Title: Development Of an Uncertainty-aware Anomaly Detection In Videos Data Using a Normalizing Flow-Bayesian Variational Autoencoder

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Abbreviated abstract: Anomaly detection is used to spot odd activity in video. Several approaches detect video abnormalities. These approaches have limitations, such as noise sensitivity, ineffective motion estimation, and unexpected data due to dynamic entities. This paper suggests a bat algorithm-based anisotropic diffusion technique for denoising video frames, Shearlet-optical flow extracts qualitative data and trains a BVAE. The proposed technique will be evaluated using the UCSD and Avenue datasets, with frame-level and pixel-level measures like AUC and EER.

Related publications: (up to 2 references)

– N. Fan et al, Computer Vision and Image Understanding, 195 (2020)
– K. Singh et al, Neurocomputing (371), 188-198 (2020)

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Problem, Data, Previous Works

Problem Definition

Inefficient Uncertainty Quantification resulting from

a. Noise in the Video Data

b. Small capture range of the optical flow methods and the inability to capture large displacement.

c. Variations and complex interactions among entities in video data

Review of related works

Bansod & Nandedkar (2020):

- **B**ackground effects were removed with the aid of a Gaussian Mixture Model (GMM),
- the appearance and motion features of the foreground objects were extracted using histogram of magnitude and momentum. However, the histogram of magnitude adopted could increase the contrast of background noise, while decreasing the usable signal.

Fan *et al*. (2020):

- Introduced an efficient deep learning technique partially supervised for the identification and location of suspicious events in surveillance videos.
- However, the optical flow method used could not handle large motion displacement and VAE employed was not expressive to produce an informative posterior distribution.

MPI Sintel Dataset

- Provides a dense groundtruth derived from the open-source 3D animated short film Sintel

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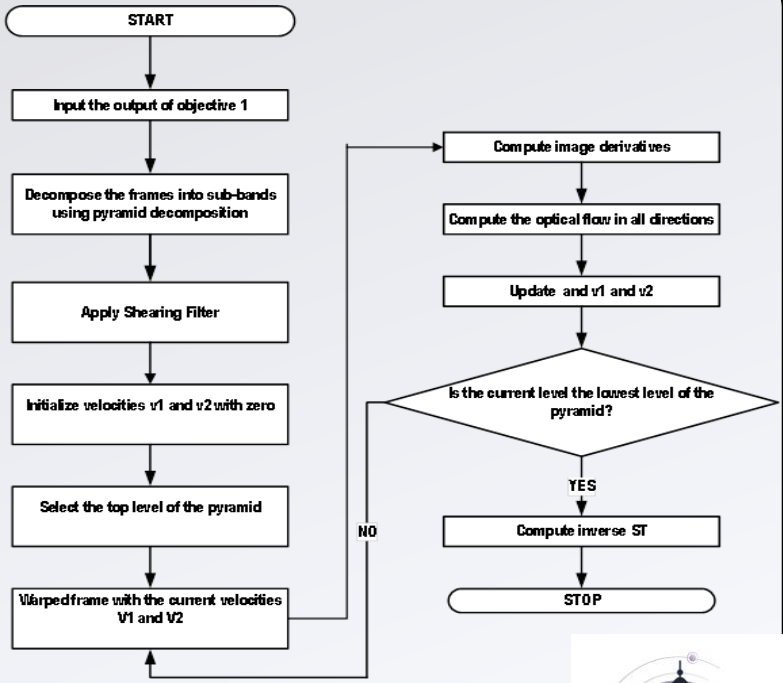
Methods

- ✓ At the top or coarse level of the pyramid, the velocities V_1 and V_2 are initialized for the computation of the optical flows as depicted in the following steps:
- ✓ prediction from previous estimates to pre-warp the next image
- ✓ use feature correspondence to establish rough initial match
- ✓ coarse-to-fine estimation: Progressive flow estimation from
- ✓ coarse to fine levels within Gaussian pyramids of the two images.
- ✓ start at coarsest level, warp images with initial guess,
- ✓ then iterate warping & LS estimation until convergence.
- ✓ warp levels, then apply iterative estimation until convergence.
- ✓ warp levels (i.e., the original images) using then
- ✓ apply iterative estimation until convergence.



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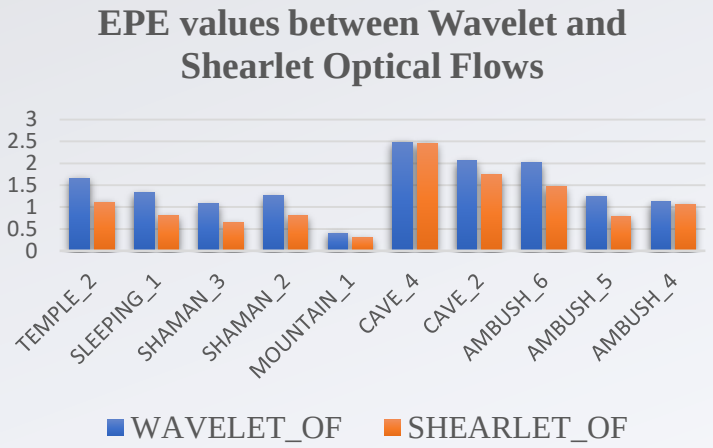
Preliminary Results and Conclusions

S/N	VIDEO DATA	WAVELET_ OF	SHEARLET_ OF
1	TEMPLE_2	1.6597	1.1131
2	SLEEPING_1	1.3278	0.7982
3	SHAMAN_3	1.0776	0.6463
4	SHAMAN_2	1.2693	0.8041
5	MOUNTAIN_1	0.4020	0.3059
6	CAVE_4	2.4830	2.4537
7	CAVE_2	2.0568	1.7429
8	AMBUSH_6	2.0132	1.4718
9	AMBUSH_5	1.2488	0.792
10	AMBUSH_4	1.1183	1.072



In conclusion, this research developed a shearlet transform based optical flow algorithm for an effective motion estimation in videos data. The developed shearlet transform based optical flow algorithm performed better as compared with the existing wavelet transform based optical flow algorithms based on the MPI Sintel standard datasets. Next is to train the BVAE.

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