

# A Video Representation Using Temporal Superpixels

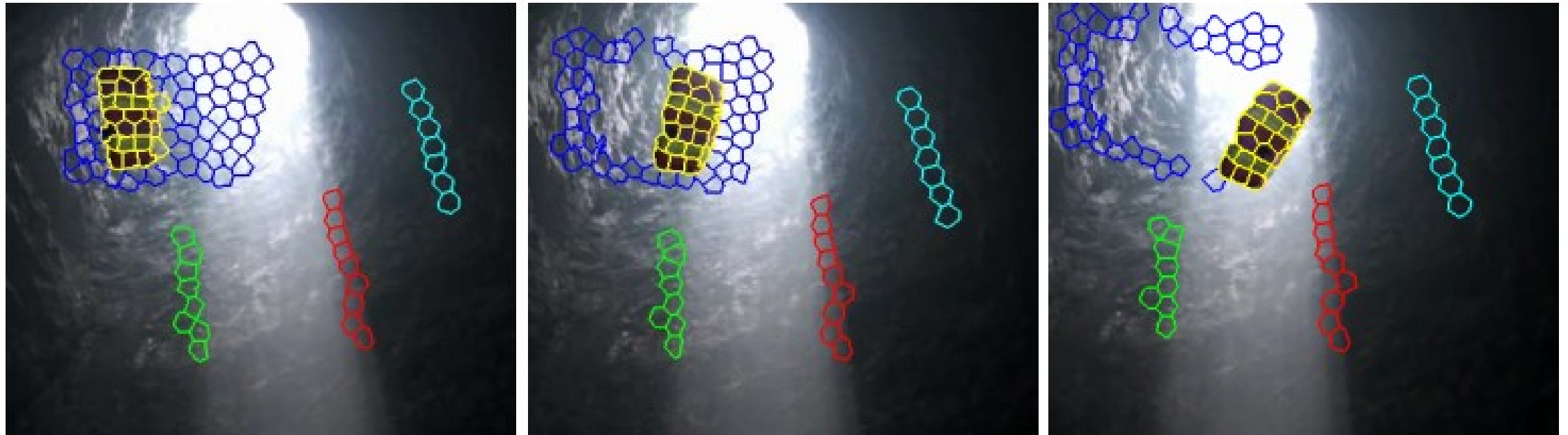
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Jason Chang, Donglai Wei, John W. Fisher III, CVPR  
2013

A solid green horizontal bar at the bottom of the slide.

# Temporal Superpixel Representation of a Video

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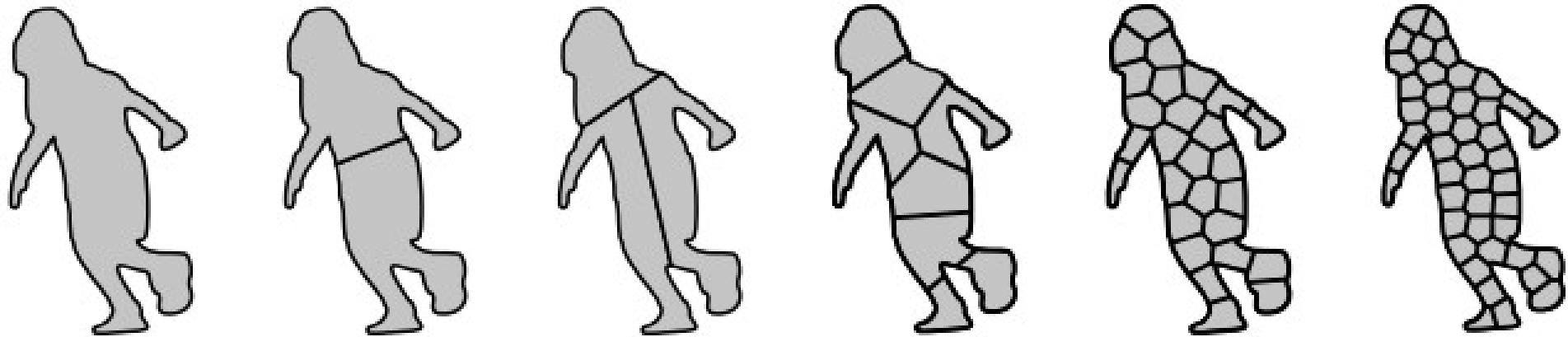
# Related Work

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- C. Xu and J. Corso. Evaluation of super-voxel methods for early video processing. CVPR, 2012.
  - Eitan Sharon, Achi Brandt, Ronen Basri: Fast Multiscale Image Segmentation. CVPR 2000: 1070-1077
  - Matthias Grundmann, Vivek Kwatra, Mei Han, Irfan A. Essa: Efficient hierarchical graph-based video segmentation. CVPR 2010: 2141-2148
- Chenliang Xu, Caiming Xiong, Jason J. Corso: Streaming Hierarchical Video Segmentation. ECCV (6) 2012: 626-639

# Object Segmentation and Superpixels

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# Oversegmentation of a Frame

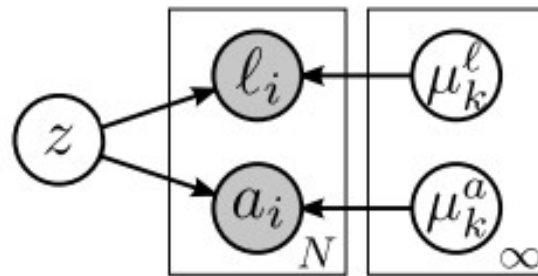
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# Initializing TSPs (for first frame)

