Computational Photography

* Study the basics of computation and its impact on the entire workflow of photography, from capturing, manipulating and collaborating on, and sharing photographs.

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Video Textures

* How can we find similar frames in a Video Volume to generate longer Videos?

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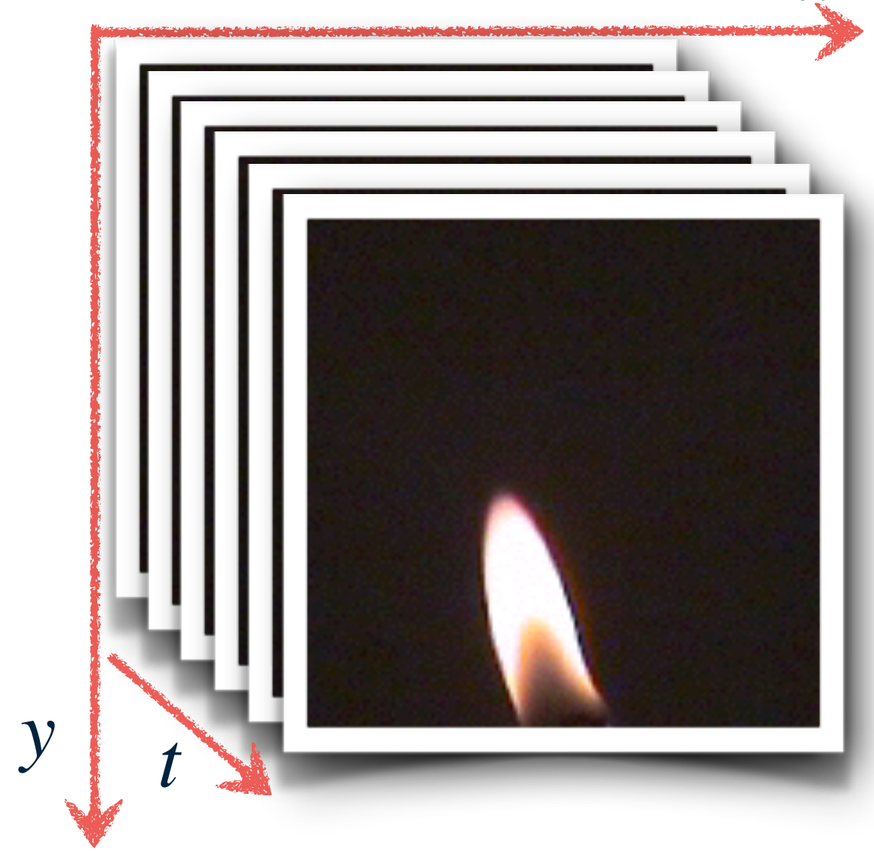
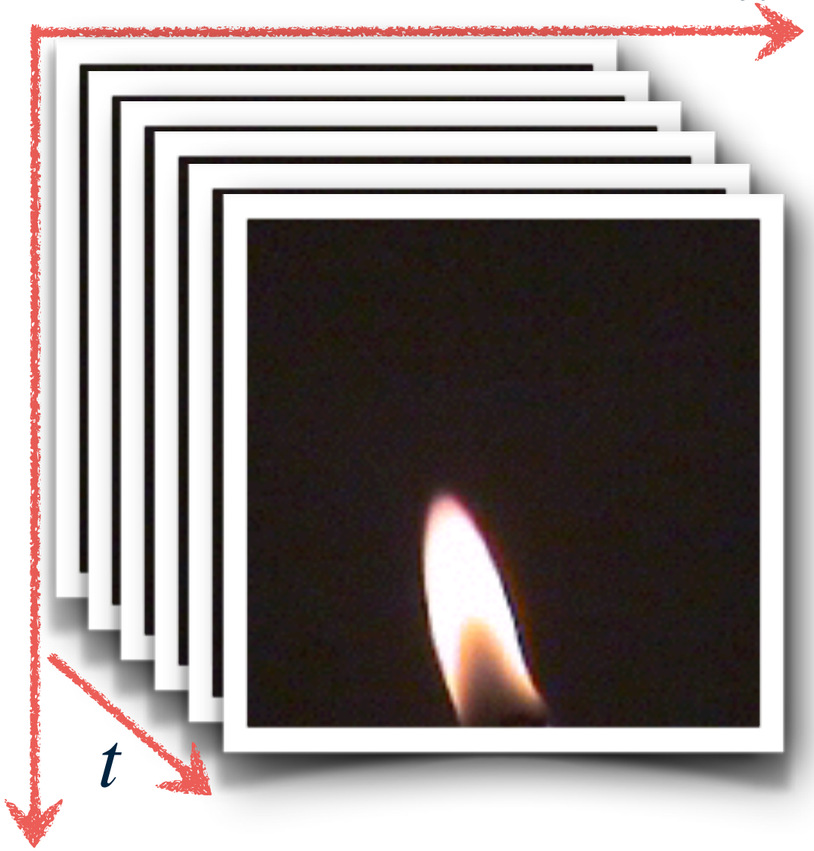
1. Concept of a Video Texture
2. Methods used to compute similarity between frames
3. Use of similar frames to find transitions to generate Video Textures
4. Fading, Cutting, Morphing for Video Textures
5. Some Applications of Video Textures

RECALL: Video is Images OVER time



* "Digital" Video:
  * numeric representation in two-dimensions (x and y), stacked in time, t
  * referred to as $I(x,y,t)$ in continuous function form, $I(i,j,t)$ in discrete

RECALL: Video is Images OVER time



* Video Resolution:
  * Expressed as representation of Width and Height of the image
  * Usually in aspect ratios of ***4x3***, ***16x9***, etc
* File formats: Include images, frame-rates, and codec/wrappers

Video Textures

Still Pictures

Schödl, Szeliski, Salesin, and Essa (2000)

