What Does “Slow Response” Mean for Images?

Slow Response of Sensor Produces "Smeared" Image “Lag” Blurs Sharp Corners

Sidebar: High-Contrast Makeup

Jane Carr made up for BBC Telecast November 15, 1932
“T’m ready for my closeup, Mr. DeMille.”

Signal Specs for Baird BBC TV

- 30 lines per frame (vs. 525 in NTSC)
- vertical scan instead of horizontal
- ≧ 70 spots per line (vs. 480 in NTSC)
- 3:7 aspect ratio (vs. 4:3 for NTSC)
- 12.5 frames per second (vs. 30 in NTSC)
- Video Signal Bandwidth
  ≧ 30 lpf × 70 spl ×12.5 fps = 26,250 spots per sec.
  ⇒ max frequency \( \nu_{\text{max}} = 13,125 \text{ Hz } \equiv 13 \text{ kHz} \)
  ⇒ Video Signal at AUDIO FREQUENCIES!!
  (was transmitted by AM radio)
Schematic of Baird TV Receiver

Baird "Televisor" Receiver
- Manufactured by Plessey Co., UK, 1930
  - Reports of Production Vary
    - 1000 to "several thousand"
  - Reports of Price Vary
    - £18 (≈ $86 US then, ≈ $1000 now)
    - (BBC quotes £100 = $480)
- Displayed video from transmitted radio signal
- Received BBC 30-line broadcasts (1932-1935)
- Image size ≈ 20mm × 60mm (≈ 0.8" × 2.4")

Televisors Also Sold as Kits
- £7 in 1930 (≈ $33 US)
1930 TV Dramatization

"The Man with the Flower in His Mouth"
by Luigi Pirandello

- Broadcast from Baird’s Studio in London by BBC
  - 3:30 PM, Monday July 14, 1930
    - video @ 330m (910 kHz), audio @ 261m (1150 kHz)
- Received in Dublin and Lisbon (!)
- Directed by Val Gielgud
  - (elder brother of Sir John Gielgud)

- The Actors
  - The Man: Earle Grey
  - The Woman (his wife): Gladys Young
  - The Customer: Lionel Millard
  - Narrator: Lance Sieveking
1930 Video “Studio”

- One fixed camera
  - 29 “scenes”
  - no pan or zoom
- One actor at a time
- Actors switched places behind “fade board”
- First recorded instance of make-up to accentuate the actor’s features

1967 Recreation of Play on 30-Line Video

- Recorded on stereo tape, audio and video in separate audio tracks
  - Lance Sieveking (original Producer) did voiceovers
  - Original music (from 78 rpm audio disc)
  - Original artwork, by C.R. Nevinson
  - Unnamed Student Actors from Inner London Education Authority (ILEA)
- Shown at Ideal Home Exhibition of 1968 on an original Televisor

1967 30-Line Camera

- Modified from Baird Televisor by Bill Elliott
  - Engineer for Granada Television in UK
- Converted one Televisor into camera by replacing neon display bulb with photomultiplier
- Lens placed focused scene onto disc
- Result displayed either on second Televisor or on homemade CRT display
Significant Error in Video

- First televised drama was broadcast September 11, 1928 by GE, Schenectady
  - 40-minute play “The Queen’s Messenger”
    - video broadcast over W2XAD
    - audio over WGY
- 24 scanning lines
- 3 cameras
  - one on each of two actors
  - one on props
- Reported on front page of New York Times next day

BBC 30-Line Broadcasting Service
BBC 30-Line Television Service

- Baird System
  - Began 11:02 PM, Monday, 8/22/1932
  - One 30-min. program, 4 nights per week
- Ran until 9/11/1935
  - (hiatus to change studios in 2/1934)

Logo Card for BBC 30-Line Service

Logo Looks Familiar?

Advance of Technology...

