A water signal based navigator echo for localized ^{1}H-MRS

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Abstract :

A water signal based navigator echo technique is presented for *in vivo* ^{1}H MRS STEAM sequence. The technique was tested on a standard Siemens water phantom as well as a healthy volunteer. The navigator echo faithfully reflected the motion effects in the test phantom and a healthy volunteer with a hysteresis band < 3%.

Introduction:

^{1}H MR single-voxel spectroscopy (MR-SVS) is routinely used to quantify cerebral metabolites *in vivo*. This is a prolonged examination due to the need for averaging to improve SNR. Patient movement during localization arbitrarily affects the localization, and degrades the effectiveness of spectral averaging [1]. Therefore, a scheme which has the ability to detect and discriminate patient head motion during the length of the scan is highly desirable. Here we describe a technique which might eventually allow us to discriminate patient motion in real time.

Methods and Materials :

A water signal based motion detection scheme was implemented on a 1.5 T Siemens Magnetom Sonata whole body MRI system. A conventional STEAM sequence with water suppression for metabolite detection was modified to include a navigator echo for motion detection. Figure 1 illustrates the sequence timing diagram. Modification involved incorporating a 90^o chemically selective (CHESS) water pulse of 51.2 ms duration. The motion sensitized water signal was collected at TE = 26.6 ms. The sequence was first tested on a standard Siemens water phantom and subsequently on a healthy volunteer. Three independent runs were conducted on the phantom: with the phantom in a reference position, with a single tap (step tap) along a pre-determined direction, and randomly tapping the phantom during the length of the sequence. *After the step tap, the phantom remained in its new position for the remaining length of the sequence*. The sequence was subsequently tested on a healthy volunteer. Four independent runs were conducted on the volunteer: one with no motion, repetitive motion along dorsum nasi direction, random motion, and again with no motion. A 6 cc voxel was localized in right sylvian fissure. The volunteer was asked to return head to the original reference position after two motion runs for the last run with no motion.

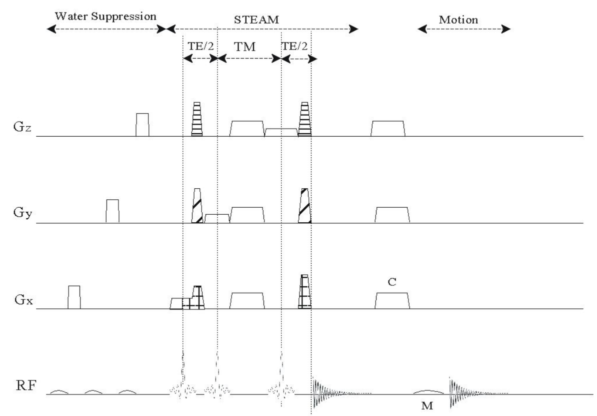

Figure 1. Timing diagram for Navigator Echo STEAM sequence.
M : *CHESS water pulse for Motion Detection..*

Results and Discussion:

Figures 2 and 3 illustrate the trend of the navigator echo for phantom and volunteer. It is evident from both figures that motion signal traces the movement of the phantom as well as volunteer head reliably. The hysteresis band is narrow (< 3%) after the volunteer head motion had ceased, as is evident form figure 3. The offset of motion signal from the basal level can potentially be used to quantify the extent of motion and reject spectra distorted by motion artifact. This is true especially for MR-SVS of elderly or Alzheimer's disease patients who have difficulty remaining still during extended evaluations. The technique permits us to use the uncorrupted spectra in the averaging dataset while excluding the ones corrupted by motion artifacts, based on the motion offset. The use of CHESS water pulse increases the efficacy of the water suppression technique. Further *in vivo* studies are needed to set the tolerance level for rejection of the spectra corrupted by motion to minimize spectral distortions. Future work will also incorporate techniques that facilitate directional motion quantification and use feedback loops to inform the operator about patient motion so that appropriate corrective measures can be adopted.

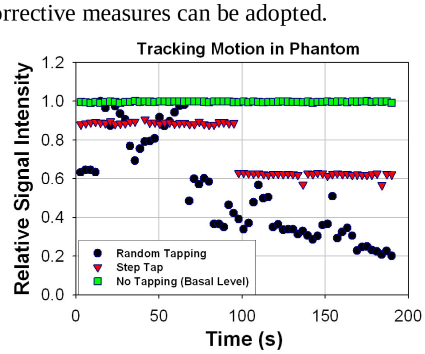

Figure 2. Navigator Echo signal from standard water phantom during three independent runs.

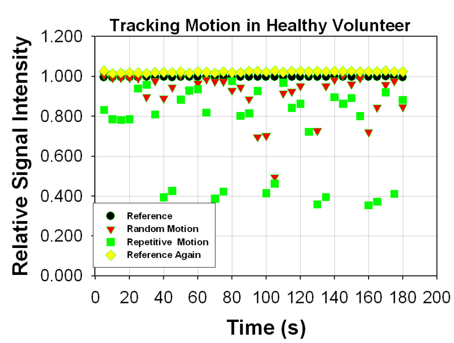

Figure 3. Navigator echo signal from a voxel *in vivo* in a healthy volunteer during four independent runs.

References :

[1]. Zhu G., Gheorghiu. D, Allen. P.S., NMR Biomed , **5** : 209–211, 1992.