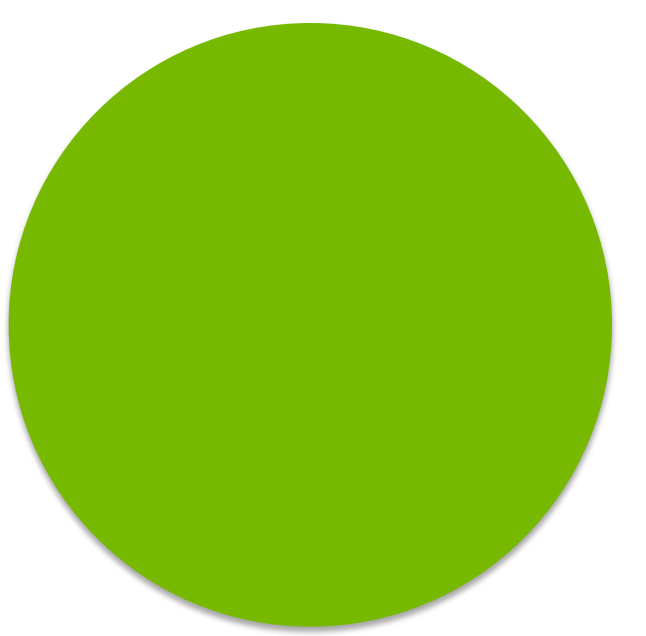


CUDA Accelerated Real Time Volumetric Cardiac Ultrasound Image Enhancement

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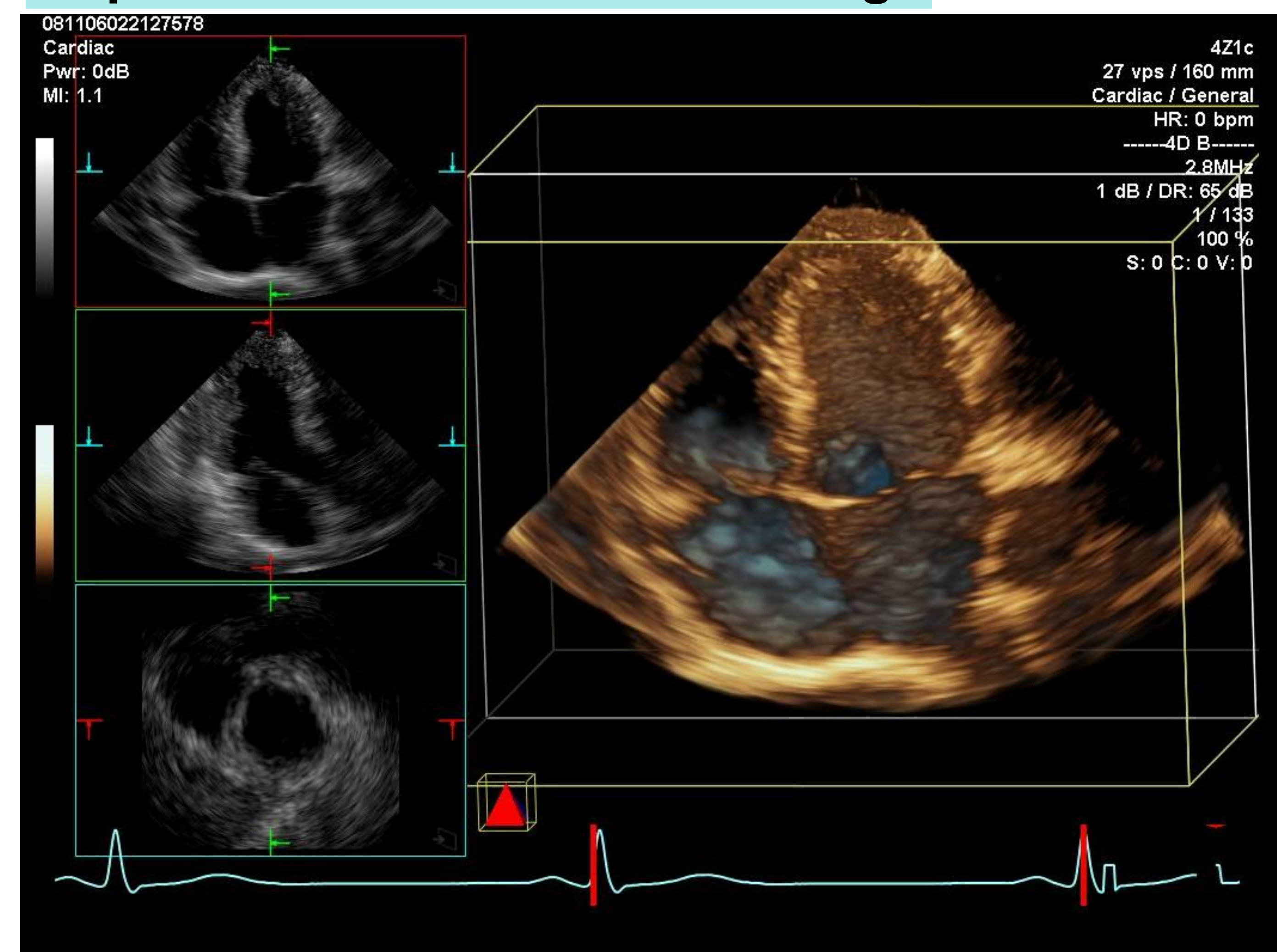
SIEMENS



