RSNA'03
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Scientific Papers

SESSION: Physics (MR Pulse Sequences, Various Topics)

Apodization in the Slice Encoding Direction for 3D Imaging

DATE: Tuesday, December 02 2003
START TIME: 11:00 AM
END TIME: 11:07 AM
LOCATION: Room S401CD
CODE: G19-702

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Keywords

- Magnetic resonance (MR), artifact
- Magnetic resonance (MR), reconstruction algorithms
- Magnetic resonance (MR), three-dimensional

Abstract:

Purpose: Evaluate the effects of signal apodization in the slice-encoding direction on the reduction of Gibb's ringing in 3D imaging.

Methods and Materials: In Fourier encoded 3D imaging, Gibb's ringing resulting from discrete sampling occurs not only in the frequency and phase directions but also in the slice direction. Two specific windows (modified Hanning and modified Tukey) were analyzed for their effect on measured slice thickness as well as their apparent effect on ringing both in the original source images and in orthogonal reformats. The modified Hanning (mHanning) includes an additional parameter that controls the amount of roll-off. The modified Tukey (mTukey) window is a piece-wise continuous window in which the central region is flat and rolls off towards the edge, with the width of the flat region and the minimum value at the windows ends being controllable. NEMA standard slice thickness measurements were performed on a Signa Lx 1.5T scanner (GE Medical Systems, Milwaukee, WI) for a 32 1.5 mm slice thickness volume and compared to the theoretically calculated full-width half-maximum (FWHM) of the window frequency response for eleven different mHanning and seven different mTukey windows. Three new windows (current GE product, one mHanning, and one mTukey) were tried on an *in vivo* 3D FIESTA brain and contrast-enhanced carotid scans for their effects on ringing and apparent increase in slice thickness.

Results: Theoretical and measured slice thickness were in close agreement with errors ranging from -0.72% to 3.04% and 0.91% to 4.60% for each of the central two slices, respectively. The measured effective slice thickness was generally slightly larger than predicted by theory - most likely due to phantom positioning. As predicted by theory, even when no

window is applied the theoretical FWHM is still 20% larger than the nominal slice thickness. The *in vivo* data demonstrated significantly less ringing and increased signal to noise both in the original source images and in the reformats with the mTukey window giving the overall best trade-off.

Conclusion: In high contrast applications even with relatively thin slices, additional apodization in the slice encoding direction is needed to reduce the inherent ringing. The amount of windowing needed is fairly subjective and also application dependent. A second finding is that to fairly compare slice thickness between 2D and 3D images, the inherent differences between the definitions of slice thickness must first be taken into account. (J.A.P., H.W., F.F. are employees of GE Medical Systems.)

Questions about this event email: jason.polzin@med.ge.com