring high image quality can make US imaging the chosen imaging method in many medical scenarios
- We present a low rate US imaging technique with sub sampled channel data transferred over WIFI

Ultrasound – delay and sum beamforming
- Each individual trace is buried in noise and has no structure
- Structure exists only after beamforming which improves resolution/SNR
- How can we perform beamforming on low rate data?
  Logic:
  1. BMF signal is a stream of pulses => can be recovered from a small number of \( c_k \)
  2. Small number of \( c_k \) requires only a small number of \( \phi_m \)

Convolutional Beamforming – Array Selection
- Image quality is determined by the beampattern of the beamformer, and is given by \( \Phi(\theta, \phi) = \sum_{n=-N}^{N} \phi_k(n) \phi(n) \), where \( M = 2N + 1 \)
- Convolutional beamformer (COBA):
  - Compute \( \gamma_m = \sqrt{\phi_m(n)} \) \( \phi(n) \)
  - Convolve \( S = Y \ast Y \)
  - Sum \( b = \sum_{n=-2N}^{2N} s_n \)
- The resulting beampattern is \( H(\theta, \phi) = \sum_{n=-2N}^{2N} (2N - |n|) e^{-2\pi i \frac{M}{2N} n} \)

Compressed beamforming
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From Vision to Implementation
- Sample within the probe
- Transmit channel data
- Recover in any imaging platform – tablet, cellular …
- Send to cloud for advanced signal processing and AI methods

Software + WIFI
- Enables beamforming from low rate samples
- Key idea: Perform beamforming in frequency

In this model we transfer 0.9~ Mbyte per frame over WIFI. We present 2 Ultrasound image frames per second.