Video Textures

Video

Video Textures

Looping Video

Video Textures

Video Textures

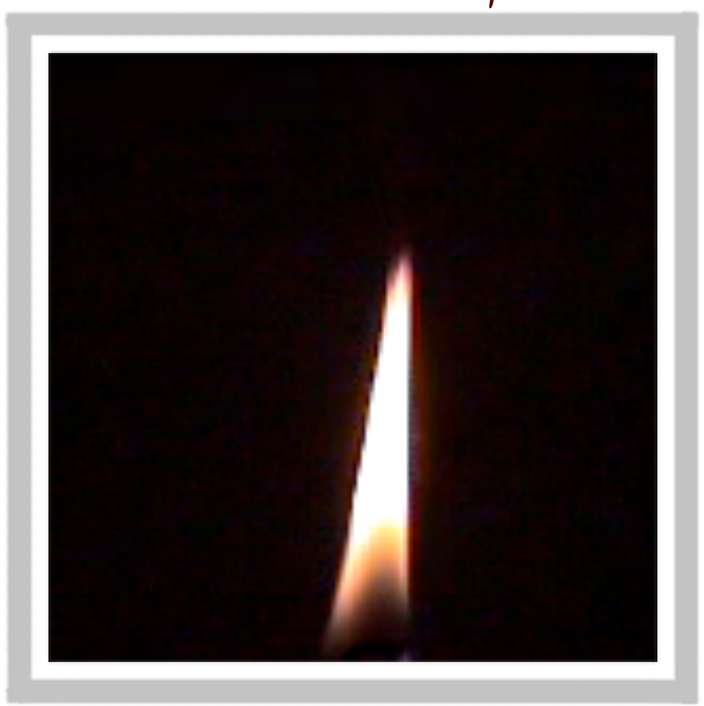
Video Clip to Video Textures

Video Clip

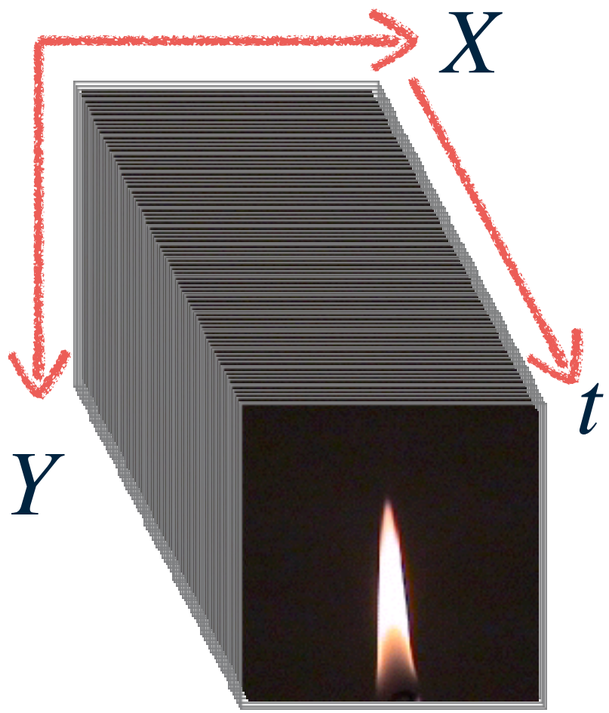
Video Texture

Video Clip to Video Textures

Video Clip



90 frames



90 frames:

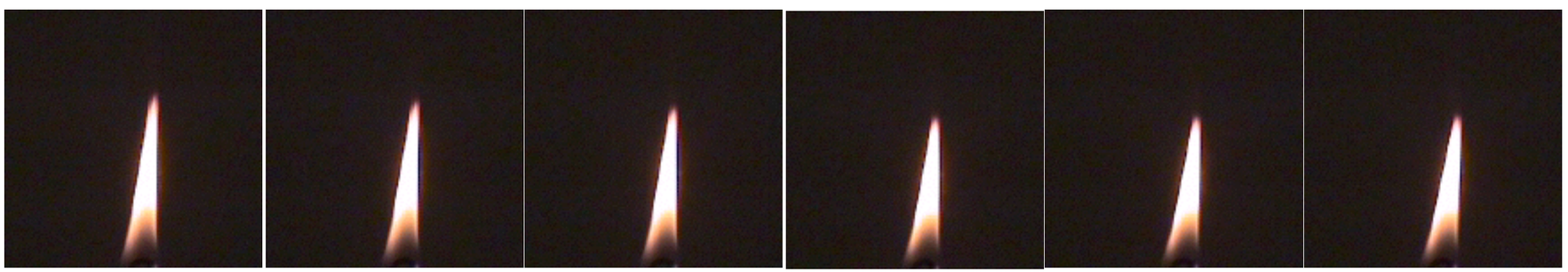
$f_1, f_2, f_3, \ldots, f_{90}$

f_1

Compute how similar f_1 is to all frames: $f_1, f_2, f_3, \ldots, f_{90}$

Do this for all $f_1, f_2, f_3, \ldots, f_{90}$

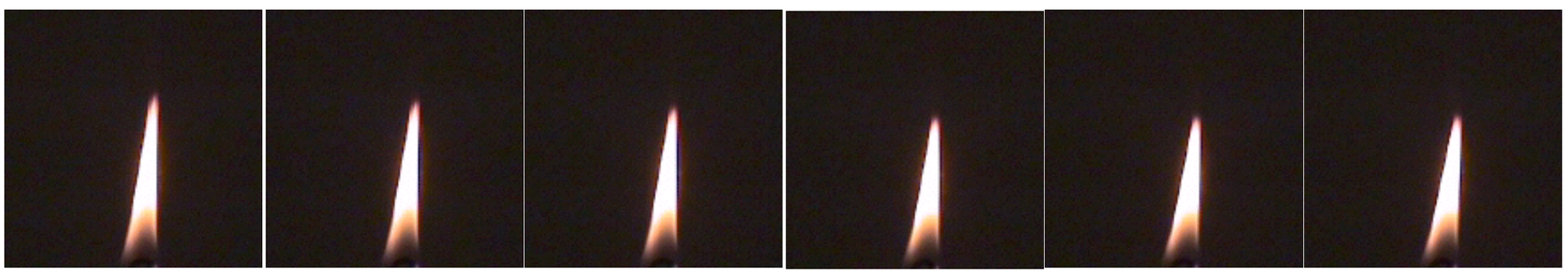
Similarity Metric (1)



f_1 f_2 f_3 f_4 f_5 f_6

* Compute the Euclidean Distance between two Frames

Similarity Metric (1)



f_1 f_2 f_3 f_4 f_5 f_6

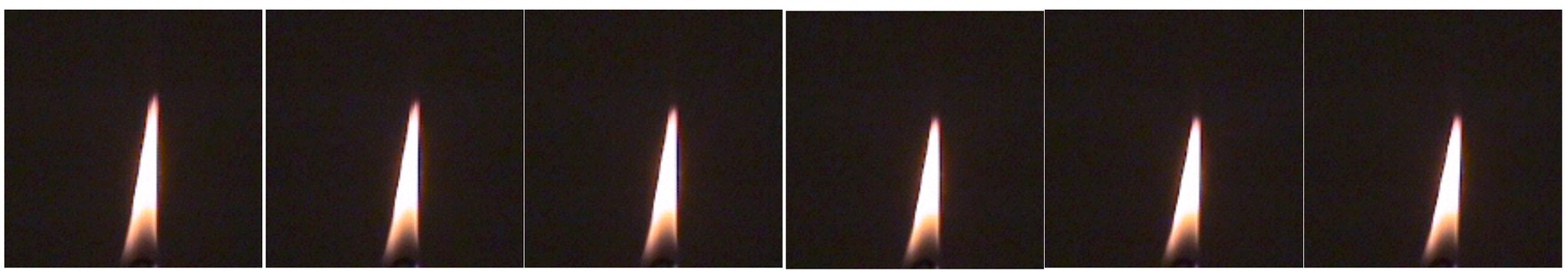
* Consider two frames, $p = \{p_1, p_2, \ldots p_n\}$ and $q = \{q_1, q_2, \ldots q_n\}$

$$d_2(p,q) = \sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2 + \cdots + (p_n - q_n)^2}$$