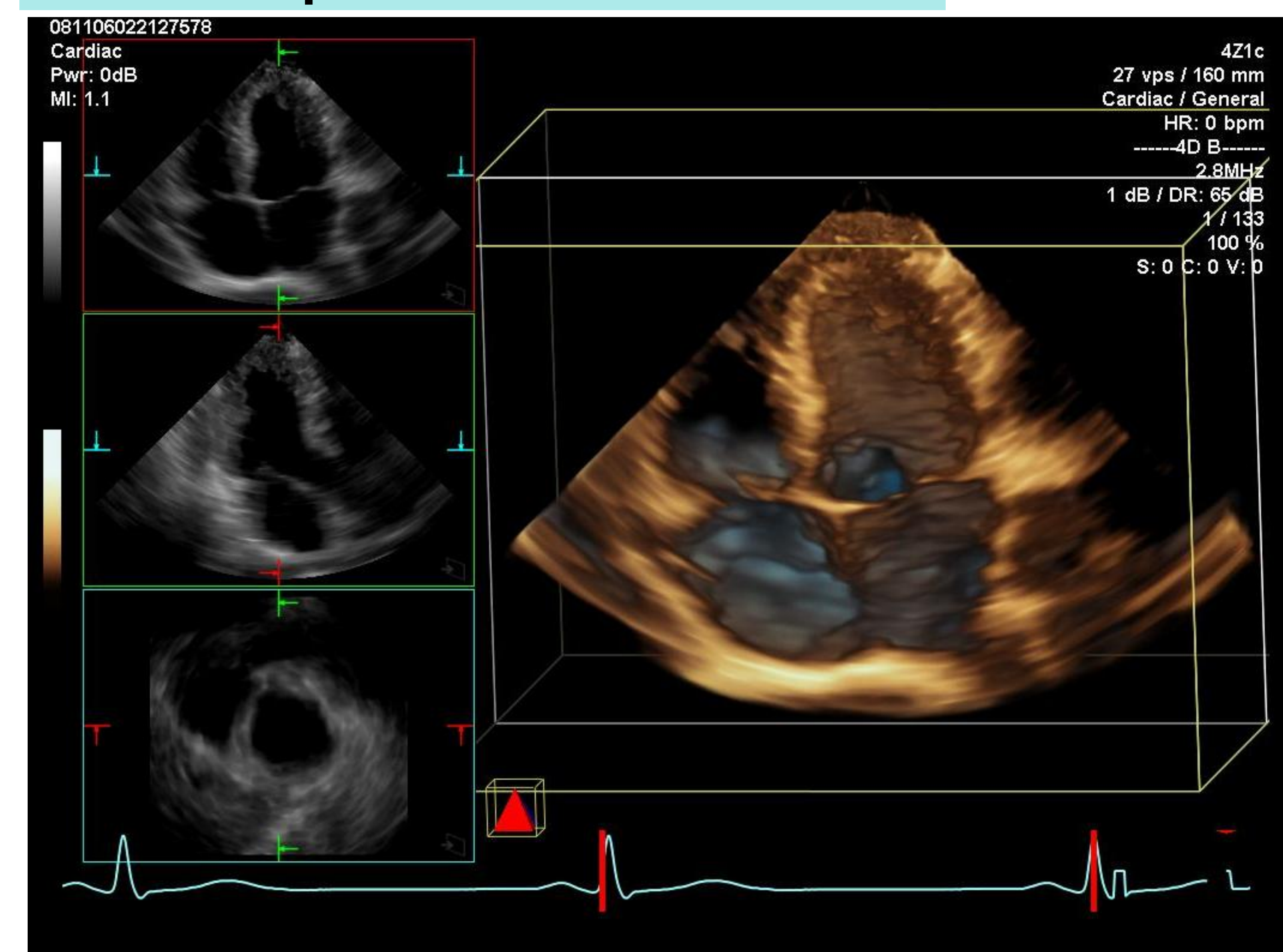
Introduction

- Image enhancement is important for cardiac imaging in diagnostic ultrasound
 - Reduces speckle noise resulting from coherent imaging
 - Improves coherence of anatomic structures
 - Enhances visualization of surfaces
 - Algorithm based on multiple orthogonal surface filters
- Real-time volume data rates are high--on the order of 100 MB/sec
- CPU-based approaches are highly memory access intensive

Unprocessed ultrasound 3D image



Reduced speckle and filled-in walls



Performance measurements

Imaging Condition

- ACUSON SC2000™ volume imaging ultrasound system with 4Z1c 3D transducer
- 160 mm imaging depth at 2.8 MHz
- Volume rate: 19 volumes/sec
- Volume size: $72 \times 137 \times 480 = 4.7$ MB
- Data rate: 90 MB/sec

Software Implementation

- Uses six active cores of a dual quad core 2.13 GHz Xeon
- Performance achieved: 141.7 Msamples/sec
- Imaging condition requires $90/141.7 \times 6/8 = 47.6\%$ of the total available compute power

CUDA Implementation

- 9800 GT (600 MHz core clock, 1800 MHz memory data rate)
- performance achieved: 268.6 Msamples/sec
- imaging condition requires 33.5% of the GPU available compute power

Conclusions

- CUDA implementation speed increased by a factor of 1.9 over dual quad core processors and greater than a factor of 11 over a single core.
- Main memory bandwidth demand reduced by an order of magnitude
- CUDA enables real-time image enhancement while freeing up CPU bandwidth for other activities such as user interface, background storage and streaming and automatic measurements

References

Ustuner, K. High Information Rate Volumetric Ultrasound Imaging
http://www.medical.siemens.com/siemens/sv_SE/gg_us_FBAs/files/misc_downloads/Whitepaper_Ustuner.pdf