- 30-line broadcasts replaced with 405-line service
  - alternated broadcasts using Baird and Marconi/EMI all-electronic systems
  11/2/1936 – 9/1/1939

Why Did It End?
Signal Specs for Baird BBC TV

- 12.5 frames per second (vs. 30 in NTSC)
- Video Signal Bandwidth
  \(\cong 30 \text{ lpf} \times 70 \text{ spl} \times 12.5 \text{ fps} = 26,250 \text{ spots per sec.}\)
  \(\Rightarrow\) max frequency \(\nu_{\text{max}} = 13,125 \text{ Hz} \cong 13 \text{ kHz}\)
  assume \(\nu_{\text{min}} = 0 \text{ Hz}\) \(\Rightarrow\) bandwidth \(\cong 13 \text{ kHz}\)

\(\Rightarrow\) Video Signal at AUDIO FREQUENCIES!!
\(\Rightarrow\) Transmitted by AM radio
Baird “Phonovision”

- Gramophone records
  - 10"-diameter shellac discs
  - (analogous to vinyl!)
- first disc dated September 20, 1927
  - four months after Lindbergh’s flight
  - seven years after first scheduled AM radio broadcasts

Needle in Groove

- Needle converts groove to motion
- Motion converted to electronic signal
  - by electromagnetic or piezoelectric interaction
  - electromagnetic vs. crystal cartridge

Response of Needle vs. Frequency

- Needle responds "well" to low frequencies
  - Can track more easily in groove
- Responds "less well" to high frequencies
- Need to "Compensate" for Response of Needle + Cartridge
  - by "Equalization"
**RIAA Equalization for Disc Recording**

- During Recording:
  - Reduce Amplitudes of Low Frequencies
  - Amplify Amplitudes of High Frequencies

---

**Significance of Phonovision**

- World’s first recorded electronic images
- Pre-dated invention of first practicable videorecorder (Ampex VR1000) by 25+ years
- Predated of home video by 50 years (±)
- Many of Baird’s problems were overcome later ONLY by investing much time and money for teams of technicians

---

**Planned Phonovision Player**

- 10-spiral Nipkow disc
  - 10 scans per rotation
  - 12.5 frames per second
  - Rotates with disc turntable
  - Improves synchronization
- Viewed directly through port
  - Promotes Chiropractic Care!
Later Proposal for Phonodisc Player

Baird’s Solution for Recording Audio with Video
- Both Signals on Same Side of One Disc

Baby Boomer Quiz
Q: How many grooves on the LP disc "Matching Tie and Handkerchief?"
A. 500 \( (= 15 \text{ min} \times 33 \frac{1}{3} \text{ rpm}) \)
B. 2 (one per side)
C. 3

Answer: C, 3!

Schematic of “Matching T&H” Side 1
- Two interlaced grooves with different programs
- Which program plays is determined by (random) drop of tonearm

"Boy, that is a short record!"
Baird Recording of Audio and Video on Same Disc

- Audio and Video in Separate Grooves
  - one each with horizontal and vertical vibration

1926 Illustration of Phonovision, showing “hill-and-dale” concept of two tracks
http://homepages.strath.ac.uk/~clcs09/pete/jlb/jlb.htm

Baird Patent #320,909 for Playback System

- Two “Tonearms” for Simultaneous Pickup

Might Remind Boomers of Their Analog Past

- Stereo LPs recorded two signals along orthogonal axes in same groove
  - originally Horizontal, Vertical
  - later 2 channels at ±45° from vertical
**Phonovision Recording Speed**

- Discs store 90 scan lines per rotation
  - Three 30-line frames per rotation
- 78 rpm playback ⇒ 3.9 frames per second
- If video at 12.5 frames per second, number of rotations per second would be:
  - \( \frac{12.5}{3} = 4 \frac{1}{6} \) rotations per second
  - = 250 rpm
  (Record would have had to rotate at 250 rpm instead of 78 rpm)
⇒ Slower frame rate must have been used

**Phonovision Recording Studio**

30-line Nipkow disc
Illumination
Subject
Connecting Shaft
Platter

Computer graphic © Don McLean: [http://www.tvdawn.com/articles.htm](http://www.tvdawn.com/articles.htm)