Explorative Analysis and Visualization of Large Information Spaces

Optimized Network-Adaptive Multimedia Transmission over Packet Erasure Channels

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1 Introduction

- Time-constrained transmission of multimedia.
- Packets are lost and delayed - poor perceived quality.
- TCP may not work well under high loss rate.
- We focus on *Forward Error Correction* (FEC) based solutions.

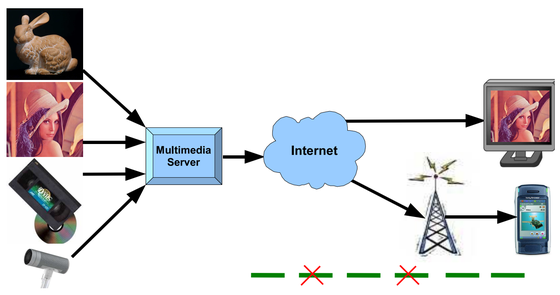


Fig. 1: Multimedia transmission over packet erasure channels

2 Transmission of 3D Meshes

- Progressive compression and transmission.
- For a given total transmission bit budget and packet loss rate:
  - How many layers to be sent?
  - How much protection should be used for each of the sent layers?
- Previous work:
  - Constrained exhaustive search - not optimal.
  - Poor block of packets (BOP) construction.
- Our proposed solution: [1, 2, 4]
  - An exact algorithm - linear time and space - Optimal solution
  - An efficient BOP construction.

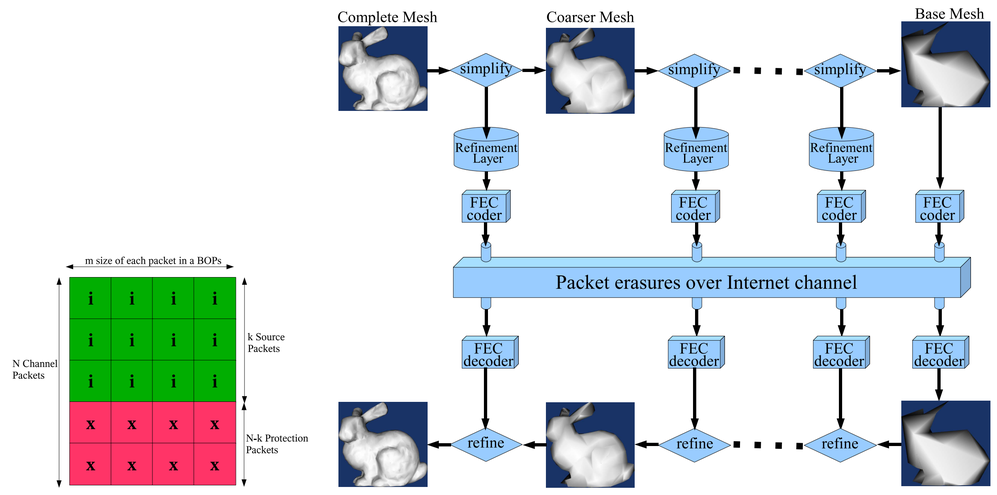


Fig. 2: A 3D mesh compressed to a base layer and a number of update layers. Each layer is packetized into a BOP along with the protection packets.

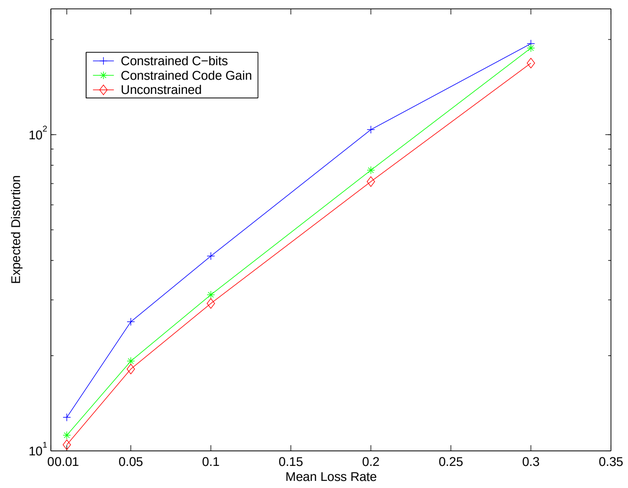


Fig. 3: Bunny mesh (5597 faces) compressed to 12 layers using a progressive compression scheme CPM. We used a two state Markov channel model. Constrained C-bits: Non increasing number of protection bit. Constrained Code Gain: Non increasing FEC strength, Unconstrained: Our solutions

3 Video Streaming

- Lost or delayed packets effect the playback quality adversely.
- FEC can improve the playback quality.
- How to choose FEC strength under fluctuating packet loss rate ?

