

EE 368 Project Proposal

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Title - Video Reconstruction from Randomized Video Frames

Goals -

This project is motivated by the talk given by TJ Lane and the need to reconstruct randomly ordered frames into a coherent video. This algorithm would allow scientist to observe dynamic information of samples from many repeated measurements of the sample at various states. The aim is to reconstruct a movie whose frames have been randomly reordered/repeated, much like what would be observed in an experiment at SLAC. This technique has the potential of opening a new set of experiments that can be carried out, allowing researchers to capture how proteins change structure even though the sample is destroyed during imaging.

To approach this problem, I plan on first designing the algorithm using various videos and computer simulations of protein dynamics possibly obtained from TJ Lane. The core of the algorithm will focus on computing metrics describing the distance between frames to find what the most likely ordering is. Possible metrics I will measure are detected features and their positions/orientations, the location of edges, absolute difference between images, and differences in the image composition (i.e. pixel intensity values). I would also like to look at how these differences appear in the diffraction patterns which is what the sensors actually capture.

My plan for implementation is to first extract features and metrics from the frames of a video and calculate the distances between frames to order them after they have been randomized. I then plan on testing the algorithm with them randomized and with repeated frames which would be present in any experiment.

From my research this problem is one that is yet to be solved and hasn't been given much attention. Inferring dynamics from a series of still images is pretty specialized to research like what is being done at SLAC, so I couldn't find previous research explicitly relating to this topic. However some video compression algorithms take advantage of the fact that you can predict future frames and interpolate motion between images when compressing video. Some of these algorithms even allow frames to be reordered, so I plan on looking at how they detect and predict motion and reorder the frames in the decoder. I also will look at video similarity algorithms that are used to detect if a movie contains content from another or is a copy and potentially recycle some of their similarity metrics.

References -

Frame reordering and prediction in MPEG compression -
http://link.springer.com/chapter/10.1007/978-1-4419-6184-6_2

Correlation between simulated protein dynamics and experiments -

Liu, L., Koharudin, L. M. I., Gronenborn, A. M. and Bahar, I. (2009), A comparative analysis of the equilibrium dynamics of a designed protein inferred from NMR, X-ray, and computations. *Proteins*, 77: 927–939. doi:10.1002/prot.22518

Measuring video similarity -

<http://www-video.eecs.berkeley.edu/papers/cheungsc/csvt2003.pdf>

Android Device - no