H.26L Video Server Modeling Using Computational Process Networks

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Embedded Software Systems

Class Project: Final Presentation

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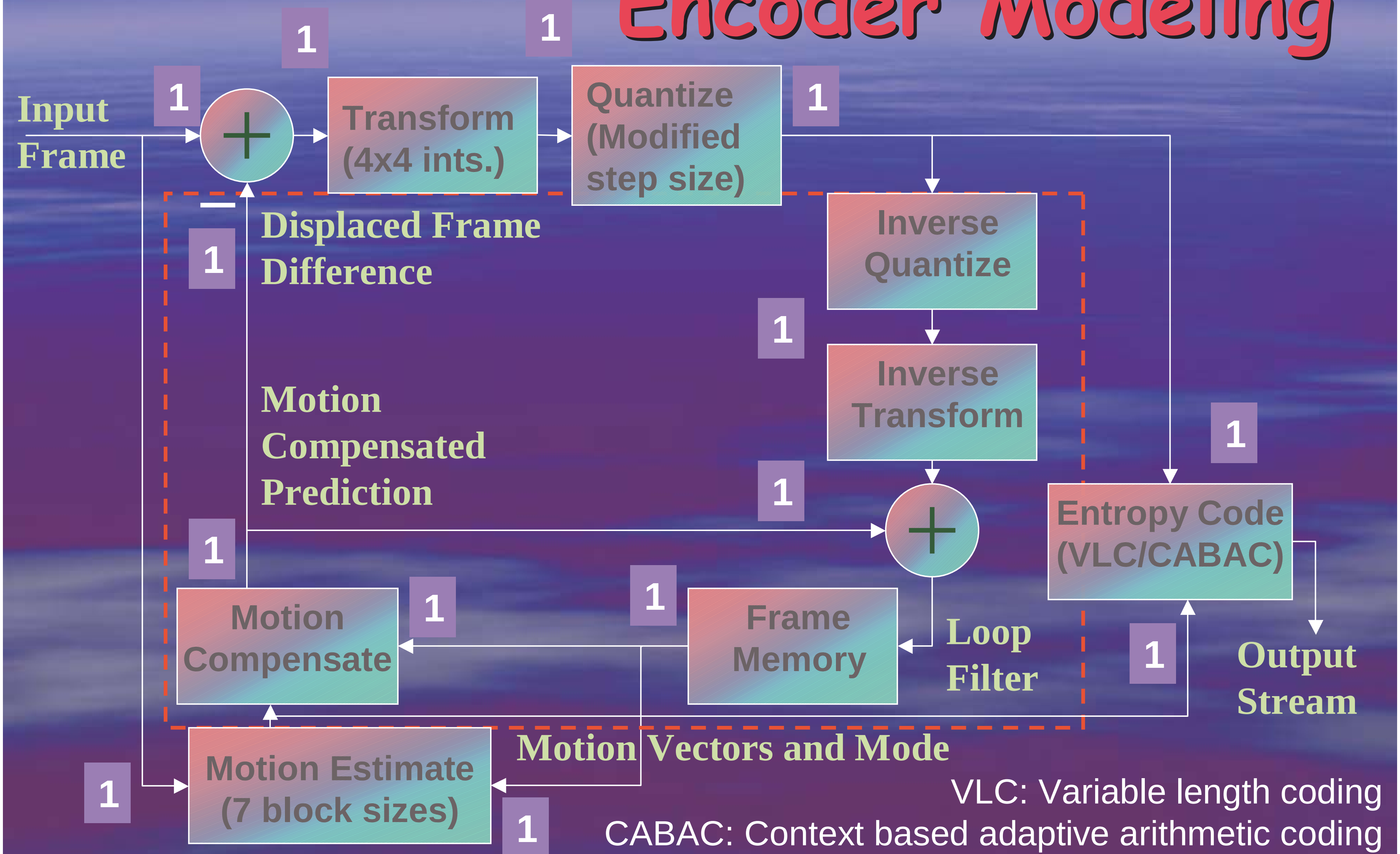
Problem Statement

- H.26L Video Encoder Modeling
  - Model computation and communication in encoder
  - Exploit inherent parallelism
  - Preserve functional precedence
  - Bounded memory implementation exists
- Design Domain
  - Computational process networks [Allen and Evans; 1999]
  - C code for H.26L video encoder [PictureTel Corp.; 2002]

Encoder Modeling

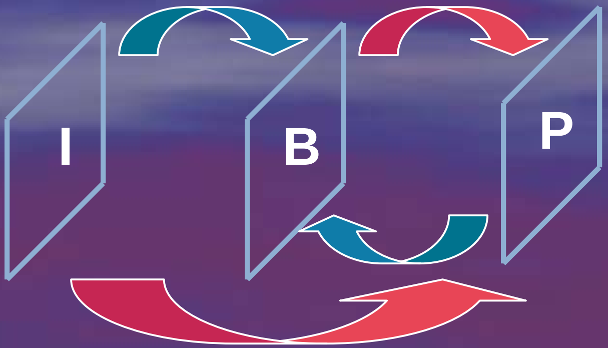


VLC: Variable length coding

CABAC: Context based adaptive arithmetic coding

Implementation

- Domain: CPN
  - Scalable design
  - Precedence preserving
- ‘Foreman’ Input Sequence
  - QCIF resolution (176 x 144)
  - 3 frames: Intra (I), Bi-directional (B), and Predicted (P)

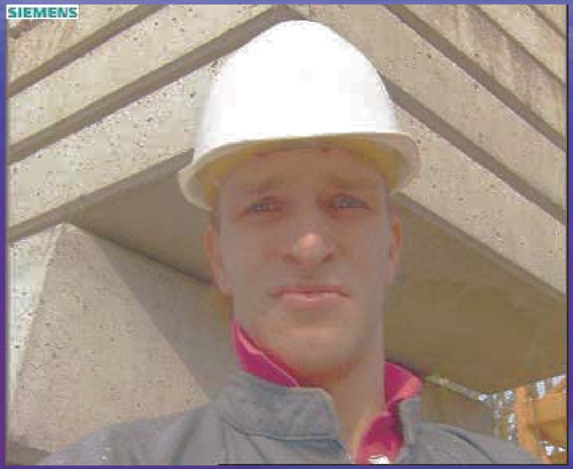


Results

- Successful Encoding
  - Nodes and queue designs [He and Zhong; 2000]
  - Generated sequence decoded with H.26L decoder
- Timing
  - Speedup could be obtained for encoding more frames
  - Parallel execution of I-frames on multiple processors

Compression Results

Original frame 2 of QCIF (176 x 144) resolution foreman sequence



Decoded frame 2 of QCIF (176 x 144) resolution foreman sequence

- **Compression:** 25:1 (comparing file sizes)
- **Time:** 20 sec for 3 frames with 10 sec for B-frame

Applications

- Video and POSIX Threads
  - On-line scene change detection in multicast video
    - Buffering of frames, and processing of frames can be modeled on separate processors for scene change detection
  - Video conferencing
  - Video streaming
- Real-time H.26L Encoding Products [2002]
  - Texas Instruments with UB Video Inc. and Ingenient Technologies: On TMS320C64x digital signal processor

Conclusions

- Deliverables
  - Data and control flow modeling of H.26L encoder
  - Computational process networks modeling
  - Applications where parallelism can be exploited
- Results Summary
  - Time taken is more than expected
    - Unoptimized code
    - Number of frames being processed is less
  - Compression is 50% more than state-of-the-art (H.263, MPEG-2, MPEG-4) encoders for same quality