$$d_2(p,q) = \sqrt{\sum_{i=1}^{N} (p_i - q_i)^2}$$

This distance metric is referred to as L2 norm

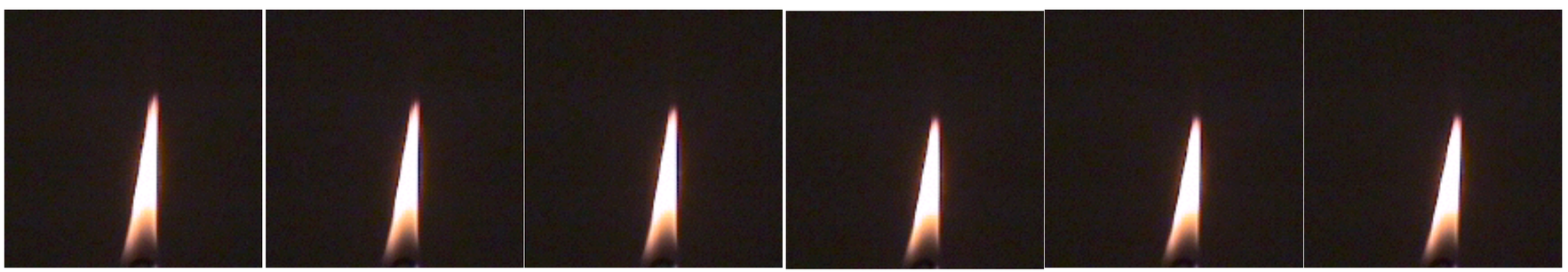
Similarity Metric (2)



f1 f2 f3 f4 f5 f6

* Compute the manhattan Distance between two Frames

Similarity Metric (2)



f_1 f_2 f_3 f_4 f_5 f_6

* Consider two frames, $p = \{p_1, p_2, \ldots p_n\}$ and $q = \{q_1, q_2, \ldots q_n\}$

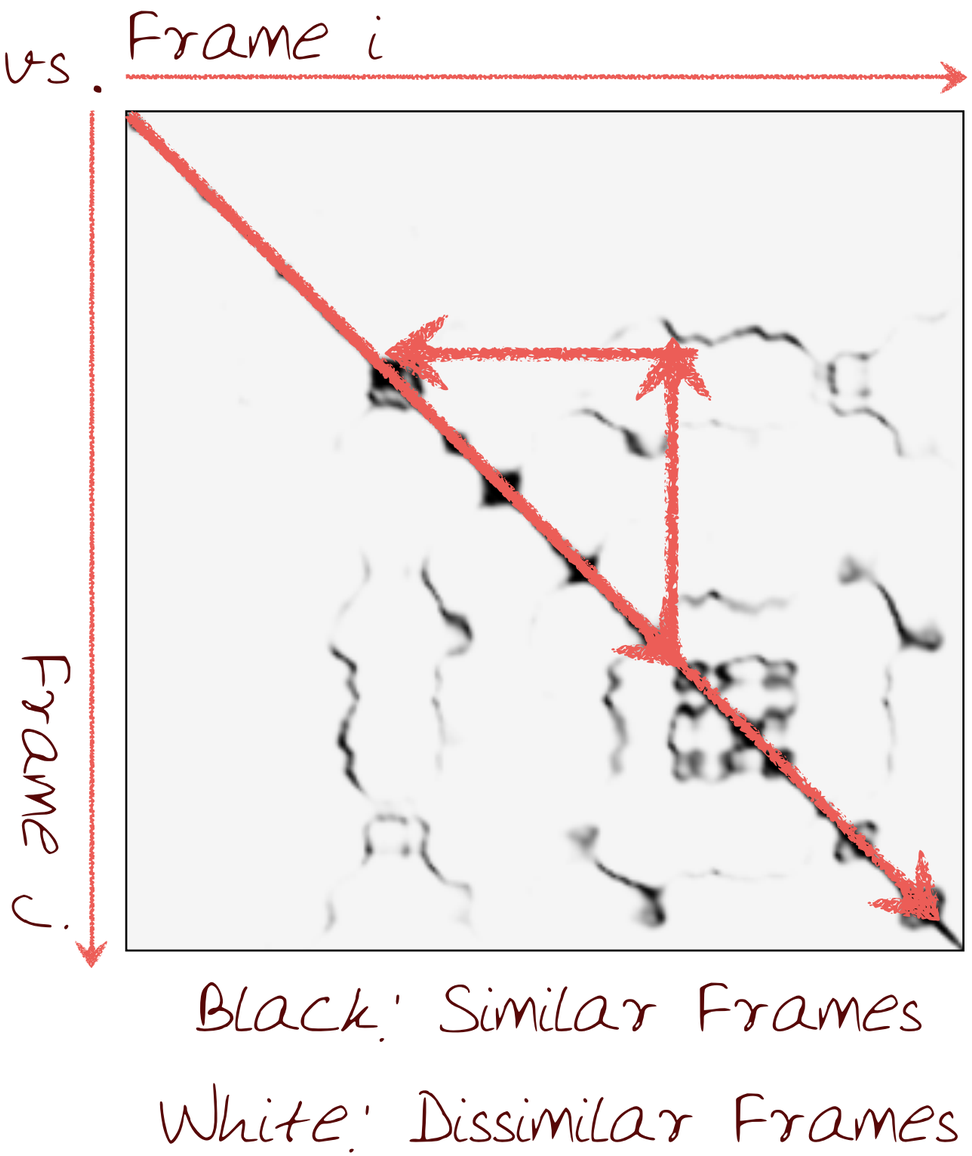
$$d_1(p, q) = (p_1 - q_1) + (p_2 - q_2) + \cdots + (p_n - q_n)$$

$$d_1(p, q) = \sum_{i=1}^{N} |p_i - q_i|$$

This distance metric is referred to as L1 norm. (|..| implies Absolute)

Finding Similar Frames

vs.



Black: Similar Frames

White: Dissimilar Frames

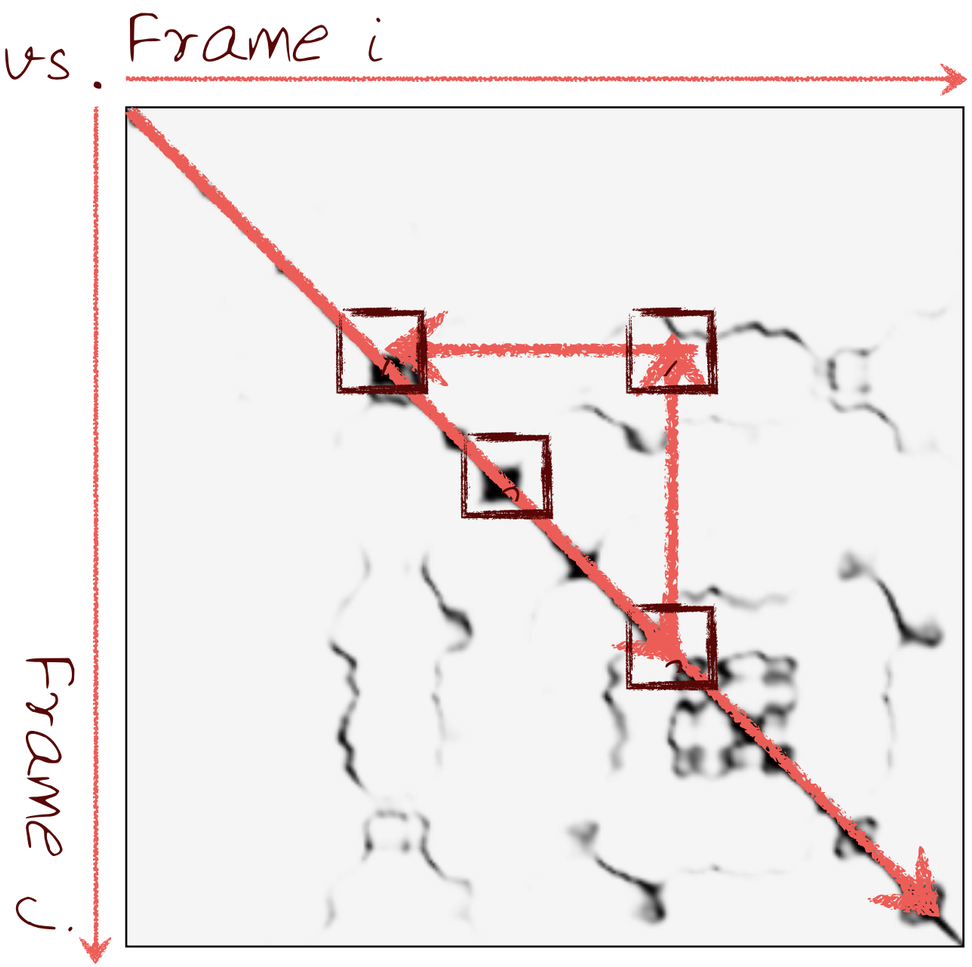
* Compute Euclidean Distance d_{ij} between all N Frames

