BROWNIAN DESCRIPTOR FOR ACTION RECOGNITION

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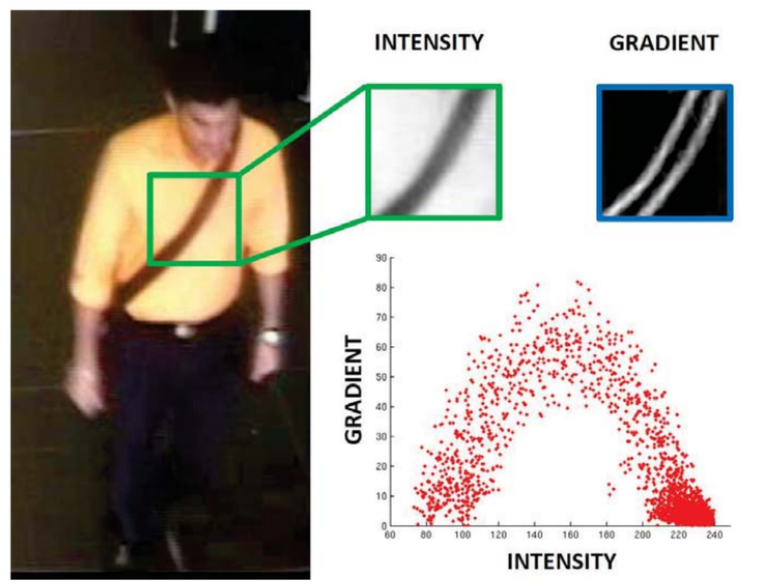
1. Abstract

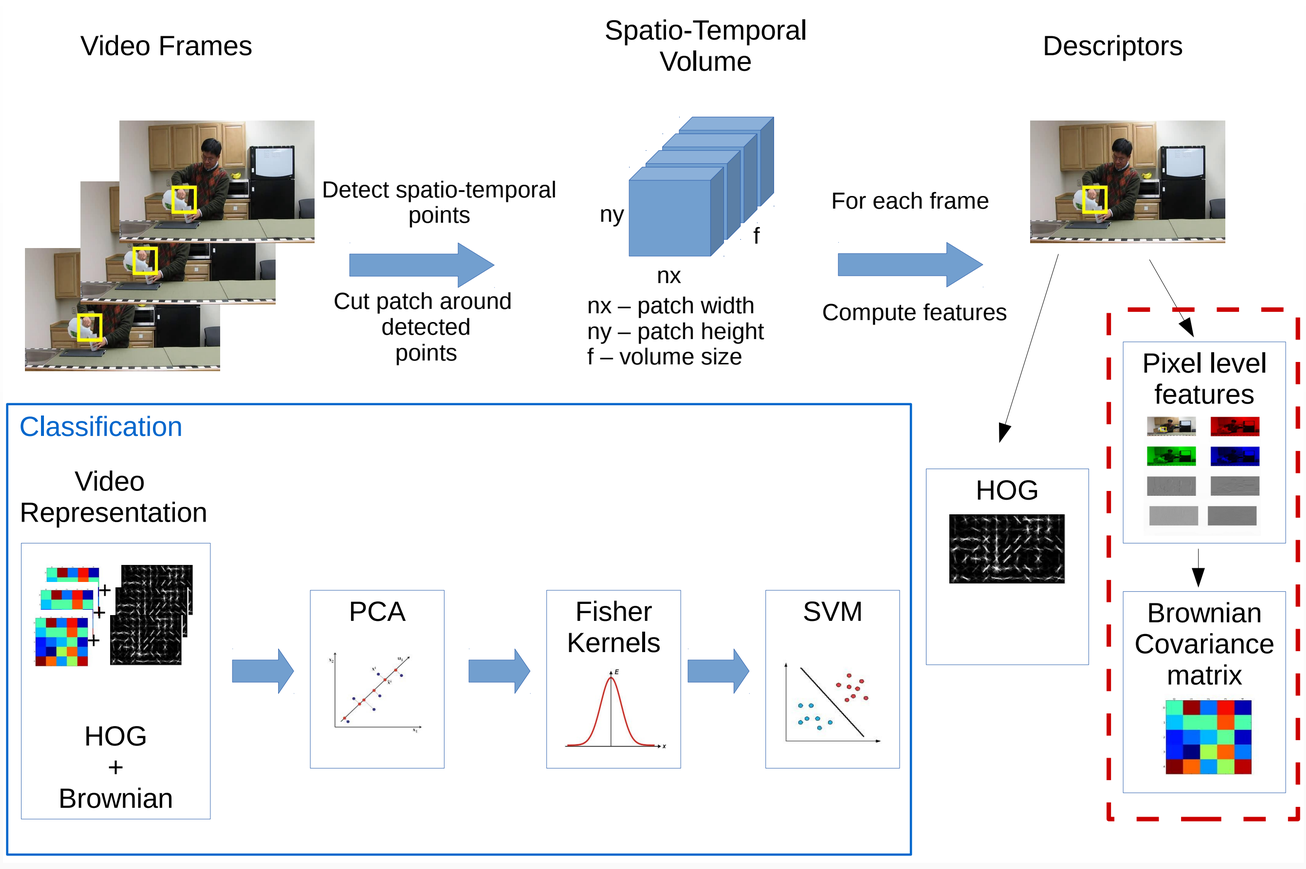
HOG is the most popular appearance descriptor in Action Recognition. We propose a novel appearance descriptor, which models relationships between different pixel-level features such as intensity or gradient, using Brownian Covariance (BC). BC is a natural extension of classical covariance measure that models any kind of relationship. We show that BC carries complementary information to HOG, because fusion of those two gives significant performance improvement. We test our method on 3 datasets.

2. Brownian covariance

- Invented to model Brownian motion of particles in fluid [1].
- Brownian covariance W measures all kinds of possible relationships, where classical covariance models only linear.
- $W(X, Y) = 0$ if and only if X and Y are independent.
- Brownian Covariance matrices are part of Euclidean space, classical covariance is a part of Riemannian manifold and needs further processing.



3. Approach



3.1 Pixel level features

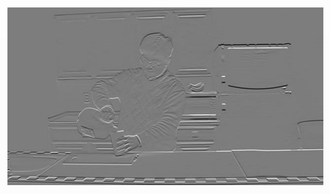

(a) original image


(b) red channel

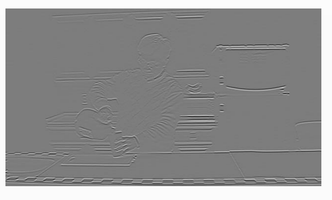

(c) green channel


(d) blue channel


(e) 1st deriv. axis-x


(f) 1st deriv. axis-y


(g) 2nd der. axis-x


(h) 2nd der. axis-y

4. Results

	HOG	Brownian	Fusion
URADL [2]	80.67%	74.00%	**80.67%**
MSR Daily Activity [3]	47.81%	47.81%	**54.38%**
HMDB51 [4]	26.21%	20.02%	**31.07%**

5. Conclusions

- Brownian Descriptor carries complementary information to HOG, as a fusion of HOG and Brownian performs better than separate descriptors.
- Brownian Descriptor like HOG carries only appearance information. To achieve better overall performance it can be combined with other motion features: for instance HOF.

6. References

[1] G. J. Székely, M. L. Rizzo, Brownian distance covariance *The Annals of Applied Statistics 3(4):1236-1265*, 2009

[2] http://www.cs.rochester.edu/~rmessing/uradl/

[3] http://research.microsoft.com/en-us/um/people/zliu/ActionRecoRsrc/

[4] http://serre-lab.clps.brown.edu/resources/