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- Each pixel is represented as a 5-dimensional feature vector: x and y location, LAB colorspace
- Gaussian mixture model is used to represent superpixels in all dimensions
- Uniform distribution is used to initialize Gaussian distributions
- A joint log likelihood is defined over random variables (such as superpixel labels and means) and maximized while preserving topology
  - Topology restricts each superpixel to be a 4-connected region and also their size



# Initializing TSPs (for first frame)

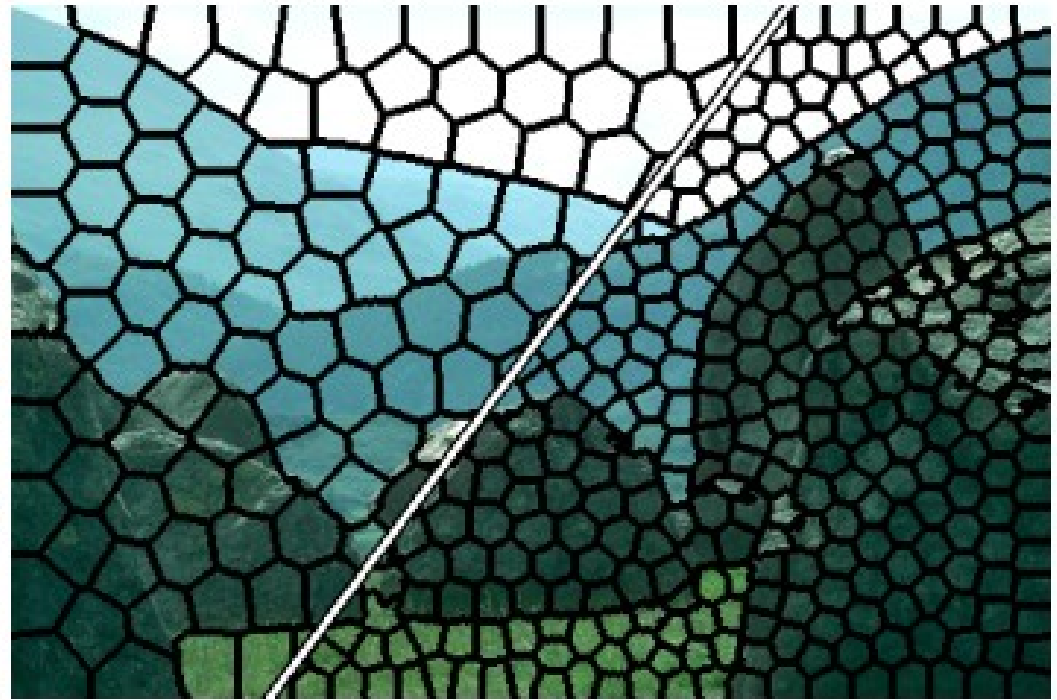
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Likelihood maximized over:

- **Local Moves** : changing label of a pixel to neighboring superpixels
- **Merge Moves** : merging two superpixels
- **Split moves**: splitting a superpixel into two by k-means

