CS754 Project Report : Robust video denoising using Low rank matrix completion

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1 INTRODUCTION

In this report we present our approach to implementing the robust video denoising method proposed by the authors of paper [1]. In the following sections we have presented the algorithm used brifely and the results that we obtained. The implementation of the project was done on MATLAB.

2 ALGORITHM

We used a Adaptive median filter as described in [2] so that the impulse noise does not affect patching too much and then these pixels whose values were changed were noted and labelled as missing entries for low-rank matrix reconstruction.

2.1 PATCHING

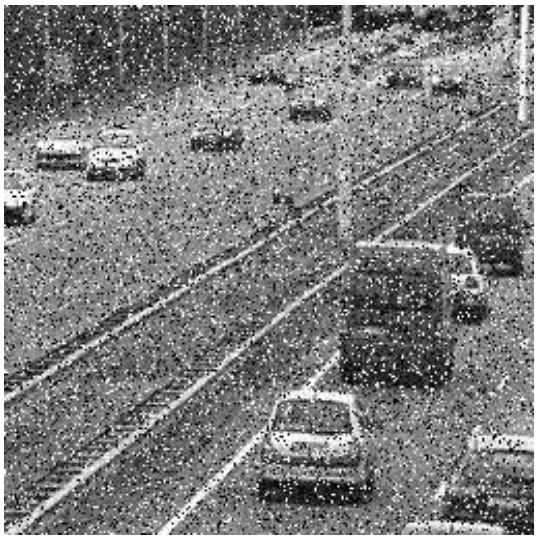
Doing an exhaustive search for each patch is not computationally feasible hence we use Three step search for patching for a reference block in each frame.Since the algorithm can fall in local minima traps we start at different positions and pick the 5 most closest patches(in MSE sense) to the reference patch and form a low rank matrix using these patches.

2.2 LOW-RANK RECOVERY

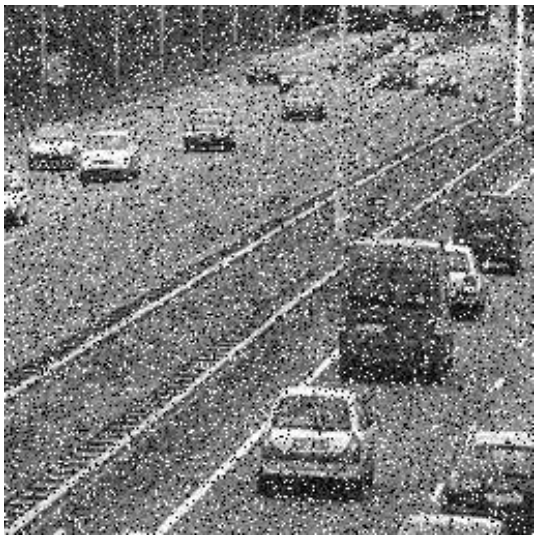
After finding the similar patches, we remove the unreliable pixels from each row (these are the pixels that differ a lot from their corresponding row means refer [1]). These pixels are added to the set of missing pixels. Then, we use a standard low-rank matrix reconstruction method which relies on nuclear norm minimization. We use the iterative procedure described in paper [1] which relies on singular value thresholding. Then we rewrite these patches back to the reconstructed image, and finally average out the pixels based on the number of patches in which the pixel was considered.

3 RESULTS

Here are the results for the image reconstruction,



(a) noisy-frame 1



(b) noisy-frame 2

Figure 1: Noisy frames of the video

(a) reconstructed frame-1

(b) reconstructed frame-2

Figure 2: two of the reconstructed frames

We also compared our reconstruction with the the noise removal method using ISTA. Which assumes that the image patches are sparse in the dct basis. The PSNR values obtained using our algorithm were significantly higher than what was obtained using ISTA.

Table 1: PSNR values

(a) Low rank matrix completion

frame	PSNR
1	22.36
2	22.22

(b) ISTA

frame	PSNR
1	15.71
2	15.75

References

[1] Hui Ji, Chaoqiang Liu, Zuowei Shen and Yuhong Xu
Robust video denoising using Low rank matrix completion
`https://ieeexplore.ieee.org/document/5539849`

[2] H. Hwang and R. A. Haddad. *Adaptive median filters: New algorithms and results. IEEE Trans. on Image Processing, 4:499–502, 1995.*