Pyramidal Zernike Over Time: A Spatiotemporal Feature Descriptor Based on Zernike Moments

Iberoamerican Congress on Pattern Recognition

CIARP 2017: Progress in Pattern Recognition, Image Analysis, Computer Vision, and Applications pp 77-85 | Cite as

- Igor L. O. Bastos (1) Email author (igorcrexito@gmail.com)View author's OrcID profile (View OrcID profile)
- Larissa Rocha Soares (2) View author's OrcID profile (View OrcID profile)
- William Robson Schwartz (1) View author's OrcID profile (View OrcID profile)

1. Smart Surveillance Interest Group, Department of Computer Science, Universidade Federal de Minas Gerais, , Belo Horizonte, Brazil
2. Reuse in Software Engineering, Universidade Federal da Bahia, , Salvador, Brazil

Conference paper
First Online: 04 February 2018

Abstract

This paper aims at presenting an approach to recognize human activities in videos through the application of Zernike invariant moments. Instead of computing the regular Zernike moments, our technique, named Pyramidal Zernike Over Time (PZOT), creates a pyramidal structure and uses the Zernike response at different levels to associate subsequent frames, adding temporal information. At the end, the feature response is associated to Gabor filters to generate video descriptions. To evaluate the present approach, experiments were performed on the UCFSports dataset using a standard protocol, achieving an accuracy of 86.05%, comparable to results achieved by other widely employed spatiotemporal feature descriptors available in the literature.

Keywords

 Activity recognition   Feature extraction   Zernike moments

This is a preview of subscription content, log in to check access.

Notes

Acknowledgments

References

1. Bastos, I.L.O., Angelo, M.F., Loula, A.: Recognition of static gestures applied to Brazilian sign language (libras). In: SIBGRAPI, pp. 305–312 (2015)
    Google Scholar (https://scholar.google.com/scholar?q=Bastos%2C%20I.L.O.%2C%20Angelo%2C%20M.F.%2C%20Loula%2C%20A.%3A%20Recognition%20of%20static%20gestures%20applied%20to%20Brazilian%20sign%20language%20%28libras%29.%20In%3A%20SIBGRAPI%2C%20pp.%20305%E2%80%93312%20%282015%29)

2. Caetano, C., Santos, J.A., Schwartz, W.R.: Optical flow co-occurrence matrices: a novel spatiotemporal feature descriptor. In: Proceedings of the 23rd ICPR (2016)
    Google Scholar (https://scholar.google.com/scholar?q=Caetano%2C%20C.%2C%20Santos%2C%20J.A.%2C%20Schwartz%2C%20W.R.%3A%20Optical%20flow%20co-occurrence%20matrices%3A%20a%20novel%20spatiotemporal%20feature%20descriptor.%20In%3A%20Proceedings%20of%20the%2023rd%20ICPR%20%282016%29)

3. Chaquet, J.M., Carmona, E.J., Antonio, F.: A survey of video datasets for human action and activity recognition. Comput. Vis. Image Underst. **117**, 633–659 (2013)
    CrossRef (https://doi.org/10.1016/j.cviu.2013.01.013)
    Google Scholar (http://scholar.google.com/scholar_lookup?title=A%20survey%20of%20video%20datasets%20for%20human%20action%20and%20activity%20recognition&author=JM.%20Chaquet&author=EJ.%20Carmona&author=F.%20Antonio&journal=Comput.%20Vis.%20Image%20Underst.&volume=117&pages=633-659&publication_year=2013)

4. Costantini, L., Seidenari, L., Serra, G., Capodiferro, L., Del Bimbo, A.: Space-time Zernike moments and pyramid kernel descriptors for action classification. In: Maino, G., Foresti, G.L. (eds.) ICIAP 2011, Part II. LNCS, vol. 6979, pp. 199–208. Springer, Heidelberg (2011). https://doi.org/10.1007/978-3-642-24088-1_21

 (https://doi.org/10.1007/978-3-642-24088-1_21)
CrossRef (https://doi.org/10.1007/978-3-642-24088-1_21)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Space-
time%20Zernike%20moments%20and%20pyramid%20kernel%20descrip
tors%20for%20action%20classification&author=L.%20Costantini&author
=L.%20Seidenari&author=G.%20Serra&author=L.%20Capodiferro&autho
r=A.%20Bimbo&pages=199-208&publication_year=2011)

5.   Dalal, N., Triggs, B.: Histograms of oriented gradients for human
     detection. In: Proceedings of IEEE CVPR 2005, vol. 1, pp. 886–893 (2005)
     Google Scholar (https://scholar.google.com/scholar?
     q=Dalal%2C%20N.%2C%20Triggs%2C%20B.%3A%20Histograms%20of%
     20oriented%20gradients%20for%20human%20detection.%20In%3A%20
     Proceedings%20of%20IEEE%20CVPR%202005%2C%20vol.%201%2C%2
     0pp.%20886%E2%80%93893%20%282005%29)

