Medical Ultrasound and Compressive Sensing

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MOTIVATION

Super-resolution is a technique to image objects much smaller than the wavelength of the source. Speckle noise and high attenuation of ultrasound waves is a main challenge towards super-resolution in the ultrasound B-scan imaging.

INTRODUCTION

We propose an ultrasound technique based on plane wave imaging. Compressive Sensing (CS) used to reconstruct images of objects significantly smaller than the source wavelength.

Conventional Ultrasound Systems:

- High-frequencies
- High sampling rate
- Beam focusing, scanning

Proposed Plane Wave Method:

- Low-frequencies
- No focusing, scanning
- High-resolution

A single plane wave (unfocused) transmission covering a full region of view with randomly generated waveforms applied to the ultrasound transducer elements.

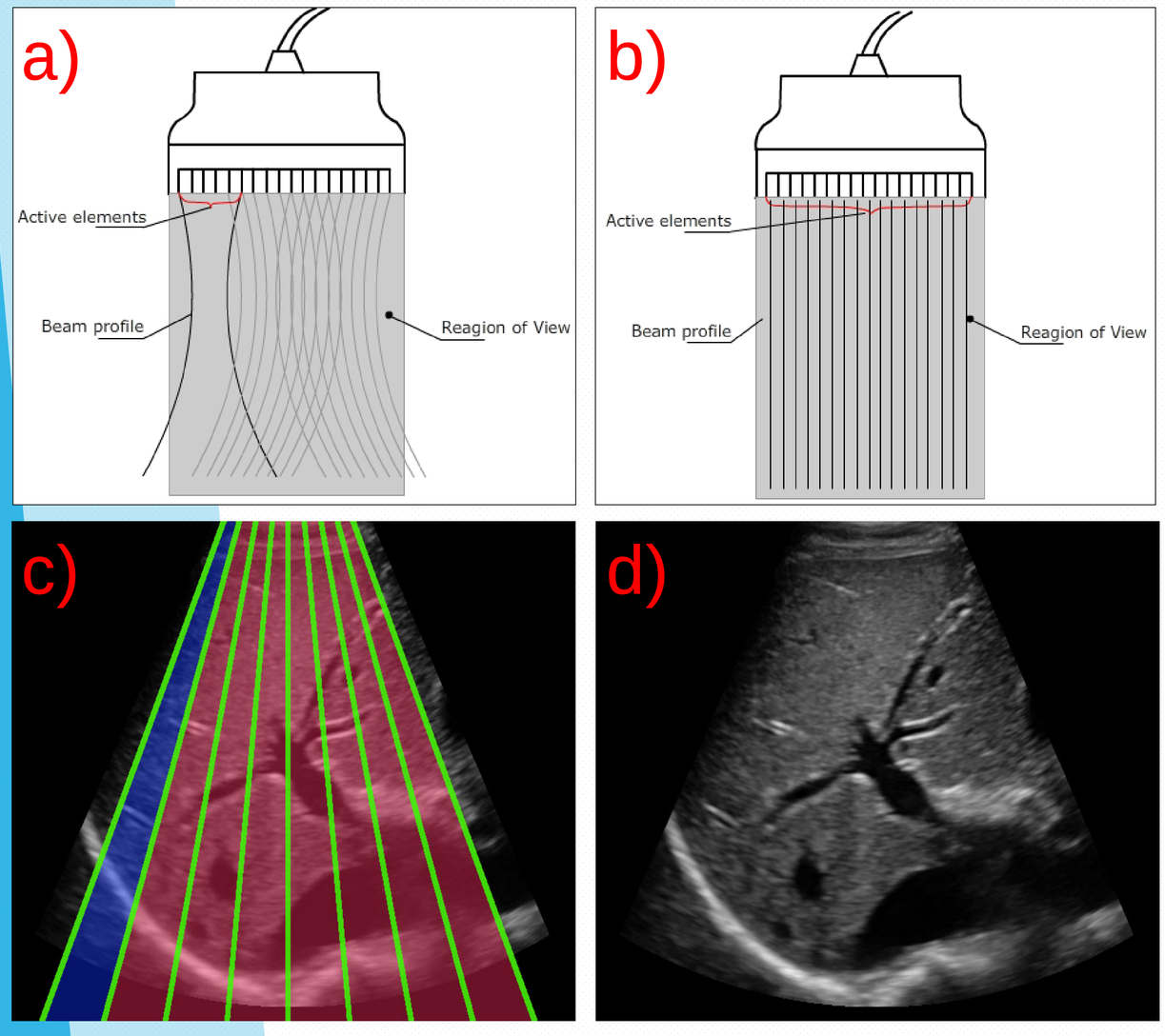
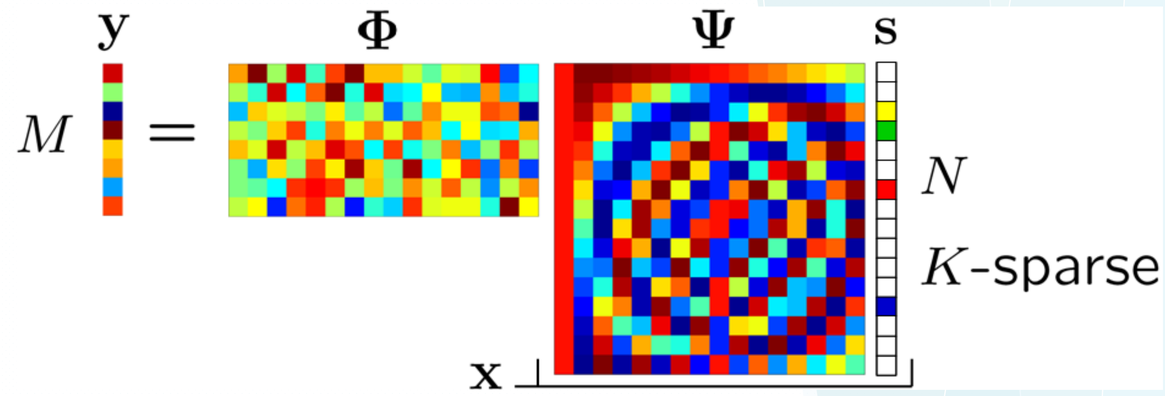


Fig 1. a) Conventional B-mode imaging b) Plane wave imaging c) scanline formation d) Ultrasound image of human liver

METHOD

We use compressive sensing theory to find estimate x. To find K-sparse solution we use YALL1 algorithm which solves $L1$ minimization problem.

$$\hat{s} = \min_{s} \|s\|_1 \text{ subject to } \|\Phi\Psi s - y\|_2 \le \varepsilon$$



RESULT AND FUTURE WORK

We use compressive sensing theory to find estimate x. To find K-sparse solution we use YALL1 algorithm which solves $L1$ minimization problem.