Crowd Motion Monitoring Using Tracklet-based Commotion Measure

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Problem

Abnormality Detection: identifying abnormal behavioral patterns in videos.

Main Challenges:

- Scarcity of training samples (supervised learning)
- Difficult to detect and track individuals and objects
- Not clear definition of abnormality, i.e., context dependent

Contributions

- We introduce a new unsupervised commotion measure to detect crowd abnormal behaviors at pixel, frame and video levels.
- We propose to encode motion pattern of each salient point per each frame using tracklet magnitude and orientation over a simple hashing function
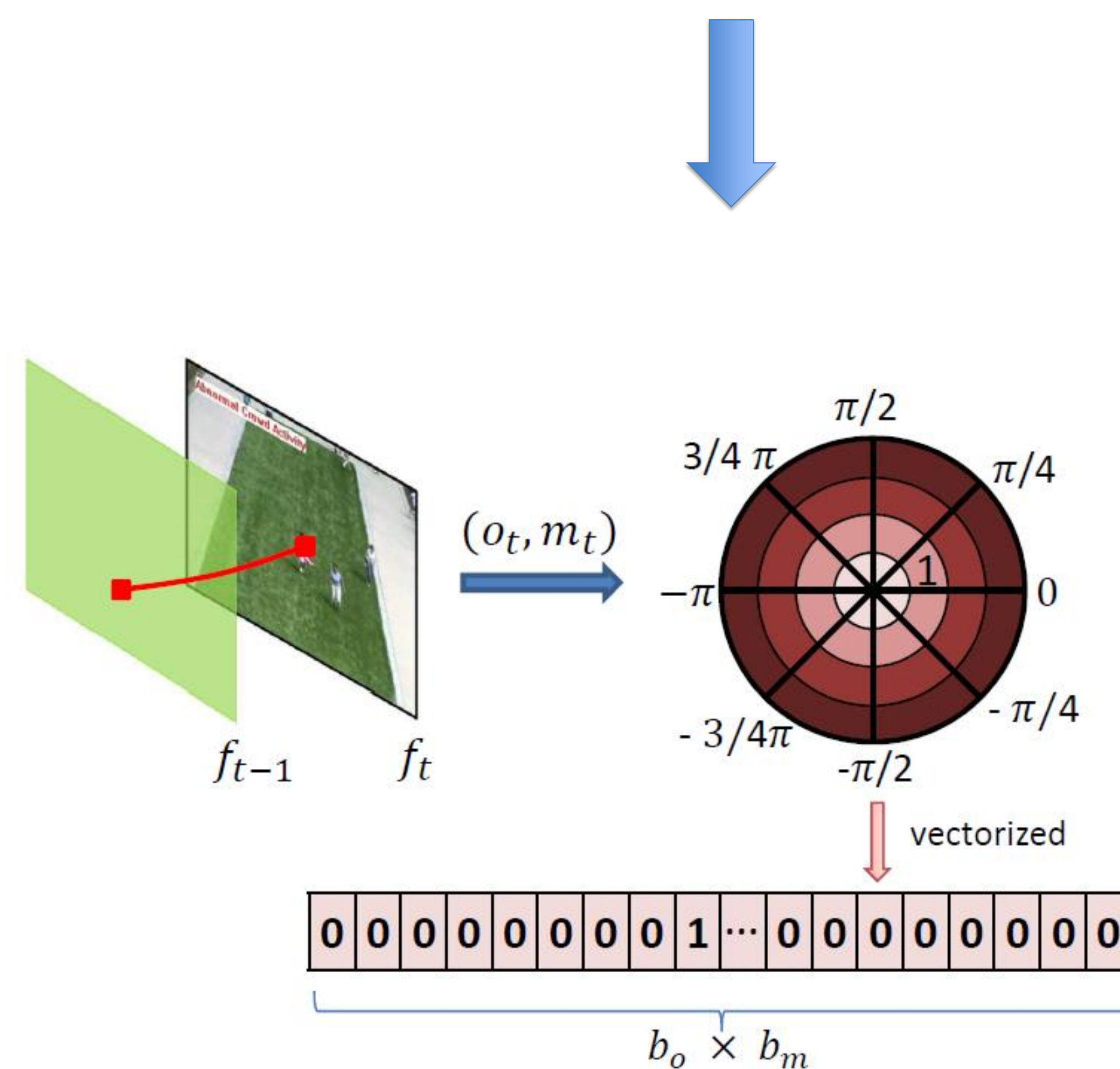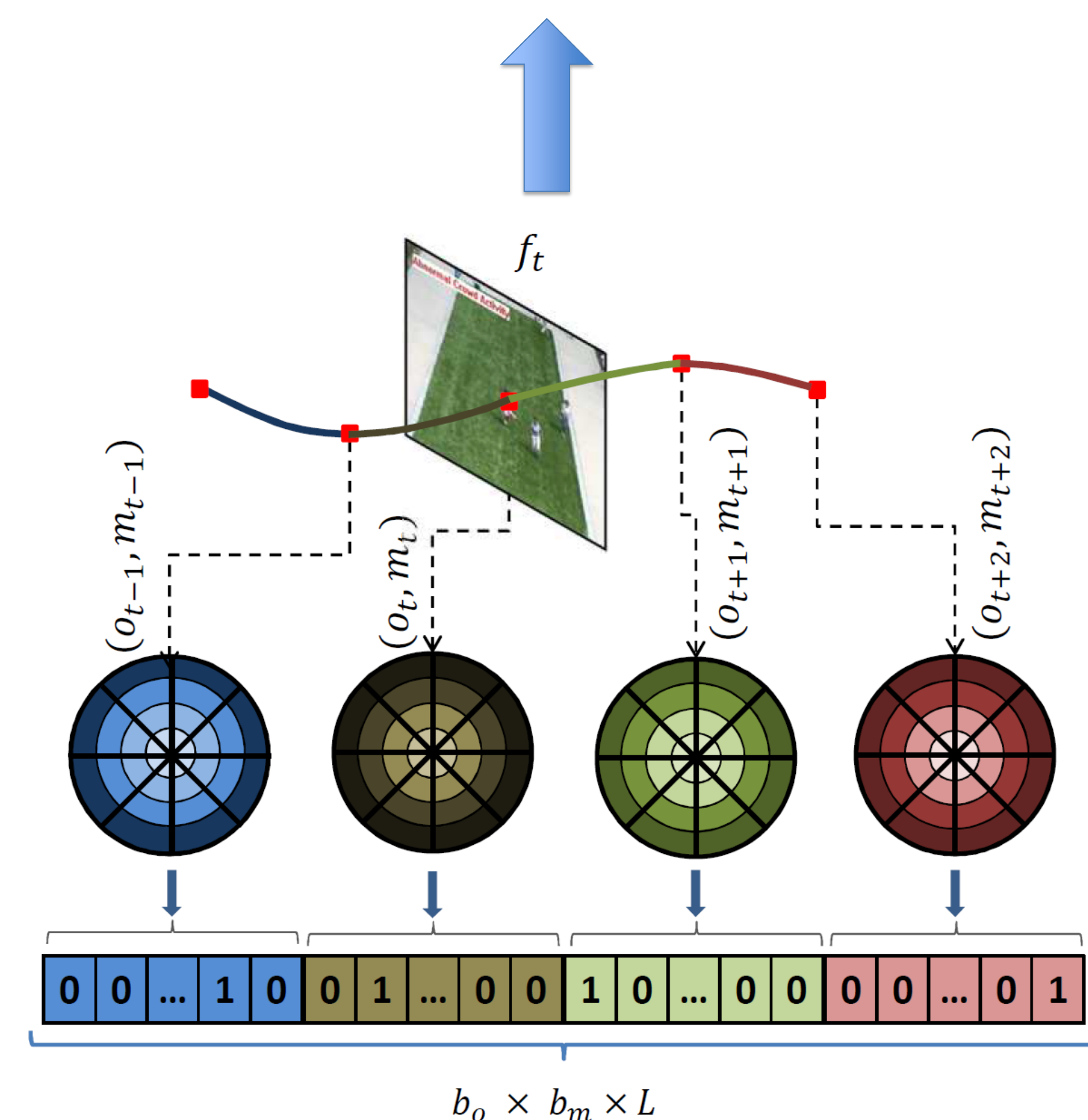- We propose Tracklet Binary Code to capture statistics of tracklets passing over a set of frames