# Example Superpixels

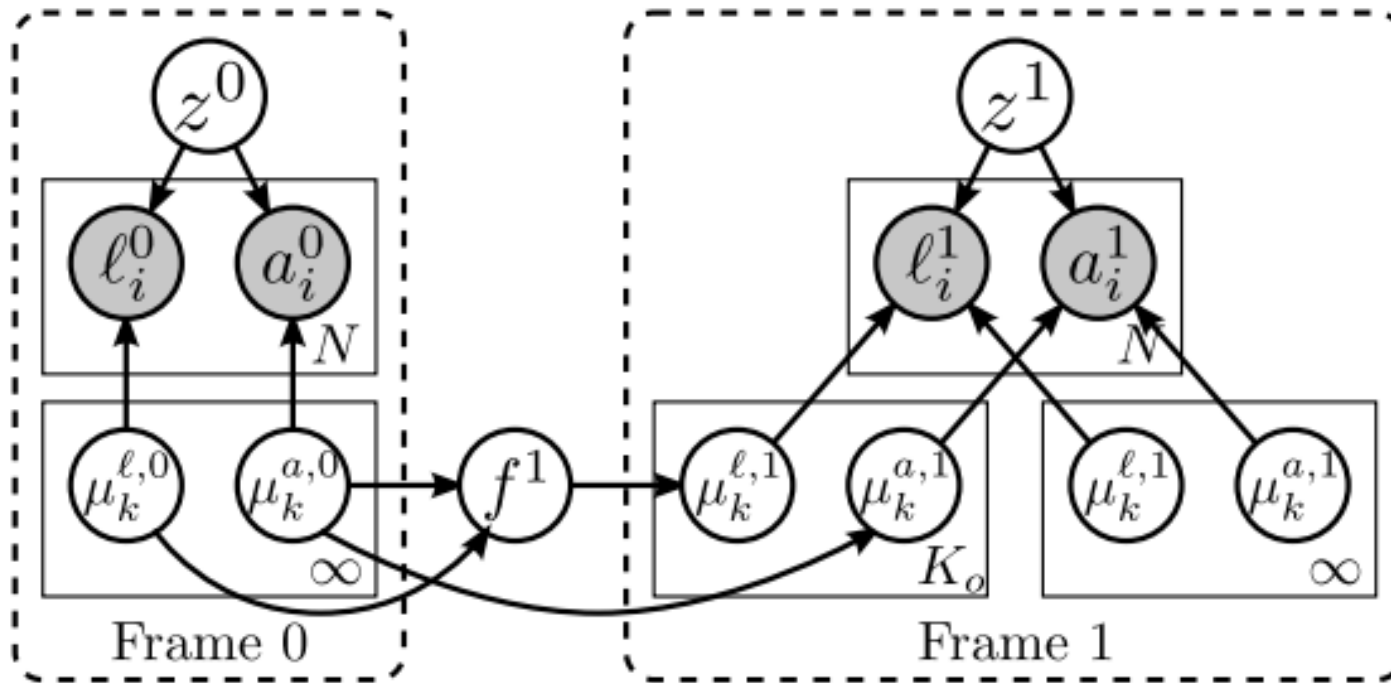
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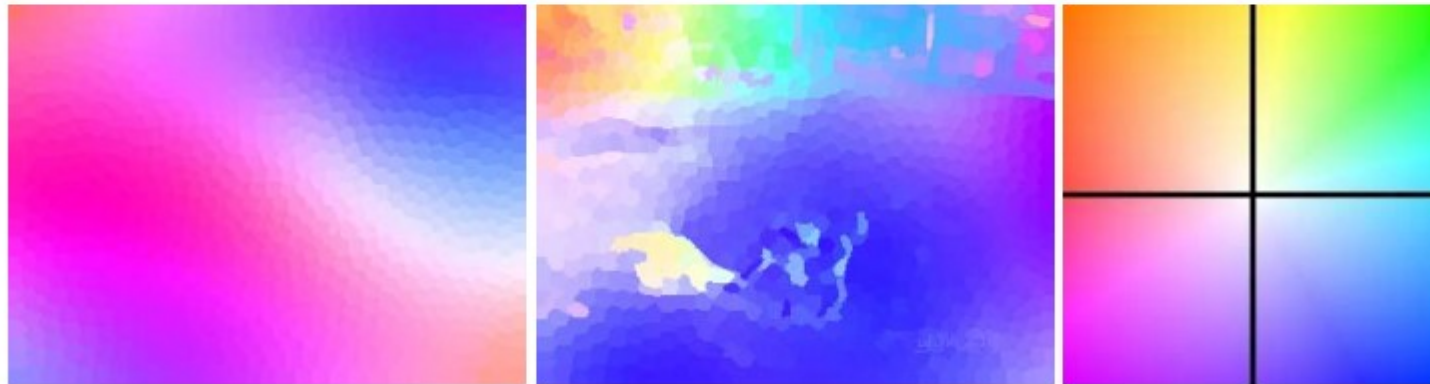
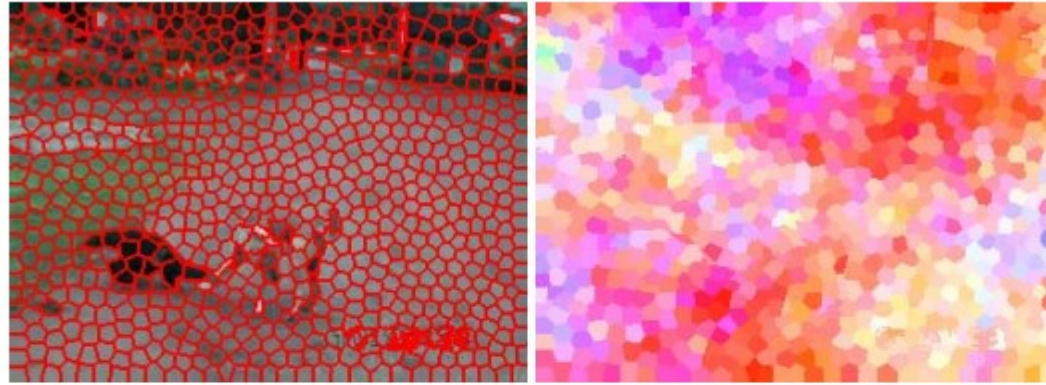
# Temporal Consistency

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# Gaussian Process Flow

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# New, Old, Dead Superpixels

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Due to camera motion, occlusions, and disocclusions, it must be allowed old superpixels to disappear and new superpixels to emerge.

