画像情報特論 (1)
Advanced Image Information (1)

Advanced Visual Communication ?

はじめに
Class Overview

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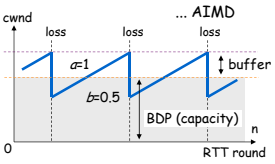
This Year's Schedule

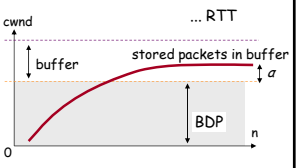
(tentative)

4/11	Class overview
4/18	Video Streaming (1) TCP/IP
4/25	Video Streaming (2) TFRC, HTTP
5/09	Video Streaming (3) Wireless
5/16	Self-study (CourseN@vi)
5/23	Video Streaming (4) CDN
5/30	Self-Study (CourseN@vi)
6/06	Video Compression (1) H.264/AVC
6/13	Video Compression (2) H.265/HEVC
6/20	Image Processing (1) Super-Resolution
6/27	Image Processing (2) 3D Image Processing
7/04	Image Processing (3) Feature Extraction
7/11	Self-study ?
7/18	Image Processing (4) Sparse Coding
TBD	Final report

Video streaming (1) TCP/IP

- Loss-driven
- Delay-driven





TCP-Reno, High-Speed TCP, TCP-Westwood, CUBIC-TCP, ...

BDP/Buffer relationship

small buffer → × efficiency
large buffer → × delay

TCP-Vegas, FAST-TCP

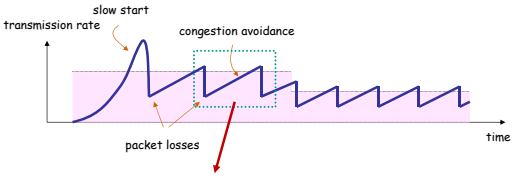
Unfairness by loss-driven TCP

× friendliness

BDP: Bandwidth-Delay Product

Video streaming (2) TFRC

- TFRC



Modeling of steady-state TCP behaviors

$$R = \frac{1}{RTT}\sqrt{\frac{3}{2p}}$$

p: packet loss rate

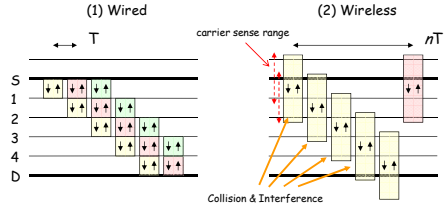
BDP/Buffer relationship

small buffer → × efficiency
large buffer → × delay

TFRC: TCP Friendly Rate Control

Video streaming (3) Wireless

- Single-Channel Multi-hop Network

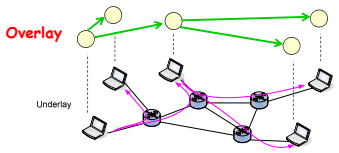


Channel Efficiency = 1

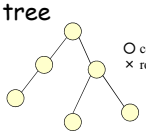
Channel Efficiency = 1/*n*
(*n* : # of multi-hops)

Video streaming (4) CDN, P2P & Cloud

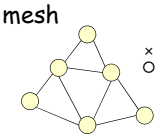
- Overlay networks



- tree
- mesh



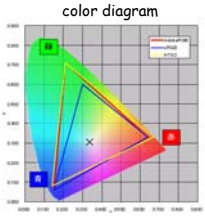
○ complexity
× robustness



× complexity
○ robustness

Video Compression (2) H.265

- H.265/HEVC
  - HEVC: High Efficiency Video Coding
  - NGVC: Next Generation Video Coding
- Other topics
  - Higher resolution
    - spatial: U-HDTV
    - temporal: 10,000 frames
  - Gamut expansion
  - High dynamic range
  - 3D / freeviewpoint



http://plusd.itmedia.co.jp/pcuser/articles/0805/23/news001.html

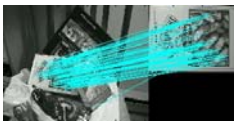
Super-resolution

- Super-resolution
  - Missing frequency estimation (freq. domain)
  - Multiple image approach (registration)
  - Single image approach (example-based, data-base)

S.Farsiu et al.: "Advances and Challenges in Super-Resolution", IJIST, Aug.2004.

Feature Extraction

- Scale Invariant Feature Transform



SIFT descriptors
Point correspondence

oriented gradients
in local regions

Human body detection

- Histogram of Oriented Gradient

http://www.cs.ubc.ca/~lowe/keypoints/, http://www.navneetdalal.com/

Sparse Coding (1)

- Sparse Decomposition

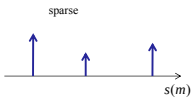
$$\mathbf{f} = A\mathbf{s}$$

M=N: complete (orthogonal, unique)
M>N: overcomplete (infinite solutions)

f: N-d vector (input)
A: MxN matrix (transform matrix)
s: M-d vector (transform coefficient)

$$\hat{\mathbf{s}} = \arg\min_{s} \frac{1}{2}\|\mathbf{f} - A\mathbf{s}\|_2^2 + \lambda\|\mathbf{s}\|_1$$

L2-norm (Euclid) L1-norm



Sparse Coding (2)

- Sparse Coding

$$\left(\hat{A}, \hat{s}\right) = \arg\min_{A,\mathbf{s}} \frac{1}{2}\sum_i \|\mathbf{f}_i - A\mathbf{s}_i\|_2^2 + \sum_i \|\mathbf{s}_i\|_1$$

Basis vector learning from sample images

Original Noisy (12.77dB) Denoise (29.87dB)

http://www.cs.technion.ac.il/~elad/talks/

Preparation

- Tools
  - ns-2 / ns-3
  - OpenCV
  - MATLAB (Image Processing Toolbox)