Issues in Voice and Video Coding

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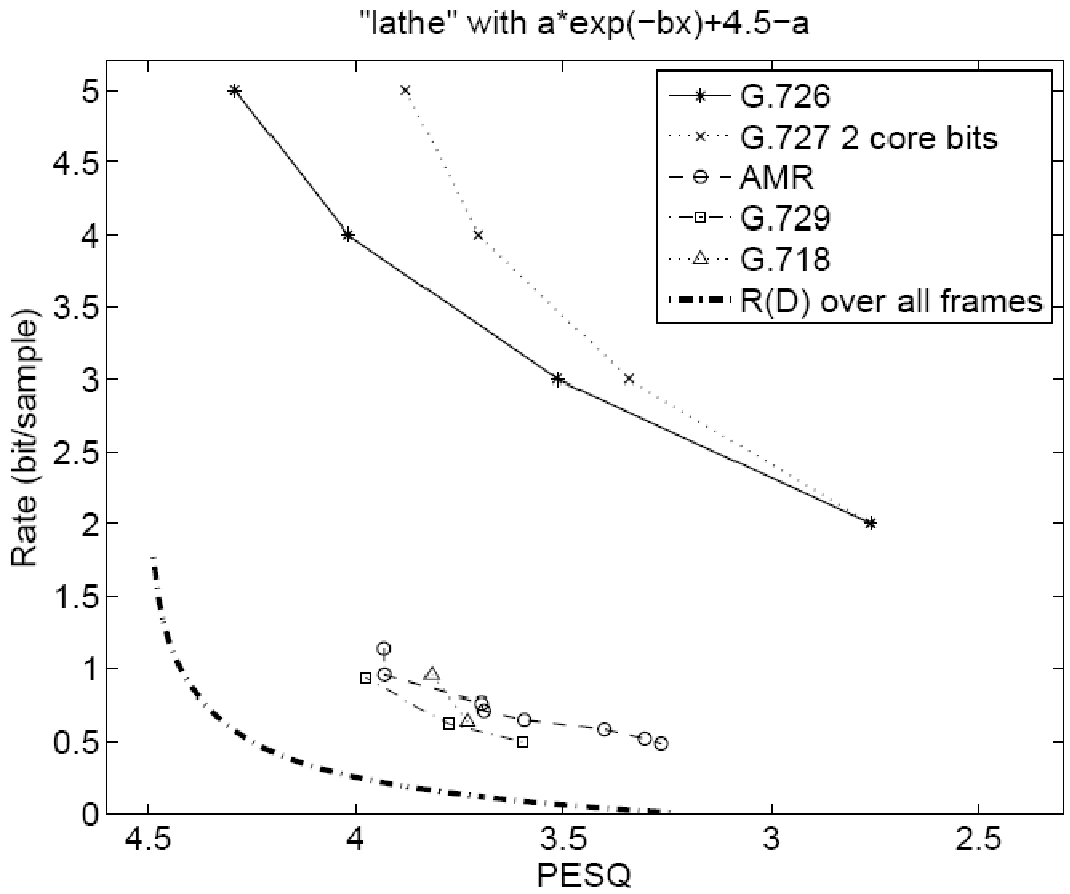
Primary Considerations in Voice and Video Coding

- Rate
- Distortion
- Complexity
- Latency

Bounding the Performance of Best Known Voice Codecs [1]