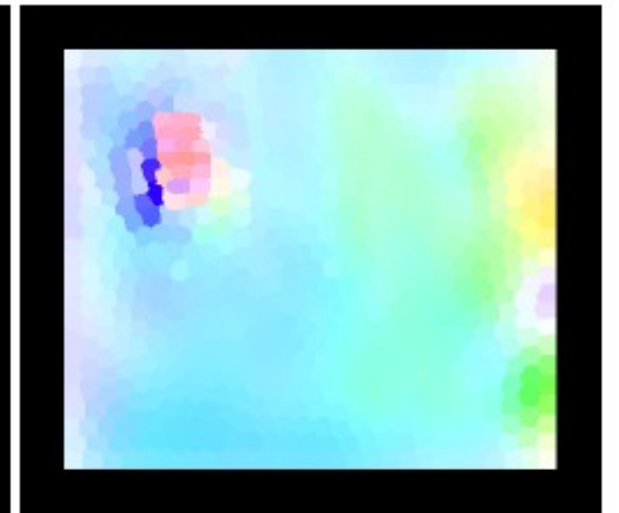
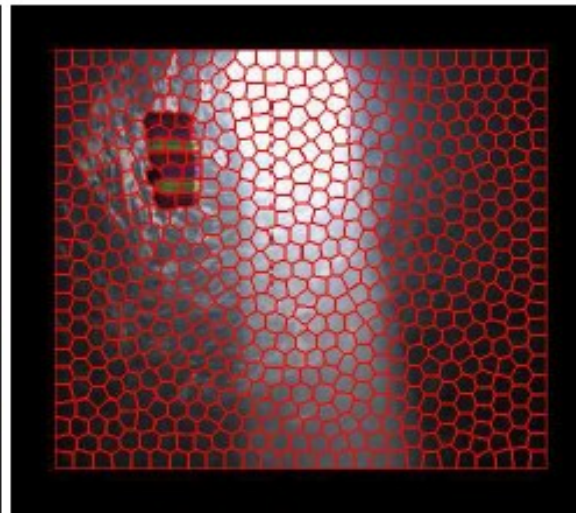
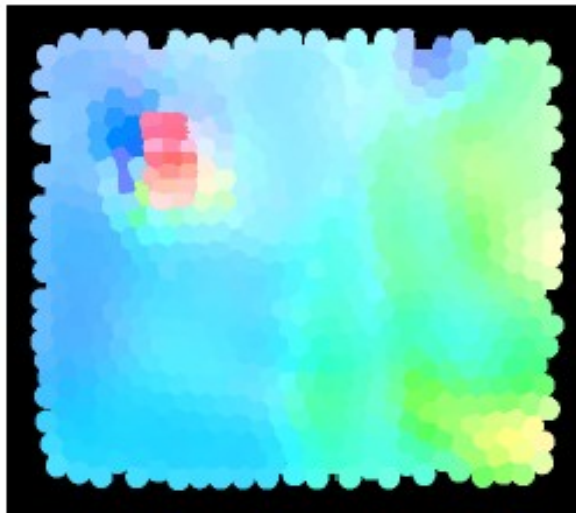
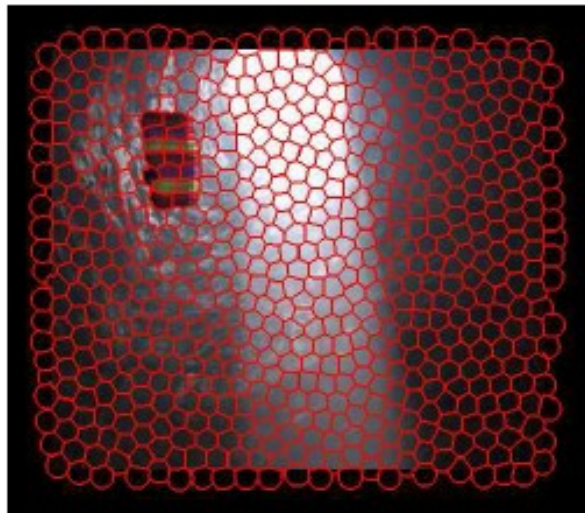
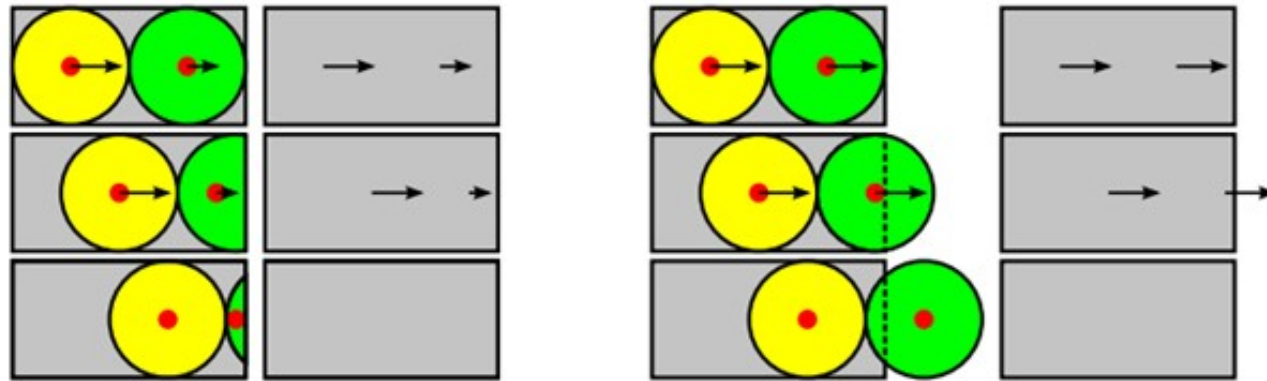
- **Dead superpixel** existed in the previous frame but no longer exists in the current frame.
- **Old superpixel** existed in the previous frame and did not die
- **New superpixel** have apperaed in the current frame