* Similar frames are the ones that would be best to jump to

Infinitely Long Video Texture

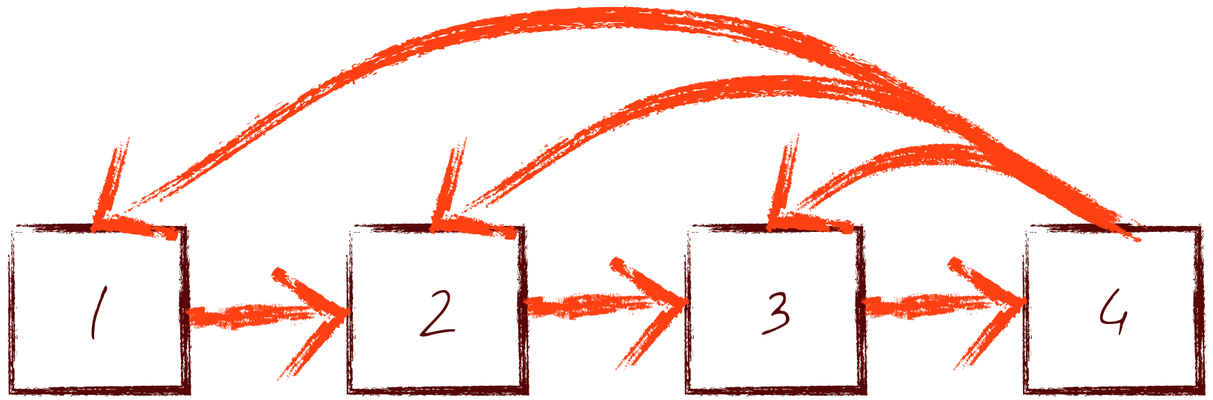
Finding Similar Frames

vs.