Overview of the Method
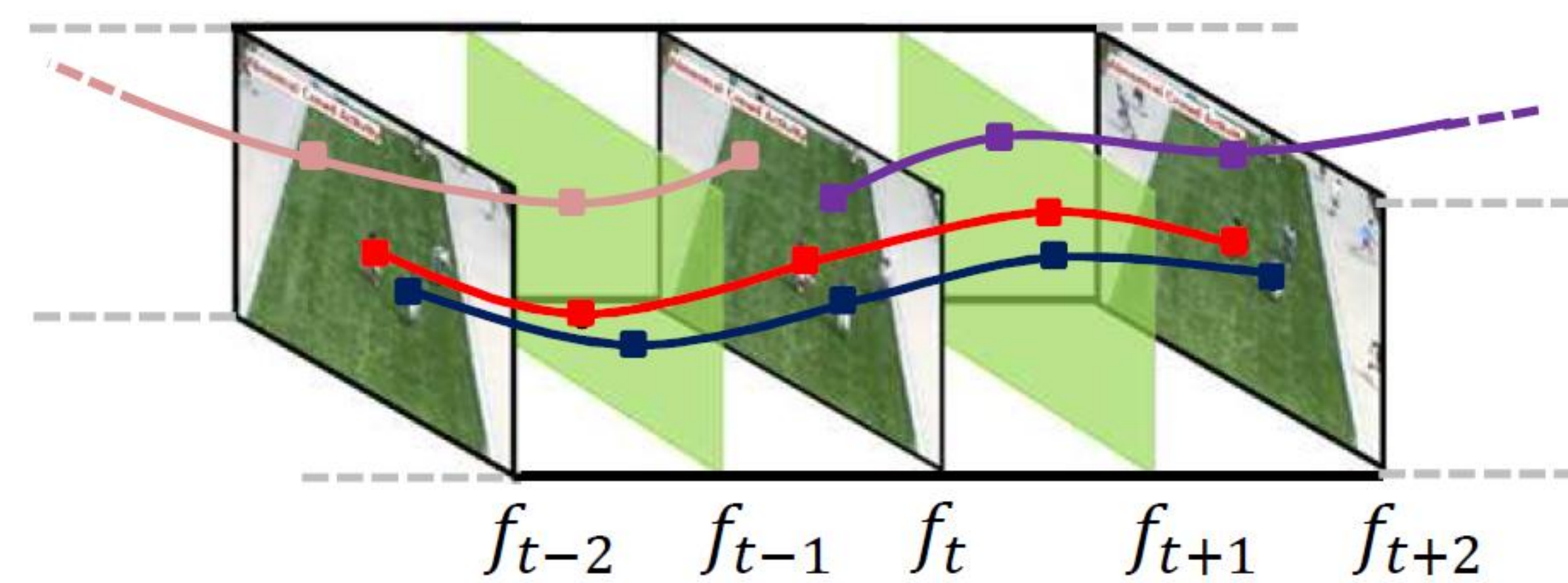
$$w(j, j_{max}) = \frac{1}{2\pi\sigma_o\sigma_m} e^{-\frac{(\bar{o}_j - \bar{o}_{j_{max}})^2}{2\sigma_o^2} - \frac{(\bar{m}_j - \bar{m}_{j_{max}})^2}{2\sigma_m^2}}$$

