Block Matching Algorithms for Motion Estimations in MPEG Compression

Siri Priya Katragadda*
Midhun Jasti
Sundeep Telidevara

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OVERVIEW OF ALGORITHMS

By
Sundeep Telidevara
Need for compensation

- Limited channel bandwidth
- Stringent requirements of real-time video playback, video coding.

Abstract

- The project is a review of the block matching algorithms used for motion estimation in video compression.
- It implements and compares 7 different types of block matching algorithms.
Purpose

- Block matching motion estimation (BMA), is temporal redundancy removal technique between 2 or more successive frames.
- *Full search* (FS) exhaustively searches for the best matching block within the search window.
- FS yields very high computational complexity and makes ME the main bottleneck in real-time video coding applications.
- Results in using BMA that is indispensable to reduce the computational cost

Motion Estimation

- Key Elements of Video Compression
  - *MOTION ESTIMATION*.
  - The idea behind block matching is to divide the current frame into a matrix of ‘macro blocks’
  - compared with corresponding block in the previous frame to create a vector that stipulates the movement of a macro block from one location to another in the previous frame.
Error Measurement

- MAD: Mean Absolute Difference
  \[ \text{MAD} = \frac{1}{N^2} \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} |C_{ij} - R_{ij}| \]

- MSE: Mean Square Error
  \[ \text{MSE} = \frac{1}{N^2} \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} (C_{ij} - R_{ij})^2 \]

- PSNR: Peak Signal to Noise Ratio
  \[ \text{PSNR} = 10 \log_{10} \left( \frac{(\text{Peak to peak value of original data})^2}{\text{MSE}} \right) \]

ALGORITHMS

- Exhaustive search
- Three step search
- New three step search
- Four step search
- Simple and efficient search
- Diamond search
- Adaptive rood pattern search
RESULTS
Discussion By
Midhun Jasti

Results

- ‘Caltrain’ video sequence with a distance of 2
  between current frame and reference frame is used to
  generate the frame-by-frame results of the algorithms
A plot of the average number of searches required per macro block for the Caltrain sequence using the 6 fast block matching algorithms.
Results

- The PSNR comparison of the compensated images generated using the algorithms is shown in
Future work

- We did only till motion compensation
- Should have done encoding and decoding and network transmission

Future Work

Discussion By

Siri Priya.
Other algorithms of interest

- Cross search pattern
- Cross Diamond search
- Small cross diamond search
- New cross diamond search

All improve on the performance of DS by modifying the starting search pattern from LDSP to cross search pattern (CSP).
- CDS uses all the 9 points whereas SCDS and NCDS use only the inner 5 points to start and then expand their search.
May be they prove to be very efficient when compared to others and they may yield good psnr and low computations.

**Staff Contribution**

- **Sundeep**: He has been successful in implementing the first three algorithms.
- **Midhun**: He has dealt with the fourth, fifth and sixth algorithms.
- **SiriPriya**: She is responsible for the simulation and debugging of the code in addition to the last algorithm.
Queries

- ????????????????????????????????