Fast Pediatric MRI

How fast computation is changing our clinical practice

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2013 Par Lab Celebration
Current Solution

INVASIVE LIMITS ACCESS
Why is MRI lengthy?

- Complex protocols with multiple sets of images in multiple planes
- Encoding spatial information takes time
MRI Sampling Concept

Fourier (k)-space

Image space

Fourier transform
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Lossy Three-dimensional JPEG2000 Compression of Abdominal CT Images: Assessment of the Visually Lossless Threshold and Effect of Compression Ratio on Image Quality¹

Ringl et. al., *Radiology* Nov. 2007

8:1 compression ratio visually indistinguishable
Compressed Sensing

Opportunity: Images are compressible.

Why spend time trying to collect information that is not there?
Concept

k-space

Image space

Fourier transform
Compression

Teleradiology approach: First collect, then compress
Compressed Sensing

Instead: Sample less, then reconstruct.

[Image of a diagram showing the process of Compressed Sensing and Compression]

Courtesy M. Lustig

Candes et al. IEEE TIF ’06

Donoho IEEE TIF ’06
2 fold speedup, i.e. 15 second breath-hold vs usual 30 seconds
Barrier to clinical use

Image reconstruction time
Use enabled by Fast Image Reconstruction ( < 1 minute)

Mark Murphy

Kurt Keutzer
5 year old male

No CS

CS

7.2 x speed
Since Last Year: Free-breathing MRI
Resolve cardiac motion

Joseph Cheng

Michael Lustig

Tao Zhang
Exam goals:
Heart anatomy
Heart Chamber volumes
Chamber wall motion
Quantification of blood flow

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Single 4D scan

Real-time stereoscopic rendering/navigation of data

8 minute scan gives same information as conventional 90 minute scan
> 1 day reconstruction time reduced to under 20 minutes as a result of ParLab innovation.
Could go even faster
Thank you Par Lab

Briefer, lighter, safer anesthesia for pediatric MRI