Black: Similar Frames

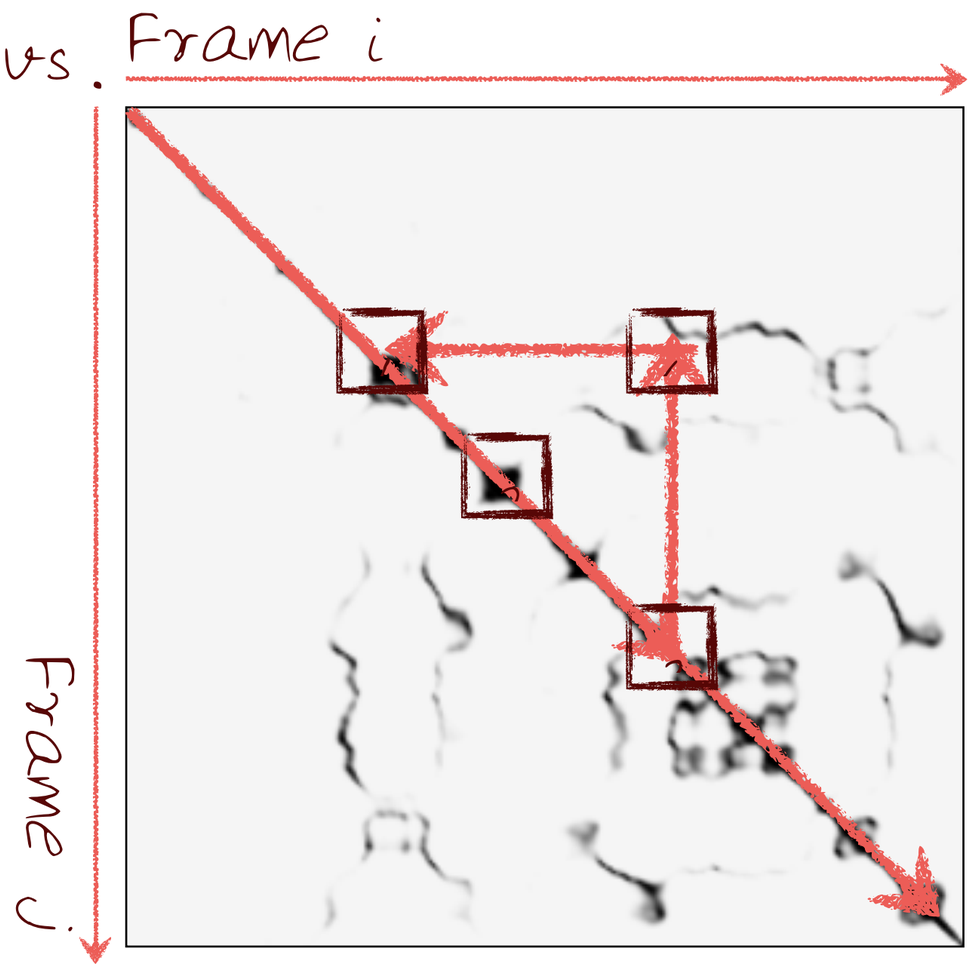
White: Dissimilar Frames



Markov Chain

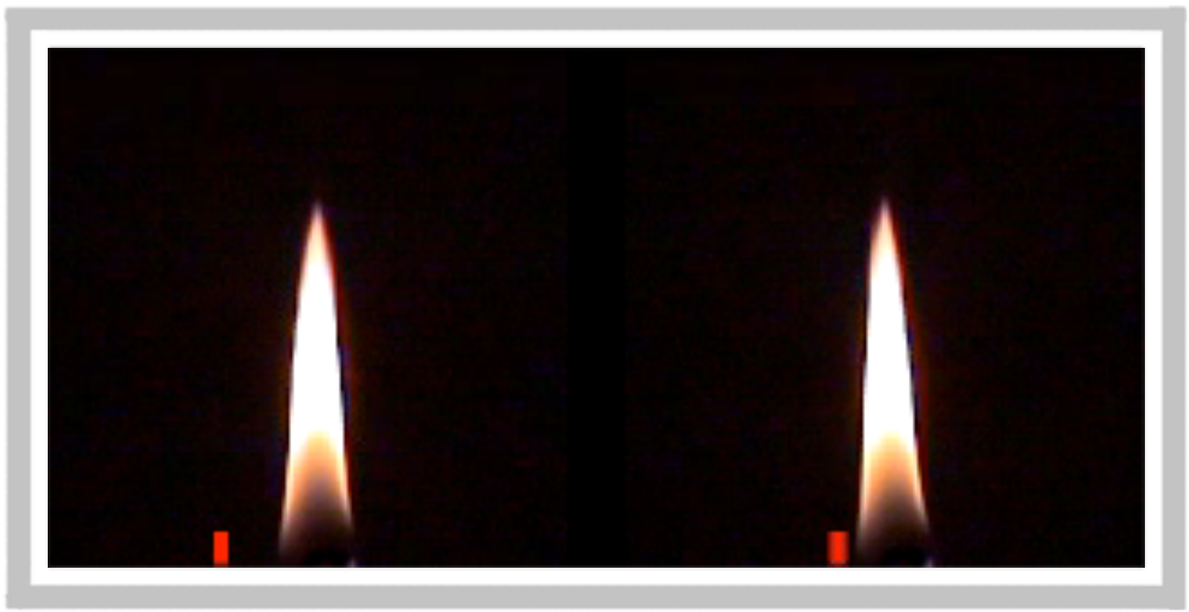
Finding Similar Frames

vs.