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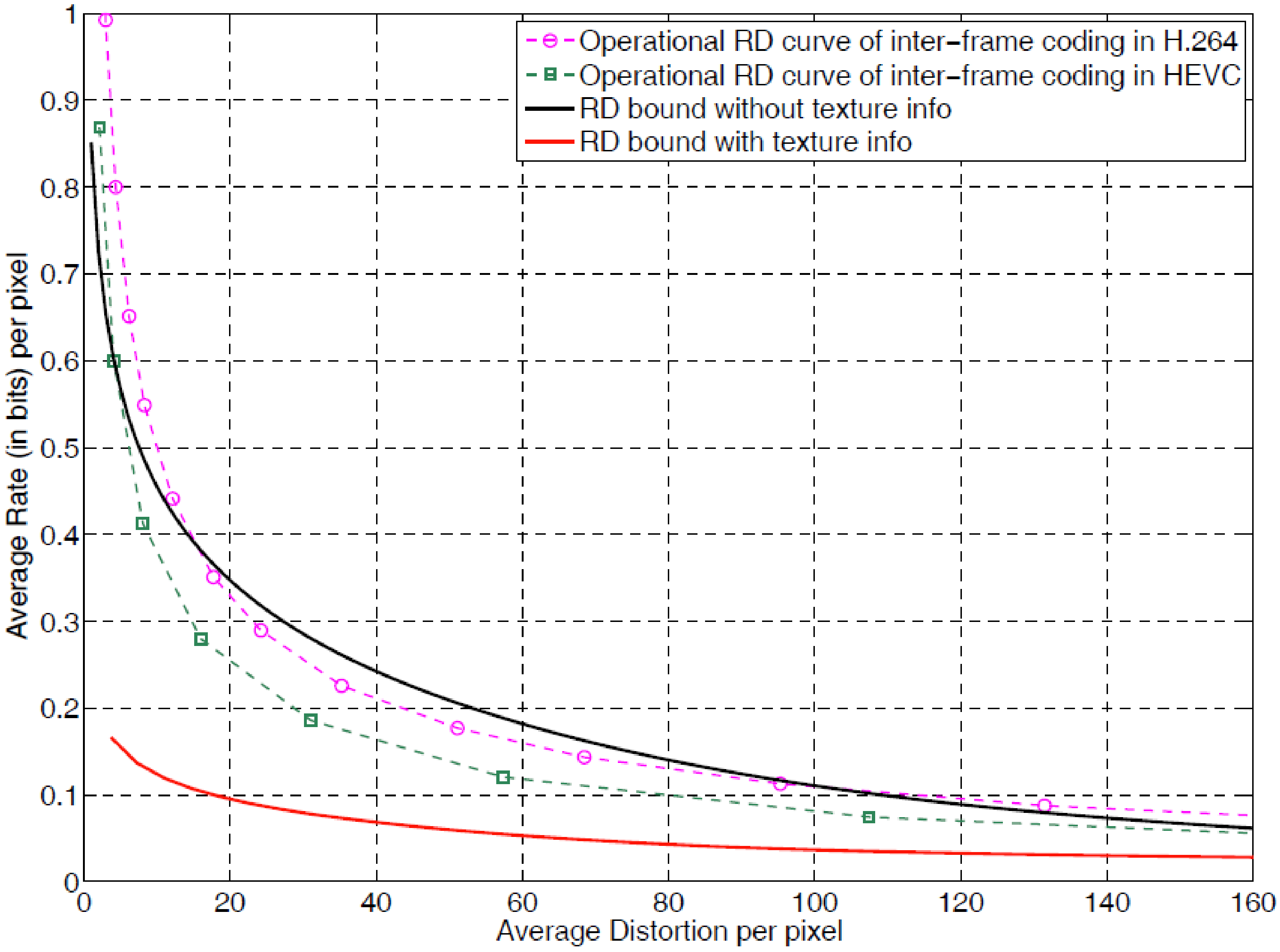
Bounding the Performance of Best Known Video Codecs—Intra/Inter Mode [2-4]



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What About Latency and Complexity?

- Does Algorithmic Delay Deserve More Attention?
- Is Complexity Becoming Too Much?

Narrowband (300-3400 Hz, 8 kHz sampling rate) speech codecs [5]

Formal Name	ITU-T G.711	ITU-T G.726	ITU-T G.729	3GPP AMR
Technology	Log PCM	ADPCM	CS-ACELP	ACELP
Bitrate(s) (kbits/sec)	48, 56, 64	16, 24, 32, 40	6.4, 8, 11.8	4.75, 5.15, 5.9, 6.7, 7.4, 7.95, 10.2, 12.2
Algorithmic Delay (msec)	0.125	0.125	15	25
Comp. Complexity (give units)	0.01 MIPS	1.25 MIPS	18 MIPS	11.9-16.7 WMOPS

Wideband Speech Codecs [5]

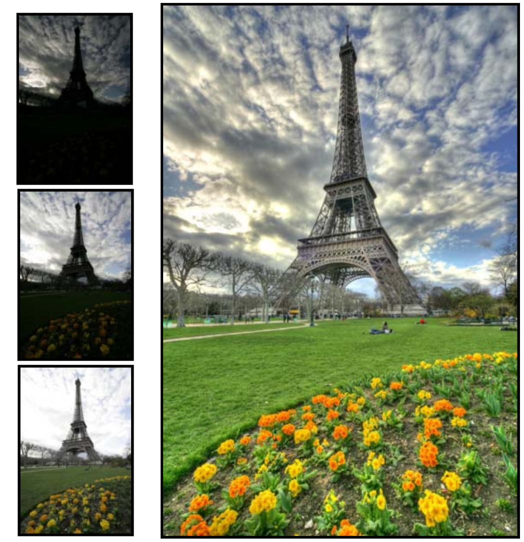
Formal Name	ITU-T G.722	ITU-T G.722.1	ITU-T G.722.2 3GPP AMR-WB	ITU-T G.718	ITU-T G.719
Technology	Sub-band ADPCM	MLT	ACELP	ACELP, MDCT	Adaptive resolution MDCT, FLVQ
Audio Bandwidth(Hz)	50-7000	50-7000	50-7000	50-7000	20-20000
Bitrate(s) (kbits/sec)	48, 56, 64	24, 32	6.6, 8.85, 12.65, 14.25, 15.85, 18.25, 19.85, 23.05, 23.85	8,12,16,24,32 & 12.65 (G.722.2, AMR-WB, VMR-WB Interop Mode)	32...128 steps of 4 kbps up to 96 kbps, steps of 8 kbps up to 128 kbps
Algorithmic Delay (msec)	1.625	40	25	32.875 to 43.875	40
Comp. Complexity	10 MIPS	< 5.5 WMOPS	27.2-39.0 WMOPS	57 WMOPS	15.39 - 21 WMOPS

