Efficient Tiling For Video Analytics

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Motivation

Video storage and indexing for efficient query processing.

Query: Run license plate detection on all cars.

Decode car pixels → Run license plate detector

Decode the entire frame

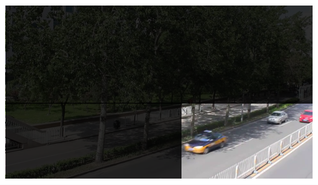
- Easy to store as encoded video
- Decode many irrelevant pixels

Decode only the car pixels

- Difficult to store as encoded video
- Decode only relevant pixels

Use tiling to decode only the region of the frame that contains car pixels

- Easy to store as encoded video
- Decode few irrelevant pixels



Strategy

- Split up video frames into independently decodable regions called “tiles”
- Set the tile layout using one of the following approaches:

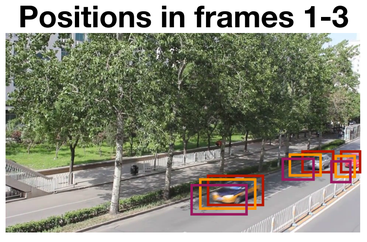
  Approach 1: Uniform tiles

  Approach 2: Non-uniform tiles around objects

  2.1: Large tiles around groups of objects

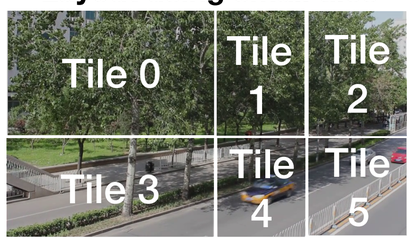
  2.2: Small tiles around individual objects
- Set the layout for a group of frames and update periodically
- Speed up queries by only decoding the tiles that contain pixels for a given query

Positions in frames 1-3

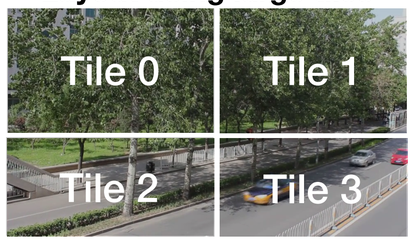


Layout using uniform tiles

Layout using small tiles



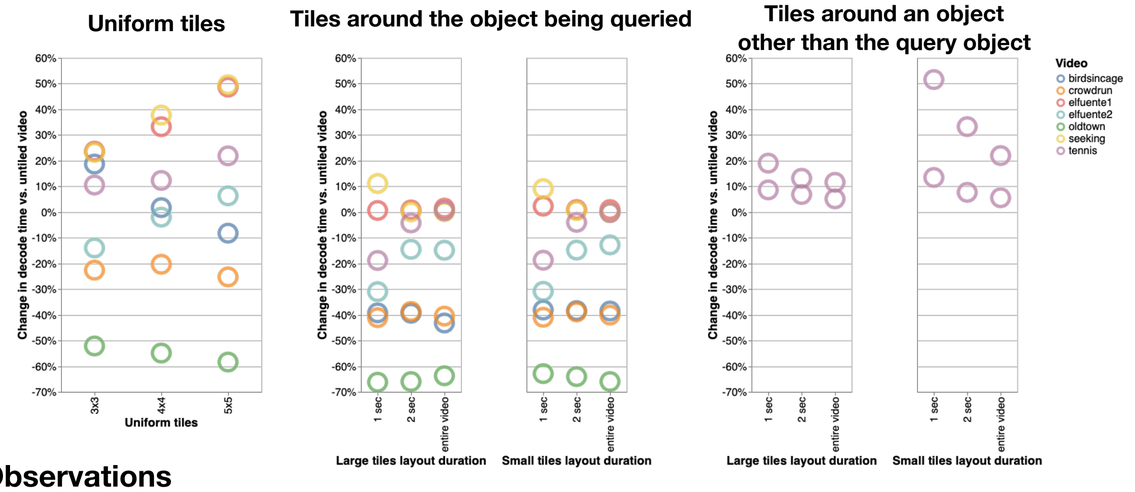
Layout using large tiles



Preliminary Results

- Run queries on videos from the Netflix public data set[2] to decode pixels for particular object types (e.g. “person”, “car”)
- Compare uniform tile layouts to layouts picked based on the locations of pixels being decoded
- Study the effect of updating the custom layouts after different durations

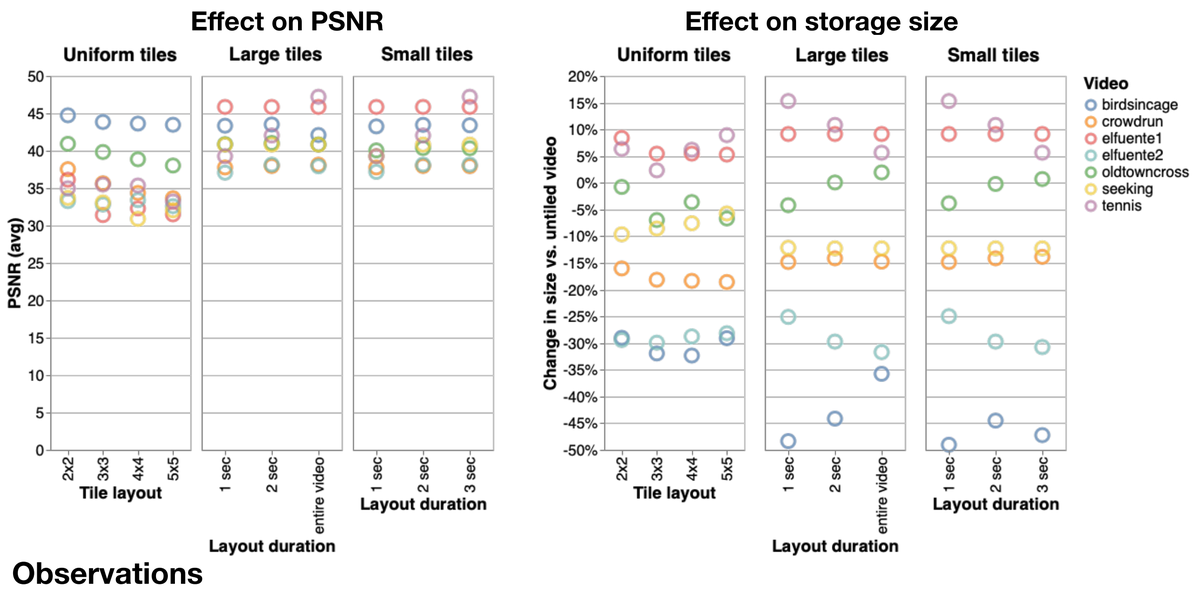
Effect of tiling on decode time



Observations

- Custom tile layouts reduce decoding time
- Tile layouts optimized for pixels different from the ones being queried can hurt performance

Effect of tiling on quality and storage size



Observations

- Custom tile layouts generally have better quality than uniform tiles (PSNR above 40 is considered lossless)
- Custom tile layouts sometimes lead to larger storage sizes. The size of the tiles depends on how they are encoded

Acknowledgements

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[2]*https://github.com/Netflix/vmaf/blob/master/resource/doc/datasets.md*

Example video frame from UADetrac: http://detrac-db.rit.albany.edu