

The Effects of Jitter on the Perceptual Quality of Video

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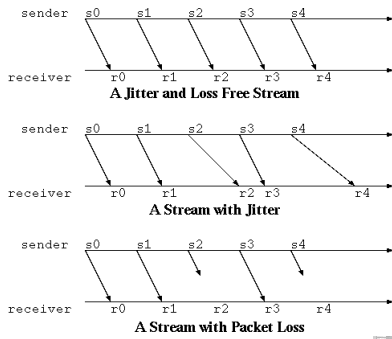


Motivation

- Computers are powerful
- Networks have high bandwidth
 - Video across the Internet to the desktop is possible
- But ... the Internet is not optimized for video playback
 - bandwidth limitations (loss)
 - delivery limitations (loss)
 - timing guarantee limitations (delay and jitter)



Loss and Jitter in a Video Stream



Effects on Perceptual Quality

- Effects of delay is well-studied
 - (Roy, 1994) ATM recommendations
 - (Dimolitsas+, 1993) Teleconf
- Effects of loss is well-studied
 - (Massimino and Sheridan, 1994) Teleoperators
 - (Gringeri +, 1998) MPEG-2 over lossy ATM
 - (Perkins, Hodson and Hardman, 1998) SuperJ
- Reducing jitter is well-studied
 - (Ramjee + 1994) Buffering
 - (Stone and Jeffay, 1995) Buffering
- But, ... effects of jitter on PQ are not studied



Experiments

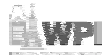
- Induce Loss and Jitter in Video
 - levels: none ("perfect"), low and high
 - based on Internet traces (GBC98)
 - Same "amount" of loss and jitter
- Users give perceptual quality rating
 - Slider (reading is 1-1000), labeled best-worst
 - over 40 users
 - most students, 20-25 years, CS majors
- Video clips
 - 1 minute clips, sampled from television
 - Temporal vs. Spatial redundancy



Sample Clip: News



Sample Clip: Sports



Sample Clip: Home Shopping



Sample Clip: Animation



Sample Clip: Sitcom



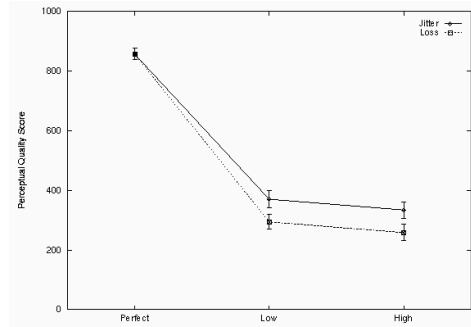
Video Playout

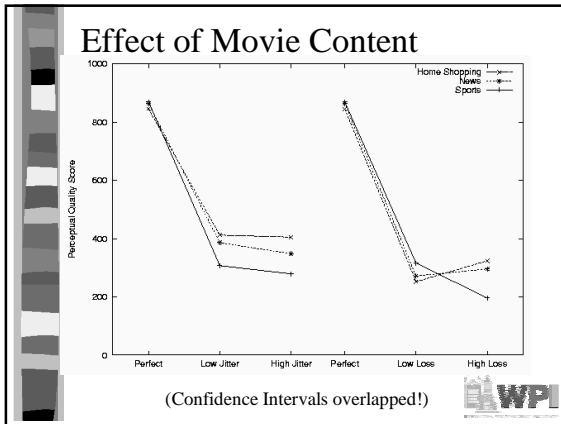
	<i>ski</i>	<i>hockey</i>	<i>cnn</i>	<i>shopping</i>
Group 1	low jitter	high jitter	low loss	high loss
Group 2	high loss	low loss	high jitter	perfect
Group 3	low loss	perfect	low jitter	high jitter
Group 4	high jitter	high loss	perfect	low loss
Group 5	perfect	low loss	high loss	low jitter

- Reduce effects of order of quality
- First picture was "perfect" to prime users equally



Effect of Jitter





Conclusions

- Jitter can degrade perceptual quality as much as loss
- Low amount of jitter or loss severely degrade quality
- Video content determines effects of jitter or loss only slightly

