Symbiosis Between Geophysics and Medicine

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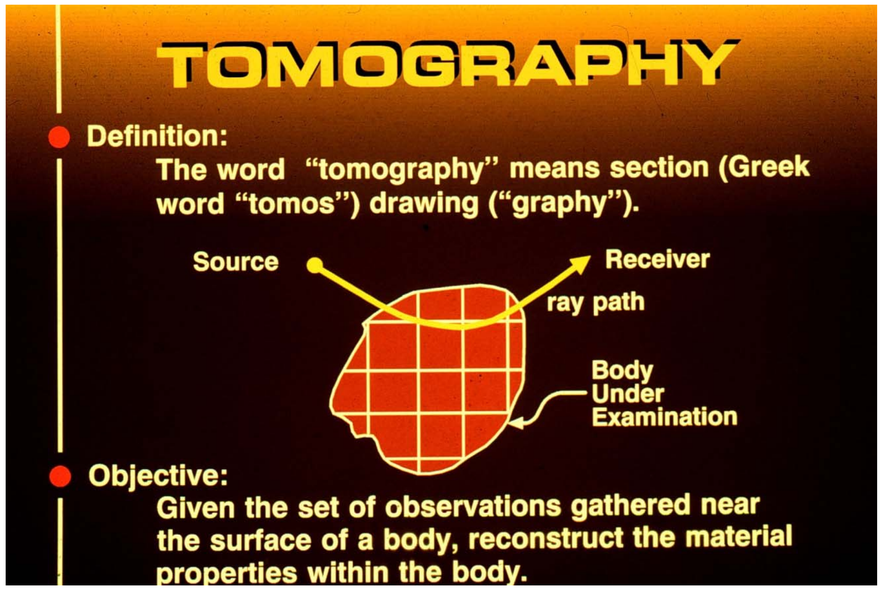
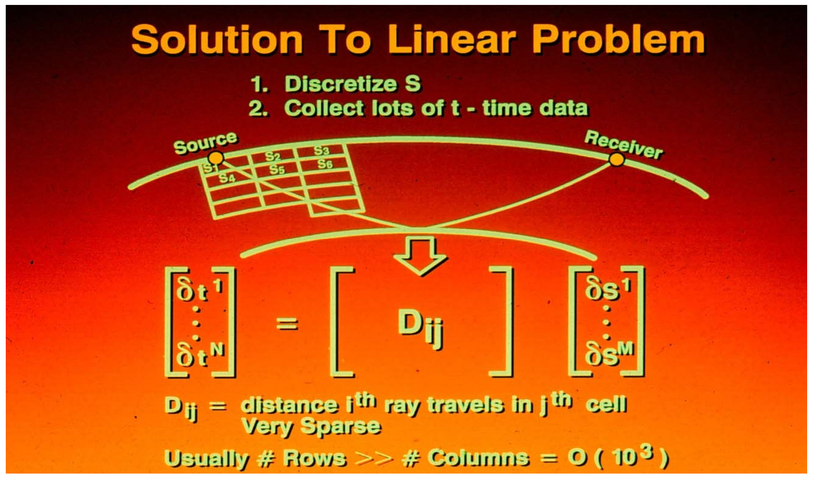
- Simillarities exist between geophysical and medical imaging methods – especially in areas of tomography (acoustical and EM), acoustical reflection imaging and EM reflection imaging
- Due to restricted aperture and ray bending due to large velocity variations, geophysical imaging cannot always use the same algorithms as those used in medical imaging.
- Key question: Are there geophysical algorithms such as deconvolution and migration that will enhance medical images?
- Recommendation: More communication between geophysical and medical imaging scientists could bring synergistic improvement in both fields.



Traveltime tomography



Comparison of Traveltime and Attenuation Tomography

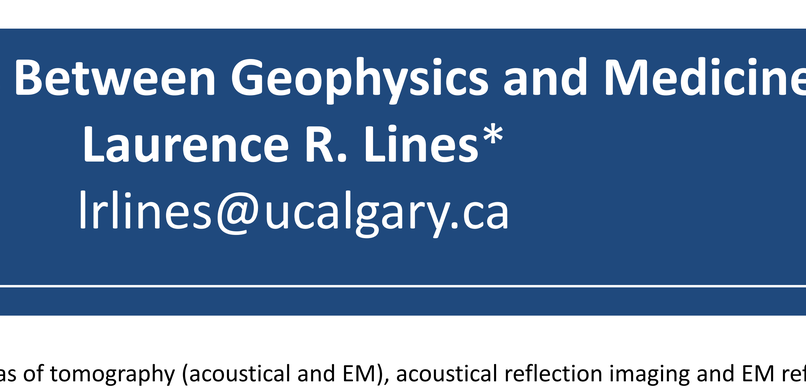
- Traveltime equations

$$\mathbf{Ds} = \mathbf{t}$$

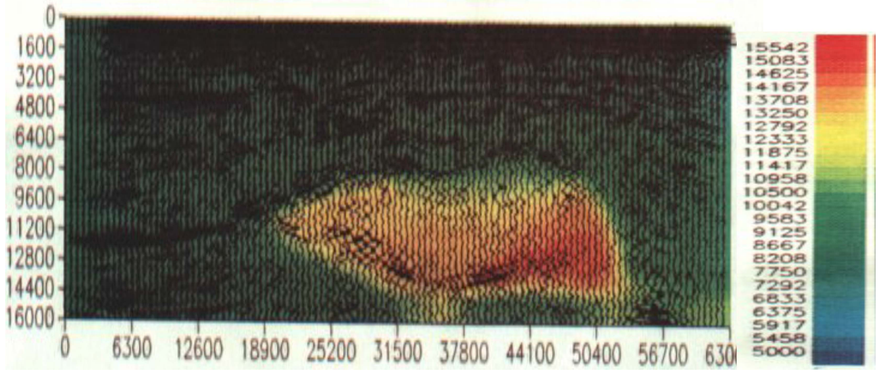
- Attenuation (Centroid Method
  (Quan and Harris, 1997)

$$\mathbf{D}\,\alpha_0 = f_s - f_r$$

α_0 = attenuation coefficient/frequency
f_s = centroid frequency at source normalized by variance
f_r = centroid frequency at receiver normalized by variance



Above results from Quan and Harris (1997) compare a velocity tomogram (left) with Q (inverse attenuation) tomogram (right) and show that high Q and high velocity rocks tend to correlate on crosswell surveys from west Texas. High velocity areas generally correlate with high Q areas. Medical CT scans (right) utilize attenuation tomography of X-ray amplitudes. The projection slice theorem can be effectively applied in CT scans but not in seismic tomography (due to an incomplete aperture).



Reflection imaging: The figure on the left from Lines (1991) shows the overlay of a velocity tomogram on a depth migration for a Gulf of Mexico salt dome. The closest similarity to reflection seismology in medical imaging is ultrasound medical imaging. Reflections of high frequency sound waves or ultrasound waves (frequencies greater than 20,000 Hz) are used to create images. The figure on the right shows an ultrasound image of a human fetus 2 months prior to birth is shown (courtesy of Dr. Wendy Benoit).