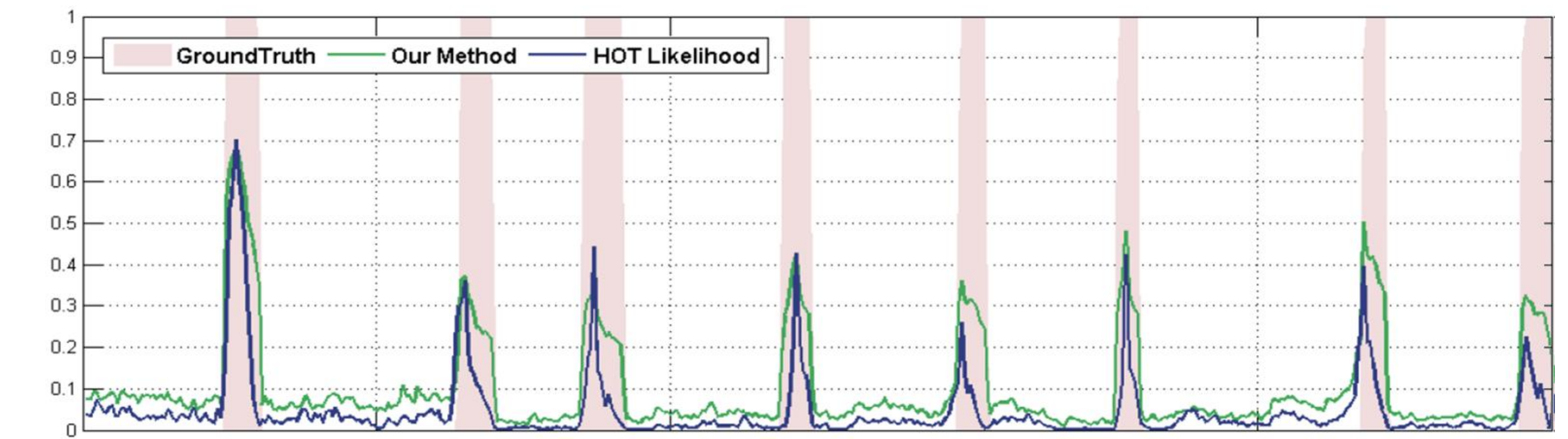$$Comm(p_i^t) = \sum_{j=1}^{|\mathcal{H}_i^t|} w(j, j_{max}) \times ||\mathcal{H}_i^t(j) - \mathcal{H}_i^t(j_{max})||_2^2$$

Experimental Results

Frame Level: (UMN Dataset)

Method	AUC	Speed (fps)
Optical Flow [1]	0.84	5
SFM[1]	0.96	3
Chaotic Invariants [16]	0.99	1
Sparse Reconstruction [17]	0.978	<1
Proposed Scheme	0.9889	5

Video Level: (Violent in Crowd Dataset)

Method	Accuracy
Local Trinary Patterns [18]	71,53%
Histogram of oriented Gradients [19]	57,43%
Histogram of oriented Optic-Flow [20]	58,53%
HNF [19]	56,52%
Violence Flows ViF [15]	81,30 %
Dense Trajectories [21]	78,21 %
HOT [9]	78,30%
Our Method	**81.55%**