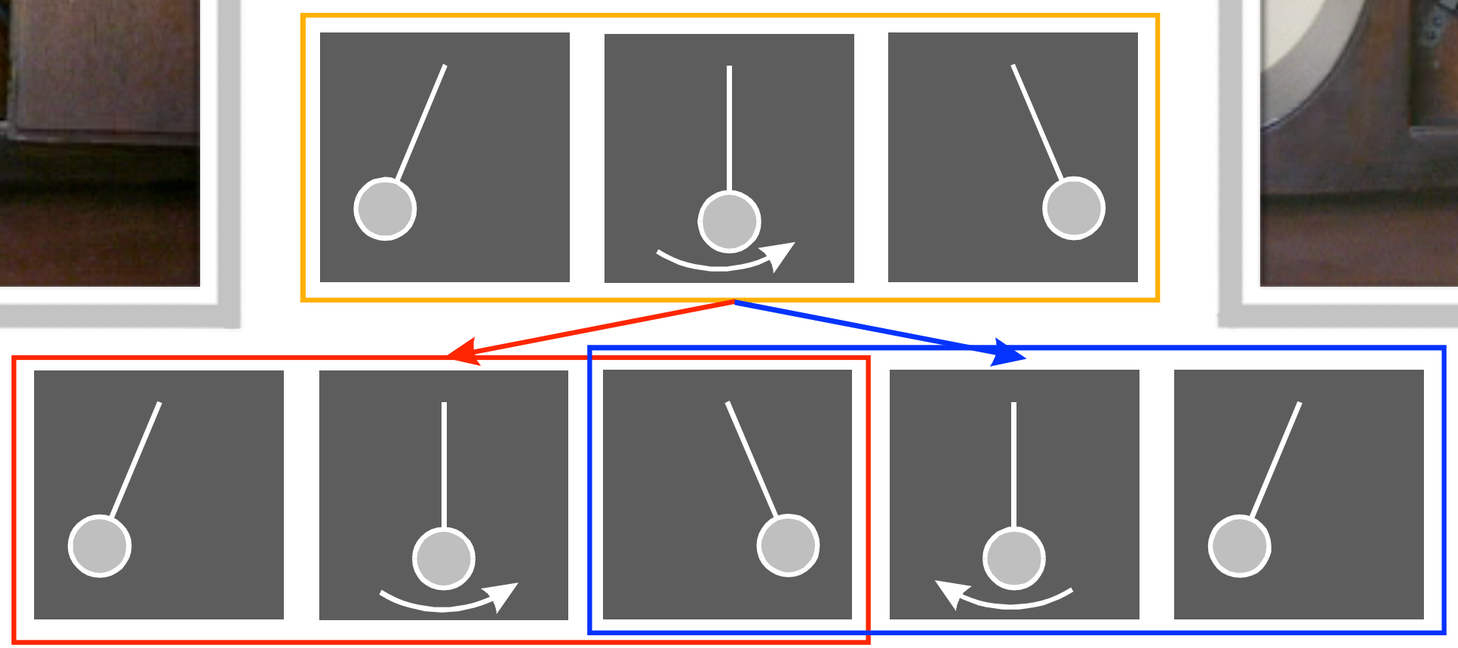


Black: Similar Frames

White: Dissimilar Frames



Preserving Dynamics with Transitions



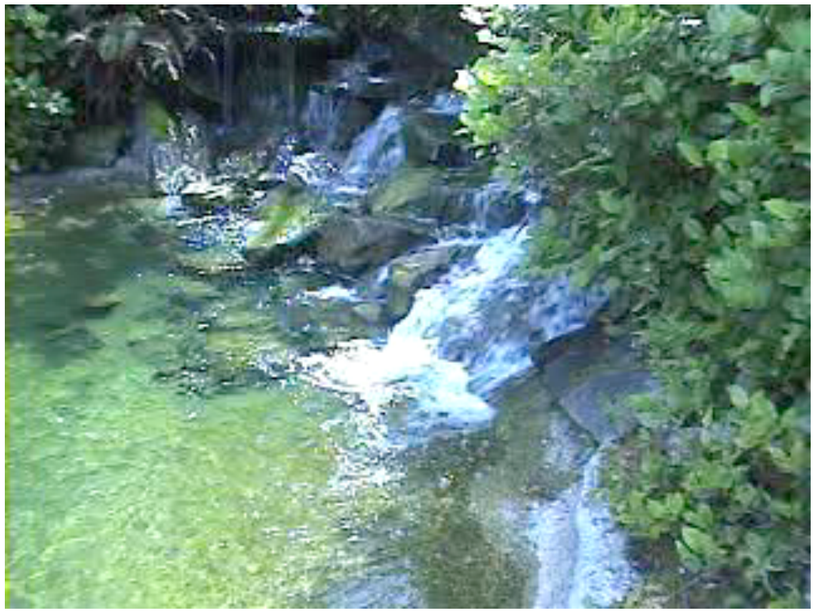
Fading and Blending in Video

Cut

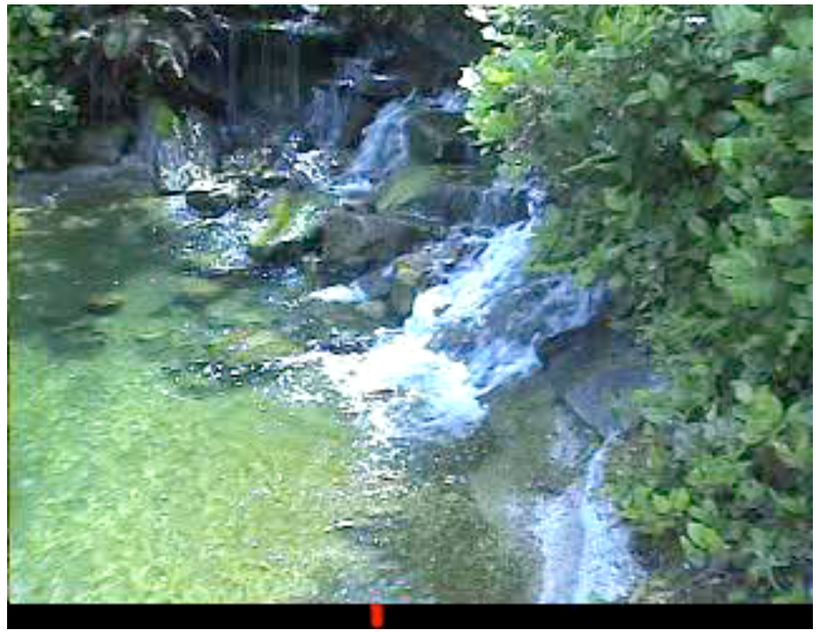
Fade

Morph/Feather

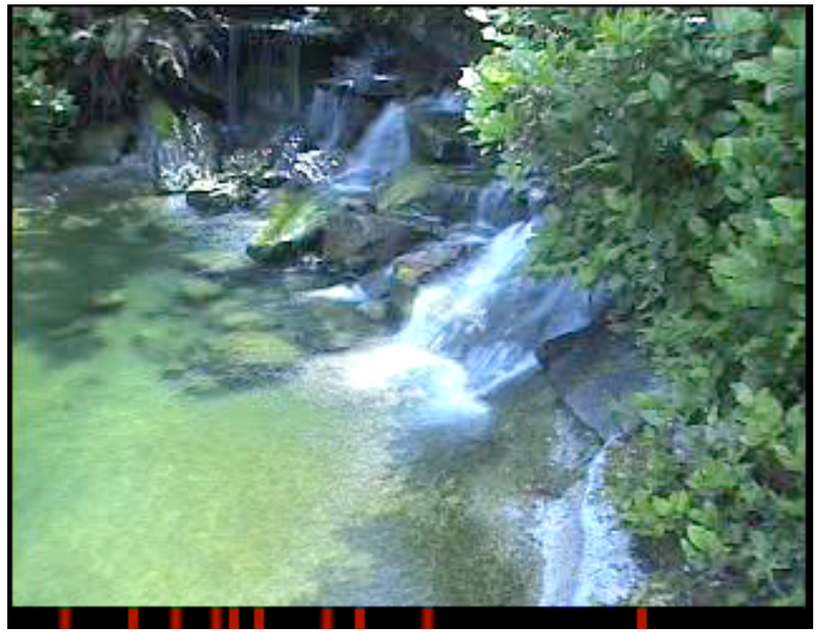
Fading and Blending in Video



Original

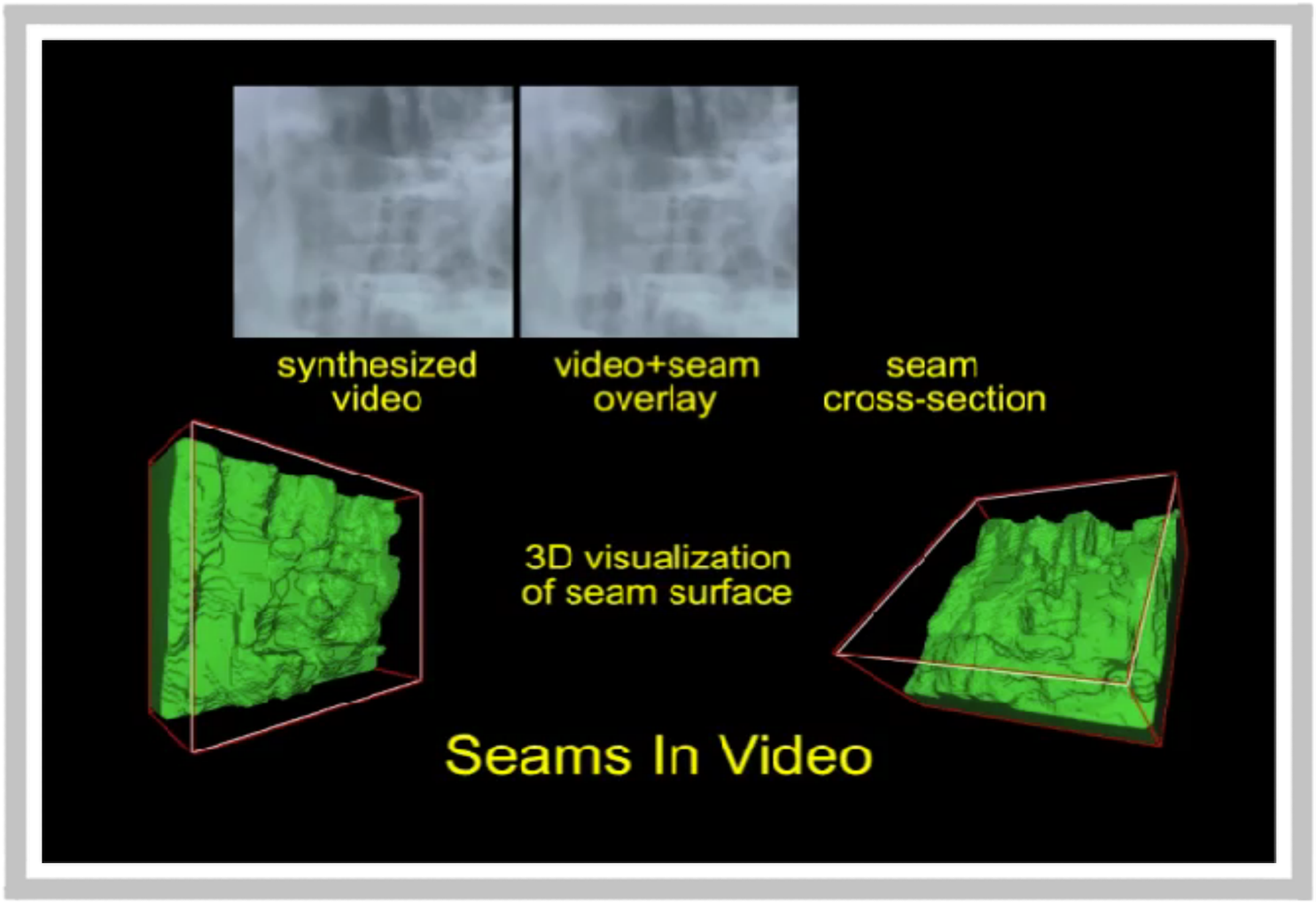


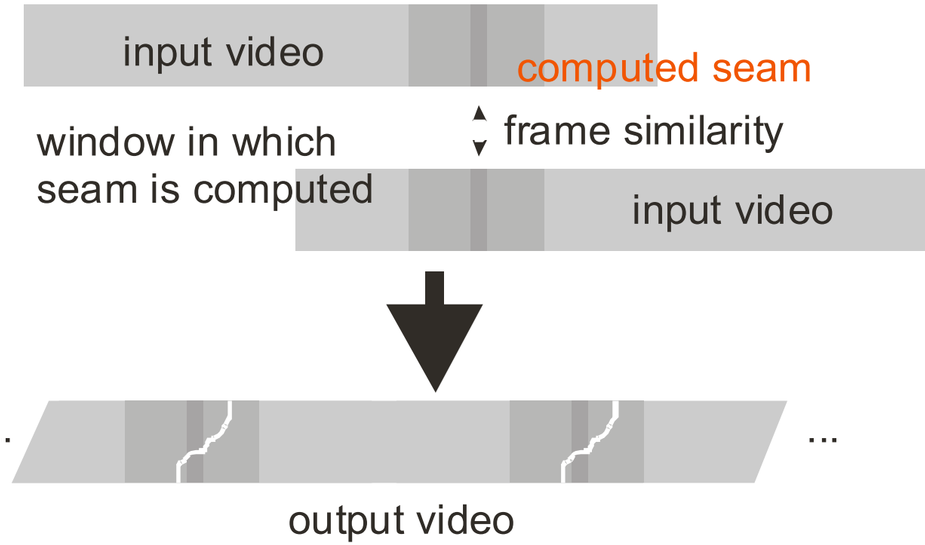
Single Fade



Multiple Fade/Blends

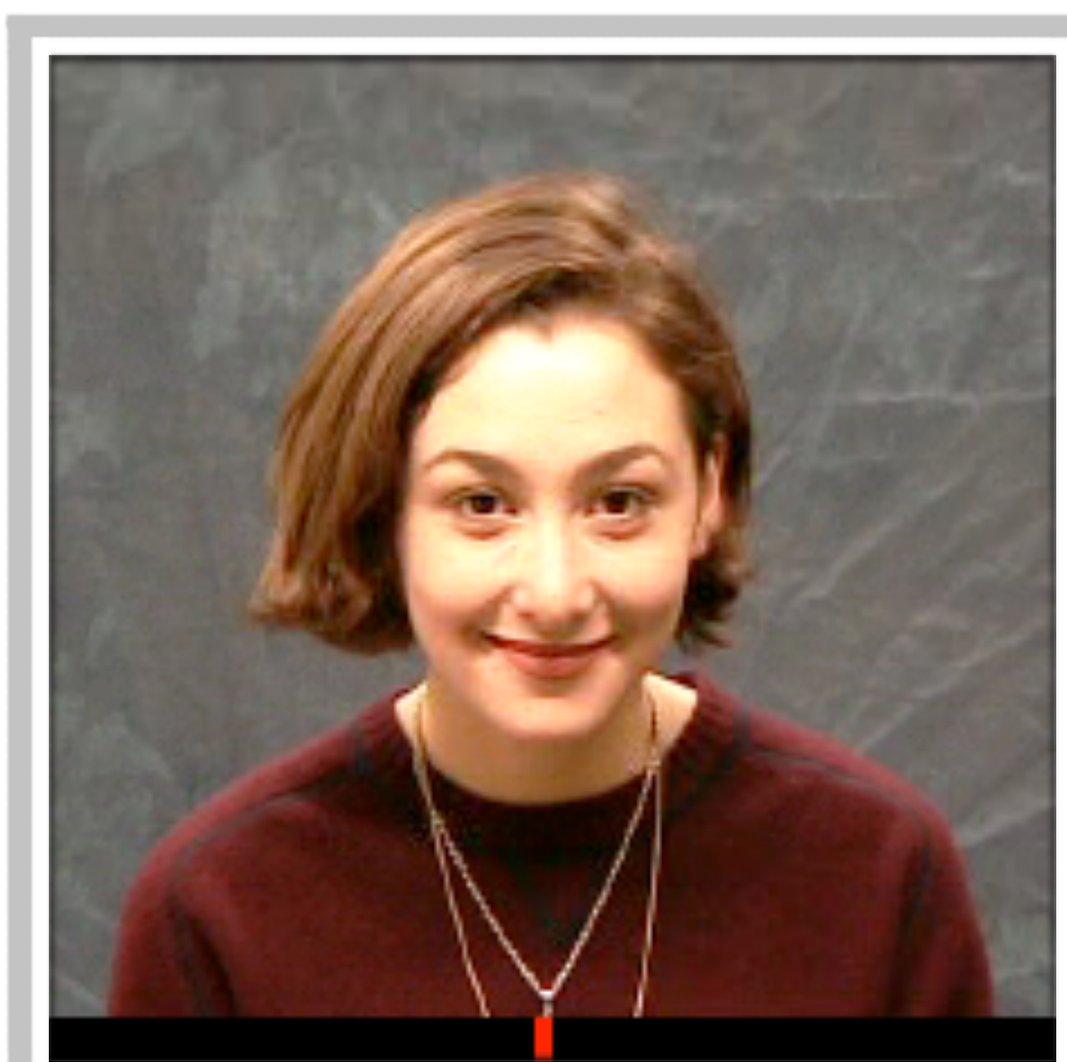
Not Just Fade/Blend, but Cut

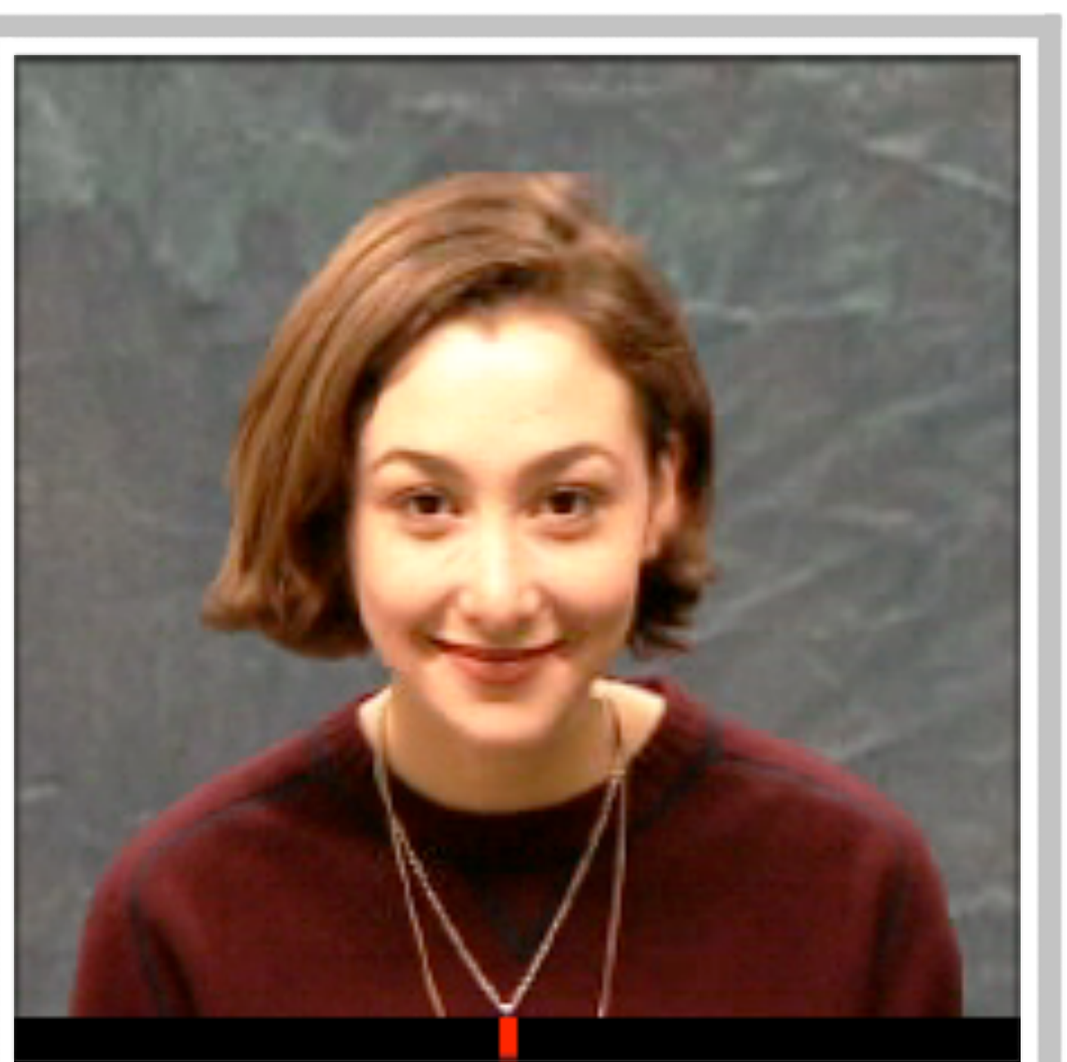




(Kwatra, Schödl, Essa 2003)

Video Portraits

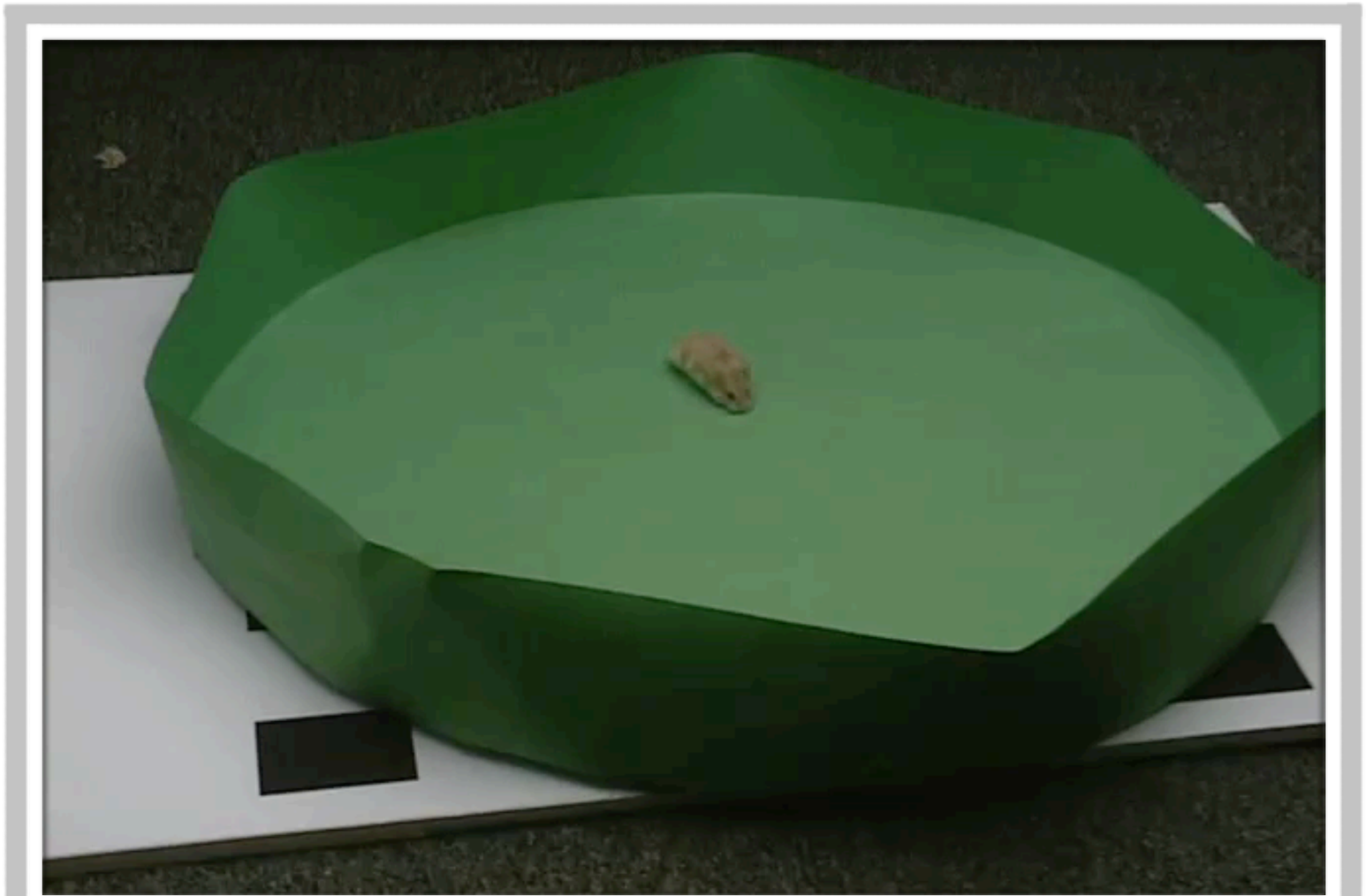




Video Sprites

Schödl and Essa (2002)

Video Sprites



Schödl and Essa (2002)