Current Efforts for Voice/Audio Coding: Quality of User Experience

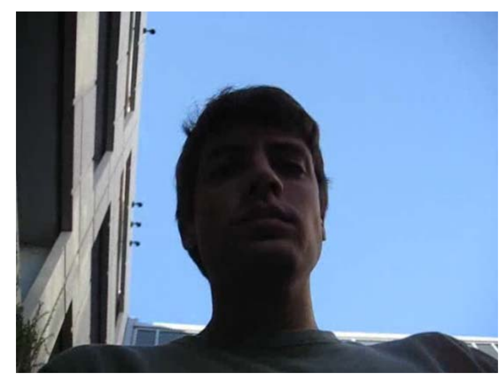
- Wider Bandwidths
  - Narrowband (200 to 3400 Hz)
  - Wideband (50 Hz to 7 kHz)
  - Superwideband (50 Hz to 14 kHz)
  - Fullband (20 Hz to 20 kHz)
- Stereo
- Spatial Localization
- Multiparty Calls
- Acoustic and Background Noise

High Dynamic Range Video for Handhelds

- Inexpensive video cameras have limited dynamic range – saturated pixels [6]
- HDR photography combines multiple exposures, yet we **need new methods for video** [7]
- Applications:
  - Videoconferencing
    - Saturated pixels on user’s face hurt experience
    - Mobile/Handhelds: extreme outdoor lighting conditions
  - Security/Surveillance [8]
    - Dynamic range crucial to “see” environment
    - Temporal fidelity secondary
  - Need low-cost solution (<$10)



HDR Still Photography

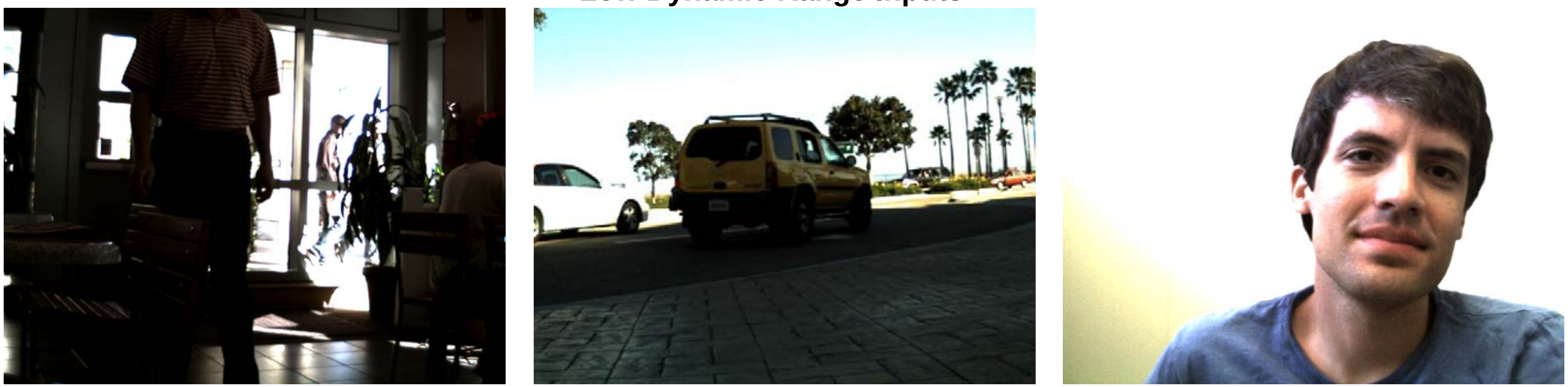


Mobile Videoconferencing (poor lighting!)

Recent Results on High Dynamic Range Video for Handhelds

- Alternate between short/long exposures
- Combine adjacent frames to achieve HDR at the **same frame rate**
- Need to **remove ghosting** with motion compensation and filtering [9]

Low Dynamic Range Inputs



High Dynamic Range Outputs

Viewing and Sensing 3D Video on Handhelds

- Glasses-free autostereoscopic displays now available on handheld gaming devices and phones
- Back-facing stereo cameras are standard
- Front-facing stereo cameras – **3D Videoconferencing**
- 3D can enhance experience if done correctly

HTC EVO 3D

LG Thrill

Front-facing Stereo Camera?

Issues for Handheld 3D Videoconferencing

- How to achieve effective and comfortable 3D for video communications on handhelds
- Close-up stereo photography is notoriously difficult! [10-11]
  - Optimal camera placement for display and analysis not the same
    - Need small stereo baseline (~9mm!) to reduce disparities
    - Need wider baseline for significant depth reconstruction
  - Need to **adjust disparities in real-time** according to scene depth [12]
- **Combine 3D and HDR**

Handheld 3D Videoconferencing

Nintendo 3DS "Depth Slider"

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