# Additional Moves

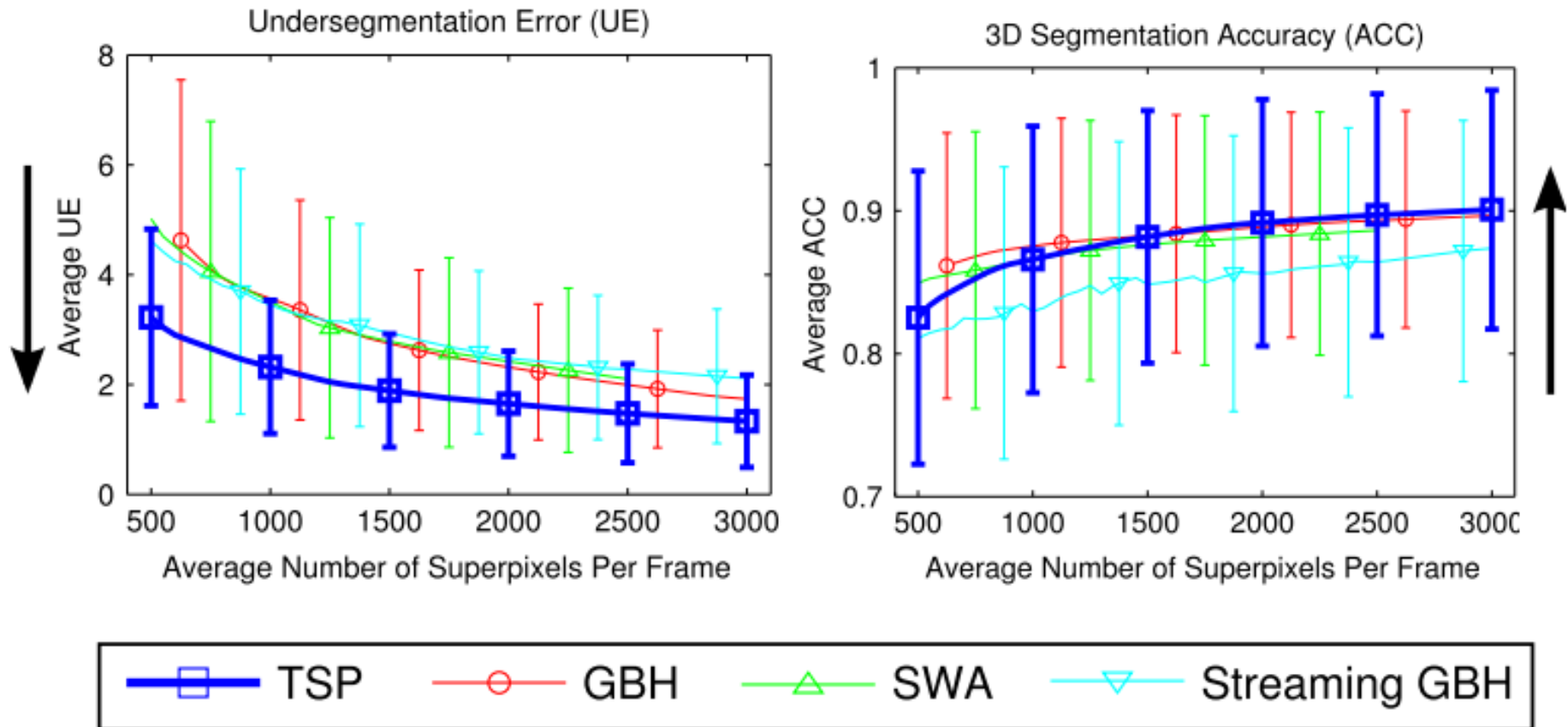
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- **Split Moves (modified):** While splitting, new labels should be selected among dead superpixels (of previous frame)
- **Switch Moves:** New superpixels should be allowed to link dead superpixels

