

Review #2

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Water fat chemical shift

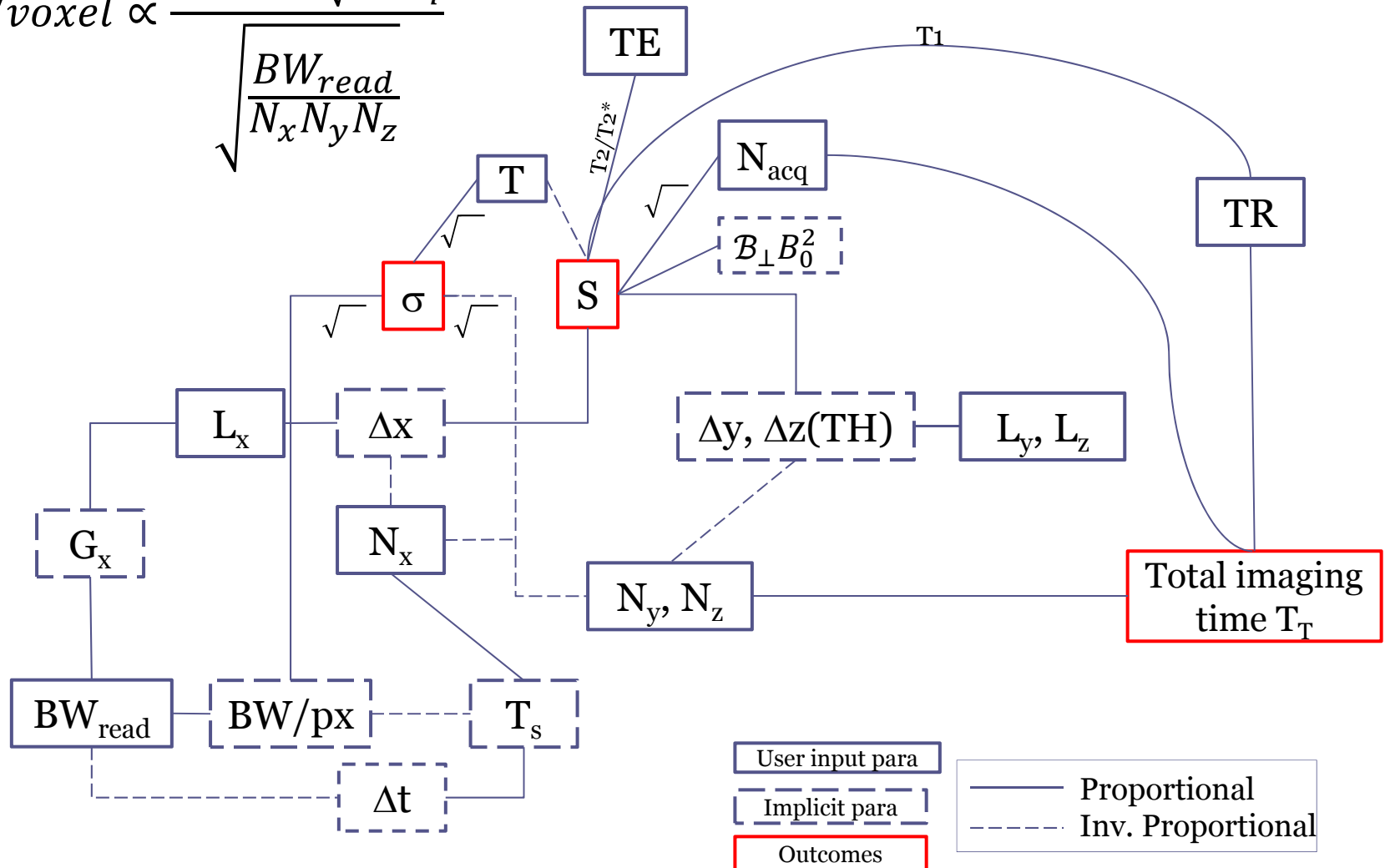
- 3.5 ppm
- Related artifacts
 - Spatial shift
 - Image phase shift
 - Partial volume effects
- Solution
 - High bandwidth, single echo, short TE
 - Fat Saturation/Water Selective excitation
 - Multi-point phase imaging (Dixon, IDEAL)

SNR, Contrast, CNR

- Definition
 - Signal intensity
 - Signal difference/change
 - Noise (origin, calculation)
 - SNR efficiency
- Imaging sequence
- Imaging parameters
 - Flip angle, TE, TR, BW, resolution...
- Intrinsic parameters
 - T₁, T₂(*), PD, T₂/T₁...

SNR dependence on imaging parameters

$$SNR/voxel \propto \frac{\Delta x \Delta y \Delta z \sqrt{N_{acq}}}{\sqrt{\frac{BW_{read}}{N_x N_y N_z}}}$$



Sequence components

- RF pulse
 - Center freq, bandwidth, freq profile
- Gradient
 - RO/PE/SS, strength/duration, gradient moment
- ADC readout
 - Center freq, bandwidth, sampling rate
- Important Sequences
 - 2D/3D Gradient Echo
 - Spin echo
 - EPI

Steady state

- SSI

- Definition, derivation, relevant imaging parameters

$$M_{xy}(\theta, t) = \frac{M_0(1 - E1)}{(1 - E1\cos\theta)} \sin\theta E2$$

- Gradient spoiling mechanism

- SSC

- Definition, relevant imaging parameters
- SSFP, image contrast



BG field inhomogeneity effects

- BG grad along RO
 - BG grad along PE
 - BG grad along SS
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- Effects on RO
 - Effects on PE
 - Effects on SS

K-space

- K-space definition, filling trajectory, segmentation
 - Relationship with gradient, FOV
 - Reordering scheme (ascending/descending/center-out/center-in/random)
 - Segment definition and scheme (interleaved/offset)
- Important Fourier transform theorem
 - Linearity
 - Space shifting

Some important constants

- Proton Gyromagnetic constant γ : $2\pi \cdot 42.58 \text{ MHz/T}$
- Water/fat chemical shift : 3.5ppm
- Units
 - Bo (T)
 - Gradient (mT/m)
 - Bandwidth (Hz, kHz, MHz, or Hz/px)
 - TE/TR/Ts/... (ms)
 - Dimension (mm, cm)



What to bring for Exam #2

- Pen
- Pencil, ruler, eraser
- Calculator (not cell phone)