6.   Dalal, N., Triggs, B., Schmid, C.: Human detection using oriented
     histograms of flow and appearance. In: Leonardis, A., Bischof, H., Pinz, A.
     (eds.) ECCV 2006. LNCS, vol. 3952, pp. 428–441. Springer, Heidelberg
     (2006). https://doi.org/10.1007/11744047_33
      (https://doi.org/10.1007/11744047_33)
     CrossRef (https://doi.org/10.1007/11744047_33)
     Google Scholar (http://scholar.google.com/scholar_lookup?
     title=Human%20detection%20using%20oriented%20histograms%20of%2
     0flow%20and%20appearance&author=N.%20Dalal&author=B.%20Triggs
     &author=C.%20Schmid&pages=428-441&publication_year=2006)

7.   Feichtenhofer, C., Pinz, A., Zisserman, A.: Convolutional two-stream
     network fusion for video action recognition. In: Proceedings of the IEEE
     CVPR 2016 (2016)
     Google Scholar (https://scholar.google.com/scholar?
     q=Feichtenhofer%2C%20C.%2C%20Pinz%2C%20A.%2C%20Zisserman%
     2C%20A.%3A%20Convolutional%20two-
     stream%20network%20fusion%20for%20video%20action%20recognition.
     %20In%3A%20Proceedings%20of%20the%20IEEE%20CVPR%202016%2
     0%282016%29)

8.   Ke, S., Thuc, H., Lee, Y., Hwang, J., Yoo, J., Choi, K.: A review on video-
     based human activity recognition. Computers **2**, 88–131 (2013)
     CrossRef (https://doi.org/10.3390/computers2020088)
     Google Scholar (http://scholar.google.com/scholar_lookup?
     title=A%20review%20on%20video-
     based%20human%20activity%20recognition&author=S.%20Ke&author=
     H.%20Thuc&author=Y.%20Lee&author=J.%20Hwang&author=J.%20Yoo
     &author=K.%20Choi&journal=Computers&volume=2&pages=88-
     131&publication_year=2013)

9.   Khotanzad, A., Hong, Y.H.: Invariant image recognition by Zernike
     moments. IEEE Trans. Pattern Anal. Mach. Intell. **12**(5), 489–497 (1990)
     CrossRef (https://doi.org/10.1109/34.55109)
     Google Scholar (http://scholar.google.com/scholar_lookup?
     title=Invariant%20image%20recognition%20by%20Zernike%20moments
     &author=A.%20Khotanzad&author=YH.%20Hong&journal=IEEE%20Tra
     ns.%20Pattern%20Anal.%20Mach.%20Intell.&volume=12&issue=5&pages

=489-497&publication_year=1990)

10. Klaser, A., Marszalek, M., Schmid, C.: A spatio-temporal descriptor based on 3D-gradients. In: Proceedings of 19th BMVC, pp. 275:1–10 (2008)
Google Scholar (https://scholar.google.com/scholar?
q=Klaser%2C%20A.%2C%20Marszalek%2C%20M.%2C%20Schmid%2C%20C.%3A%20A%20spatio-
temporal%20descriptor%20based%20on%203D-
gradients.%20In%3A%20Proceedings%20of%2019th%20BMVC%2C%20pp.%20275%3A1%E2%80%9310%20%282008%29)

11. Laptev, I., Marszalek, M., Schmid, C., Rozenfeld, B.: Learning realistic human actions from movies. In: Proceedings of IEEE CVPR 2008, pp. 1–8 (2008)
Google Scholar (https://scholar.google.com/scholar?
q=Laptev%2C%20I.%2C%20Marszalek%2C%20M.%2C%20Schmid%2C%20C.%2C%20Rozenfeld%2C%20B.%3A%20Learning%20realistic%20human%20actions%20from%20movies.%20In%3A%20Proceedings%20of%20IEEE%20CVPR%202008%2C%20pp.%201%E2%80%938%20%282008%29)

12. Lassoued, I., Zagrouba, E., Chahir, Y.: An efficient approach for video action classification based on 3D Zernike moments. In: Park, J.J., Yang, L.T., Lee, C. (eds.) FutureTech 2011. CCIS, vol. 185, pp. 196–205. Springer, Heidelberg (2011). https://doi.org/10.1007/978-3-642-22309-9_24
(https://doi.org/10.1007/978-3-642-22309-9_24)
CrossRef (https://doi.org/10.1007/978-3-642-22309-9_24)
Google Scholar (http://scholar.google.com/scholar_lookup?
title=An%20efficient%20approach%20for%20video%20action%20classification%20based%20on%203D%20Zernike%20moments&author=I.%20Lassoued&author=E.%20Zagrouba&author=Y.%20Chahir&pages=196-205&publication_year=2011)