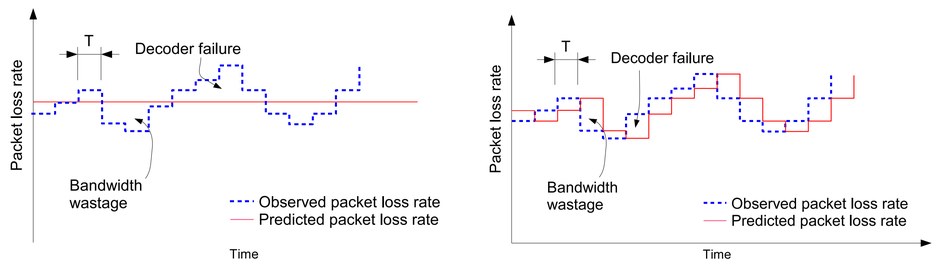
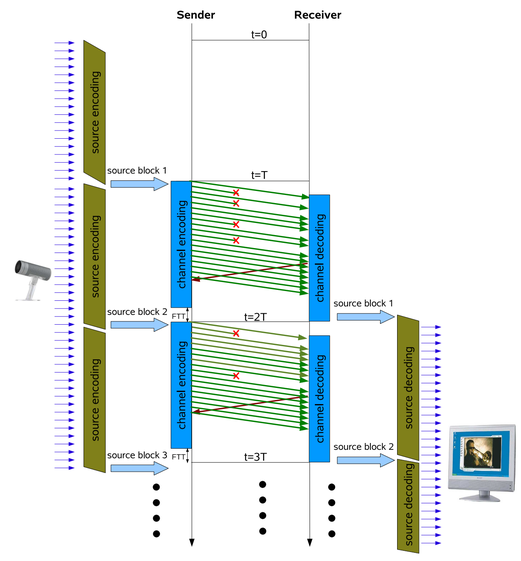


Fig. 4: Static prediction (left) and adaptive prediction (right)

- Our proposed solution:
  - Use rateless (or *digital fountain*) [3] codes with the receiver feedback to combat the effect of fluctuating packet loss rate.
  - An efficient transmission strategy and an algorithm to minimize the bandwidth usage.

Fig. 5: Proposed video streaming framework. The sender keeps on sending channel symbols until it receives an acknowledgment from the receiver indicating that decoding is completed. The sender may send some extra channel symbols because it takes time to get an acknowledgment from the receiver [5, 6].



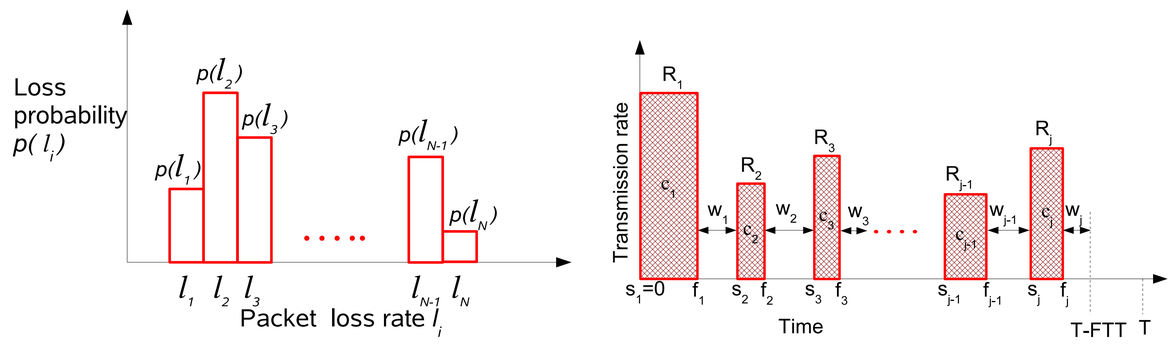


Fig. 6: Channel is described by N packet loss rates with their probabilities (left). The proposed transmission strategy (right) assures channel decoding for packet loss rate upto l_j for $j \in \{1, \cdots, N\}$.

- Analytical and simulated results show that our approach outperforms the traditional FEC based approaches.

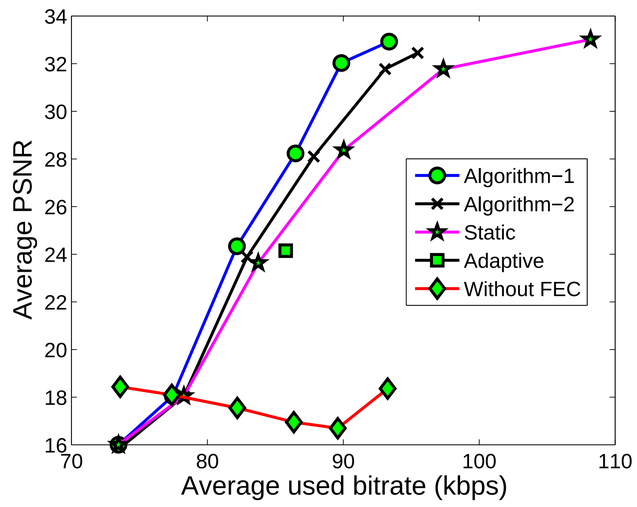


Fig. 7: H.264 encoded Foreman sequence in QCIF format was transmitted over a real Internet channel Konstanz-Beijing-Konstanz. *Algorithm-1* & *Algorithm-2* represent our approach. *Algorithm-1* uses prior channel knowledge whereas *Algorithm-2* does not. The *Static* scheme uses fixed transmission rate and in the *Adaptive* scheme the transmission rate is updated after each transmission interval T.

References

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[3] S. Ahmad and R. Hamzaoui. *Encyclopedia of Wireless and Mobile Communications*, chapter Reliable Wireless video streaming with digital fountain codes. Taylor & Francis, 2007.

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[6] S. Ahmad, R. Hamzaoui, and M. Al-Akaidi. Practical channel-adaptive video streaming with fountain codes. 2008. submitted.