Using scan lines to make accurate time measurements

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Timing measurements
Timing data: constriction size

cigar (video time)

distance (mm)

-40.0 0.0 40.0 80.0 120.0 160.0 200.0

time (ms)

S ʊ g
The problem

- Our SonoSite TITAN™ ultrasound unit with C-11/7-4 11-mm broadband curved array transducer takes 36.5 ms to complete a scan.

- Events which appear simultaneous may have occurred at different times.

- Events which appear asynchronous may have occurred at the same time.
New/old information

- After a scan, the right edge is 36.5 ms older than the left.
- The alveolar constriction is about 30° behind the velar.
- 30° ~ 12 ms.
New/old information

- The left side of a scan line is 36.5 ms behind the right side.
- The velar constriction is about 60° behind the alveolar.
- 60° ~ 24 ms.

36.5 ms ago
now
now
Scan line facts

- Scan lines are most noticeable in the middle of the image, but every image has one.
- Scan lines are curved because echoes from farther away take longer to get back.
- Our video is 60 fps (after deinterlacing), so the scan line travels about 42° per frame.
Scan lines in action
Timing data: reprise

cigar (scan time)

distance (mm) vs. time (ms)

-40  0  40  80  120  160  200

s  e  g
Timing data: reprise
New/old information

- Information used to locate the palate is newer than most of the image.
- Previous frames contain the relevant head/transducer info.
Discussion

• Event time is a function of time and angles:

\[ t_{\text{event}} = t_{\text{video}} - 0.405 (\alpha_{\text{scan}} - \alpha_{\text{event}}) \]

• Compensation for head/transducer movement should consider video at time of event (usually 1 or 2 frames back).

• Easier to take into account info from other frames when analyzing sequences of frames (this is also when it is most helpful).