Pixel Level:
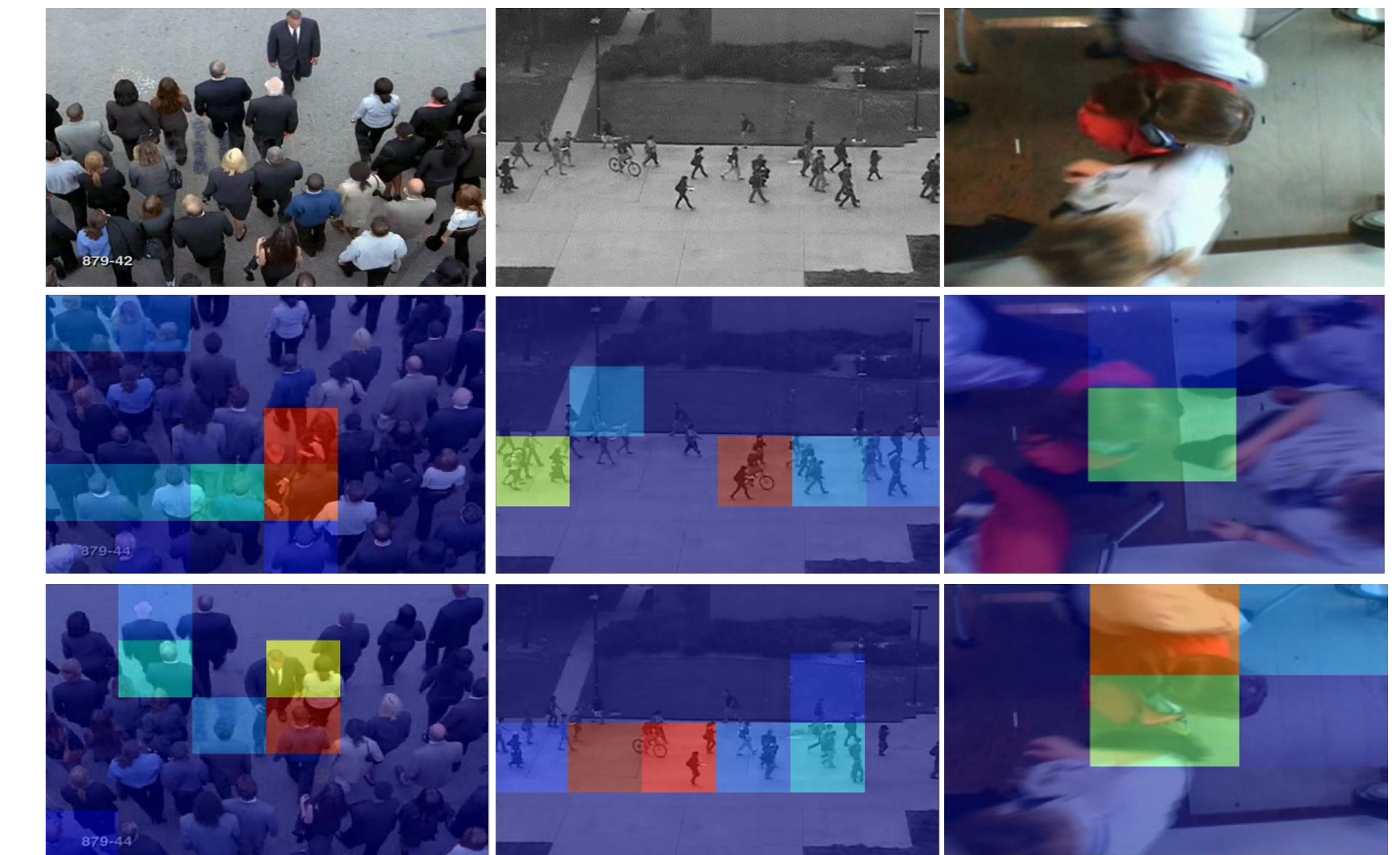
Conclusions

- A new measure to compute commotion of a given video to detect/localize abnormal events in crowded scenarios
- For the future work, we will evaluate the proposed feature for the task of action recognition.

References

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- Cui, X., Liu, Q., Gao, M., Metaxas, D.N.: Abnormal detection using interaction energy potentials, CVPR, 2011
- Hassner, T., Itcher, Y., and Kliper-Gross, O.: Violent flows: Real-time detection of violent crowd behavior, CVPRW, 2012