Cliplets Cinemagrams

Selecting and playing (animating) only parts of a Video

Henrik Sozzi,
http://www.youtube.com/watch?v=gkYL9weEDWE
using Microsoft Research Cliplets

Tom Freestone,
http://www.youtube.com/watch?v=u_scohnE9Wg

Summary

* Introduced the concept of a Video Texture
* Methods used to compute similarity between frames
* Using similar frames to generate Video Textures by finding similar points to transition to
* Discussed blending, fading, and cuts to generate Video Textures
* Extensions of Video Textures

Further Information

* Schödl, Szeliski, Salesin, and Essa (2000), "Video textures," in SIGGRAPH 2000
* Kwatra, Schödl, Essa, Turk, Bobick (2003), "Graphcut textures: image and video synthesis using graph cuts" in SIGGRAPH 2003
* Schödl and Essa (2002), "Controlled animation of video sprites" in ACM SIGGRAPH Symposium on Computer animation
* Agarwala, Zheng, Pal, Agrawala, Cohen, Curless, Salesin, and Szeliski (2005) "Panoramic video textures." SIGGRAPH 2005
* Bai, Agarwala, Agrawala, Ramamoorthi (2012), "Selectively De-animating Video," SIGGRAPH 2012

Credits

* For more information, see
  * Richard Szeliski (2010) Computer Vision: Algorithms and Applications, Springer
* Some videos retrieved from
  * From Professors Essa's Lab
  * Microsoft Research Cliplets

Computational Photography

* Study the basics of computation and its impact on the entire workflow of photography, from capturing, manipulating and collaborating on, and sharing photographs.

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