Title:
Compressed sensing and dictionary learning to alleviate tradeoff between temporal and spatial resolution

Research material:

3. "Video from a Single Coded Exposure Photograph using a Learned Over-Complete Dictionary", Y. Hitomi, J. Gu, M. Gupta, T. Mitsunaga and S.K. Nayar

"Efficient Space-Time Sampling with Pixel-wise Coded Exposure for High Speed Imaging", D. Liu, J. Gu, Y. Hitomi, M. Gupta, T. Mitsunaga and S.K. Nayar

Original Intent:

1. Implementation of the method proposed in the paper
2. Suggest and experiment with possible modifications (eg. other sampling schemes)
3. Summarize experiments and results

Status of solutions:
Achieved:

1. Implemented all the three stages - sampling, dictionary learning and reconstruction

2. Details of experiments performed:

Trained a dictionary using 20 high frame rate(~1000 fps) video segments of 36 frames each by using the KSVD algorith. The training videos were in greyscale. Coded imgae was formed using a sampling matrix with bump period 3 and starting point of bump generated uniformly randomly for each pixel. We train and reconstruct the videos patchwise with nonverlapping patches of size 8x8. Total number of basis elements in the learnt dictionary is 12500. Sparsity level is assumed to be 40.

From the coded images of the training videos, we reconstructed the videos back using the OMP algorithm. Average relative MSE was 0.2555 with standard deviation of 0.1131. In the reconstructed videos, we could observe the motion. However, the seam artifacts were observed because the recontruction patches were non-overlapping.

We can improve the performance by using overlapping patches, increasing dictionary size, tuning sparsity level, bump length, and patchsize.

Things to be done:

1. Run the pipeline for colored images
2. Reconstruct video which was not a part of the learnt dictionary
3. Vary/tune hyperparameters such as bump length, temporal depth, patchsize and stride, sparsity constraint, number of dictionary elements
4. Implement different sampling schemes (not adhering to hardware limitations)
5. Summarize experiments and results

Revised Intent: Same as original Intent