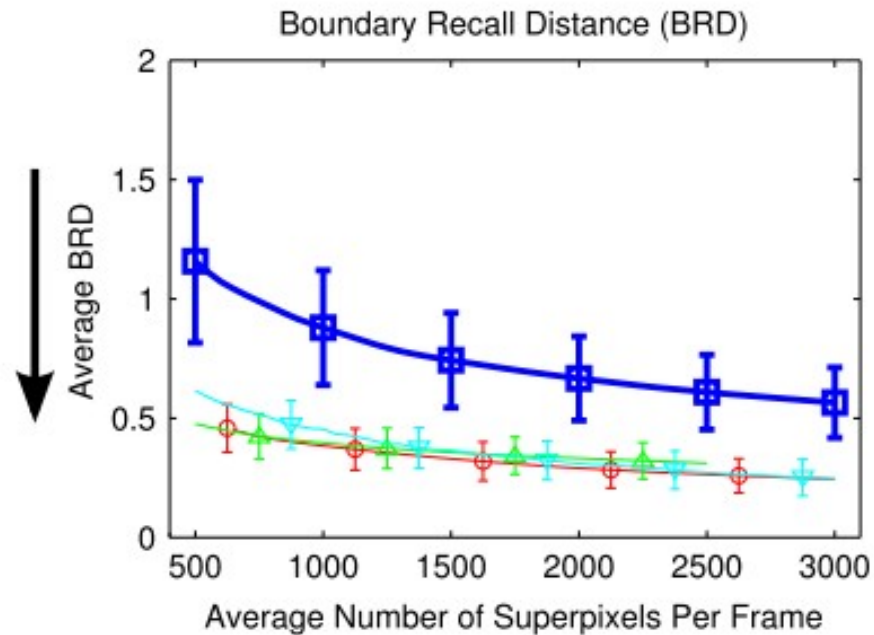
# Boundary Effects



# Experiments - Object Segmentation Consistency



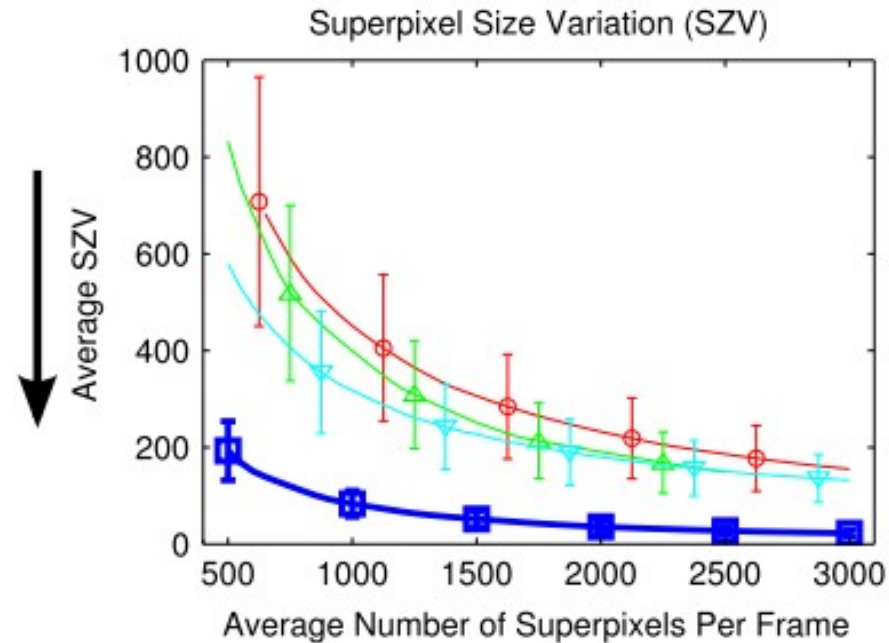
# Experiments - 2D Boundary Accuracy



—□— TSP    —○— GBH    —△— SWA    —▽— Streaming GBH

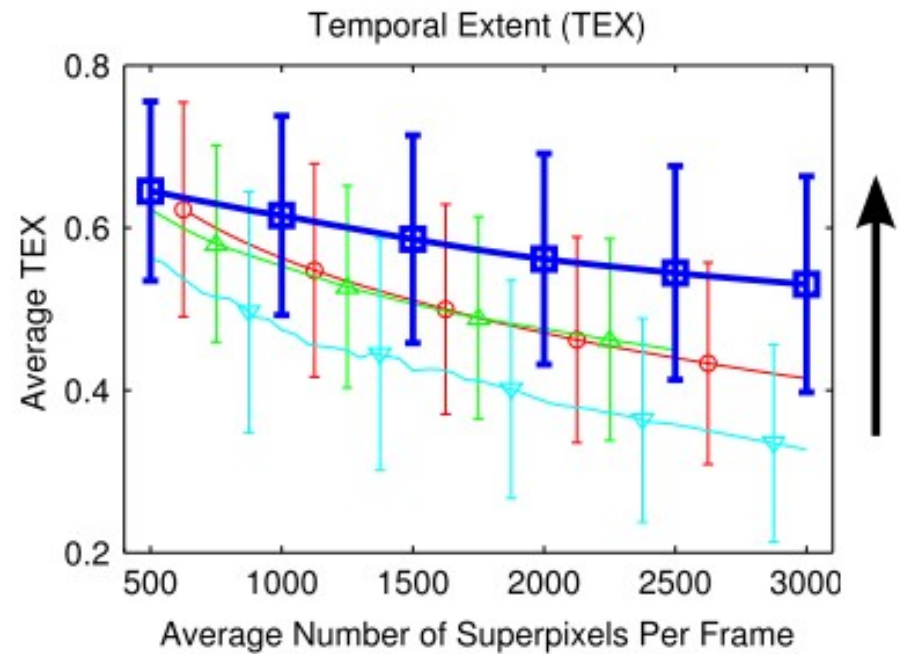


# Experiments - Intra-Frame Spatial Locality

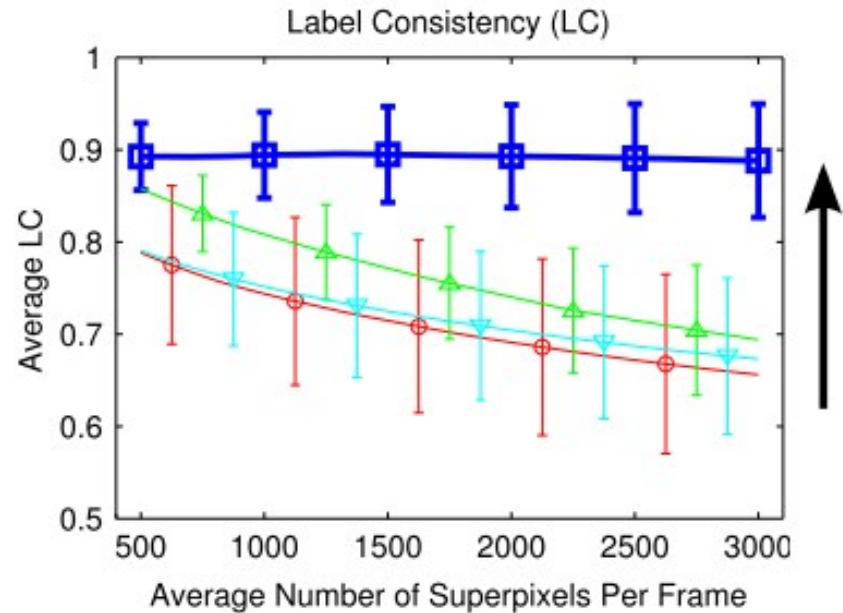


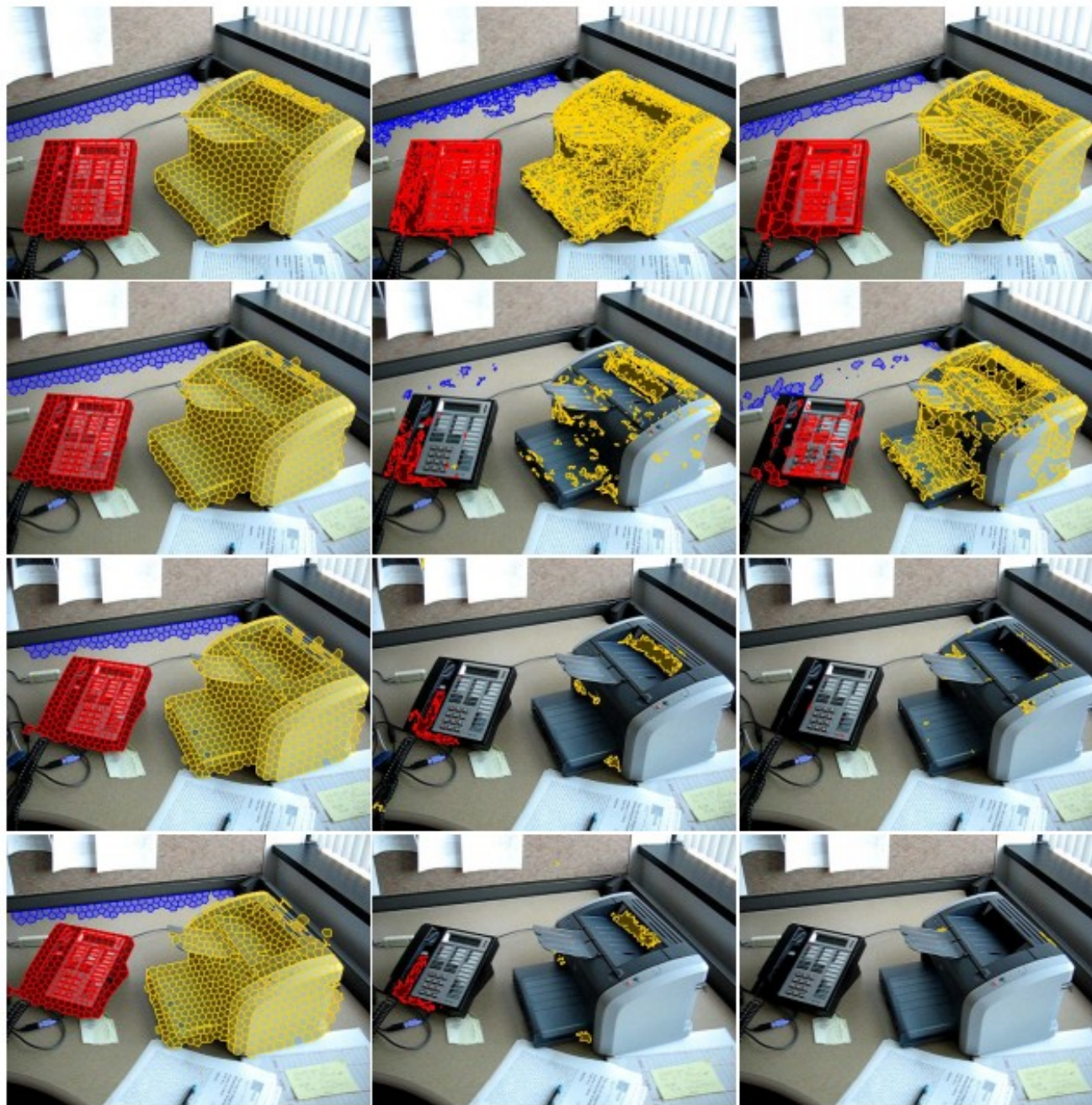


# Experiments - Intra-Frame Temporal Extent



# Experiments - Inter-Frame Label Consistency



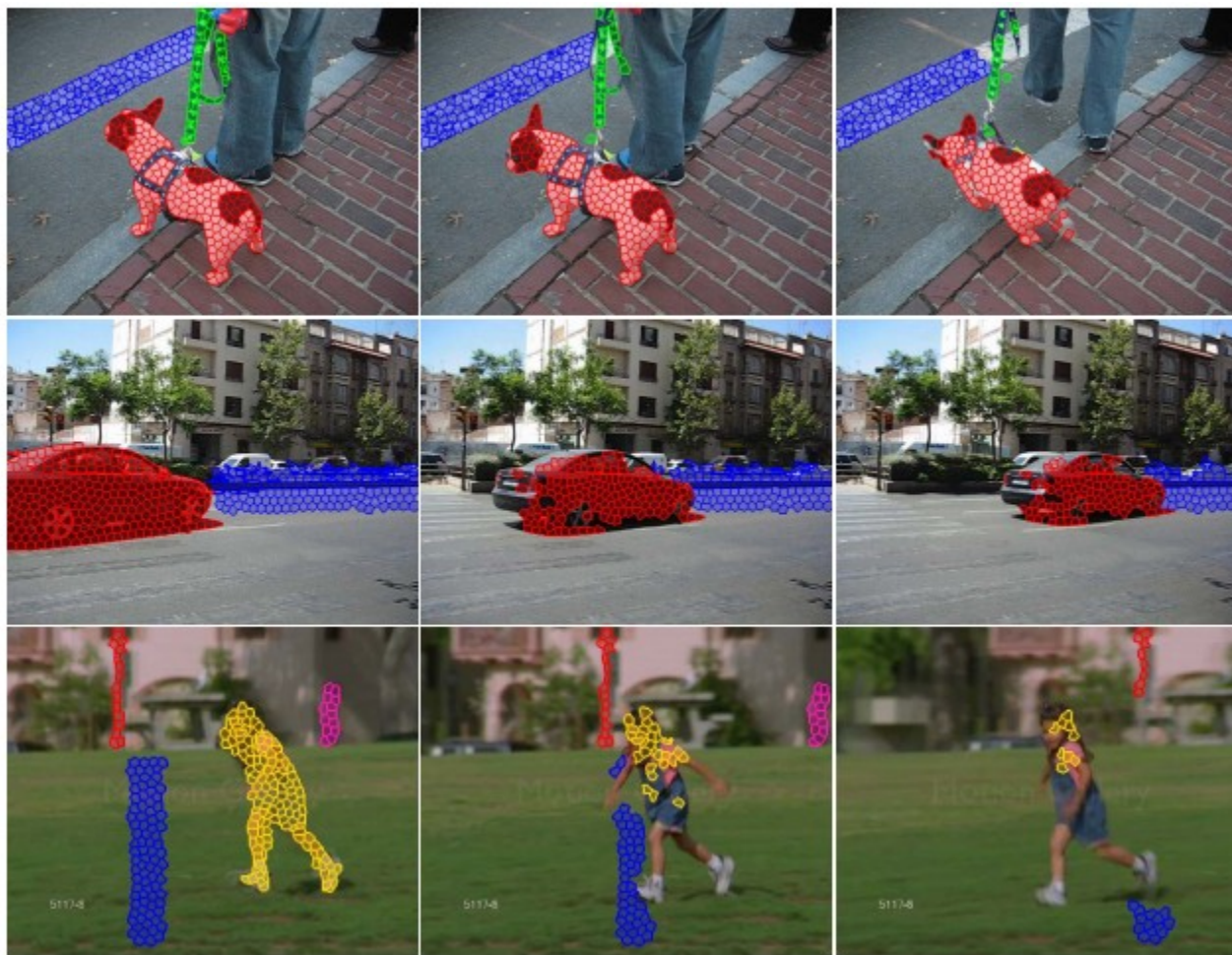


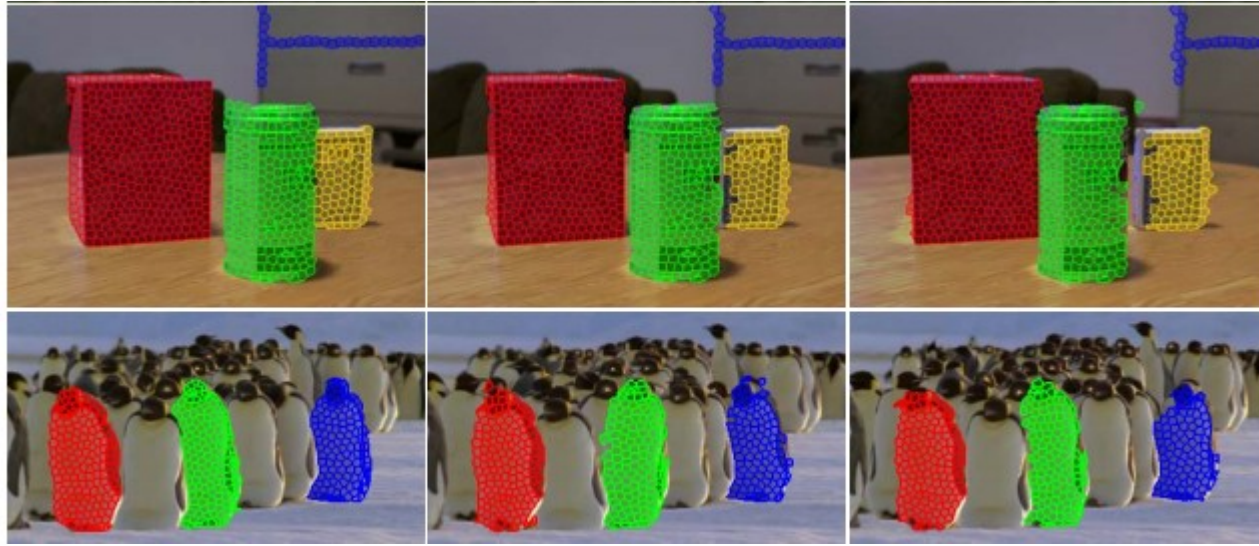
TSP

GBH

SWA







Thanks