13. Newton, A.R., Hse, H.: Sketched symbol recognition using Zernike moments. In: Proceedings of the 17th ICPR, vol. 1, pp. 367–370 (2004)
Google Scholar (https://scholar.google.com/scholar?
q=Newton%2C%20A.R.%2C%20Hse%2C%20H.%3A%20Sketched%20symbol%20recognition%20using%20Zernike%20moments.%20In%3A%20Proceedings%20of%20the%2017th%20ICPR%2C%20vol.%201%2C%20pp.%20367%E2%80%93370%20%282004%29)

14. Rodriguez, M.D., Ahmed, J., Shah, M.: Action mach: a spatio-temporal maximum average correlation height filter for action recognition. In: Proceedings of CVPR 2008 (2008)
Google Scholar (https://scholar.google.com/scholar?
q=Rodriguez%2C%20M.D.%2C%20Ahmed%2C%20J.%2C%20Shah%2C%20M.%3A%20Action%20mach%3A%20a%20spatio-
temporal%20maximum%20average%20correlation%20height%20filter%20for%20action%20recognition.%20In%3A%20Proceedings%20of%20CVPR%202008%20%282008%29)

15. Scovanner, P., Ali, S., Shah, M.: A 3-dimensional sift descriptor and its application to action recognition. In: Proceedings of the 15th ACM ICM, pp. 357–360 (2007)

Google Scholar (https://scholar.google.com/scholar?
q=Scovanner%2C%20P.%2C%20Ali%2C%20S.%2C%20Shah%2C%20M.%
3A%20A%203-
dimensional%20sift%20descriptor%20and%20its%20application%20to%
20action%20recognition.%20In%3A%20Proceedings%20of%20the%2015t
h%20ACM%20ICM%2C%20pp.%20357%E2%80%93360%20%282007%2
9)

16. Simonyan, K., Zisserman, A.: Two-stream convolutional networks for
action recognition in videos. In: Advances in NIPS 27, pp. 568–576 (2014)
Google Scholar (https://scholar.google.com/scholar?
q=Simonyan%2C%20K.%2C%20Zisserman%2C%20A.%3A%20Two-
stream%20convolutional%20networks%20for%20action%20recognition%
20in%20videos.%20In%3A%20Advances%20in%20NIPS%2027%2C%20p
p.%20568%E2%80%93576%20%282014%29)

17. Sivic, J., Zisserman, A.: Video Google: a text retrieval approach to object
matching in videos. In: Proceedings of the IEEE ICCV 2003, vol. 2, pp.
1470–1477 (2003)
Google Scholar (https://scholar.google.com/scholar?
q=Sivic%2C%20J.%2C%20Zisserman%2C%20A.%3A%20Video%20Googl
e%3A%20a%20text%20retrieval%20approach%20to%20object%20matchi
ng%20in%20videos.%20In%3A%20Proceedings%20of%20the%20IEEE%
20ICCV%202003%2C%20vol.%202%2C%20pp.%201470%E2%80%93147
7%20%282003%29)

18. Tsolakidis, D.G., Kosmopoulos, D.I., Papadourakis, G.: Plant leaf
recognition using Zernike moments and histogram of oriented gradients.
In: Likas, A., Blekas, K., Kalles, D. (eds.) SETN 2014. LNCS (LNAI), vol.
8445, pp. 406–417. Springer, Cham (2014). https://doi.org/10.1007/978-
3-319-07064-3_33 (https://doi.org/10.1007/978-3-319-07064-3_33)
CrossRef (https://doi.org/10.1007/978-3-319-07064-3_33)
Google Scholar (http://scholar.google.com/scholar_lookup?
title=Plant%20leaf%20recognition%20using%20Zernike%20moments%2
0and%20histogram%20of%20oriented%20gradients&author=DG.%20Tso
lakidis&author=DI.%20Kosmopoulos&author=G.%20Papadourakis&page
s=406-417&publication_year=2014)

19. Wang, H., Klaser, A., Schmid, C., Liu, C.: Action recognition by dense
trajectories. In: Proceedings of the IEEE CVPR 2011, pp. 3169–3176 (2011)
Google Scholar (https://scholar.google.com/scholar?
q=Wang%2C%20H.%2C%20Klaser%2C%20A.%2C%20Schmid%2C%20C.
%2C%20Liu%2C%20C.%3A%20Action%20recognition%20by%20dense%
20trajectories.%20In%3A%20Proceedings%20of%20the%20IEEE%20CV
PR%202011%2C%20pp.%203169%E2%80%933176%20%282011%29)

20. Willems, G., Tuytelaars, T., Van Gool, L.: An efficient dense and scale-
invariant spatio-temporal interest point detector. In: Forsyth, D., Torr, P.,
Zisserman, A. (eds.) ECCV 2008, Part II. LNCS, vol. 5303, pp. 650–663.
Springer, Heidelberg (2008). https://doi.org/10.1007/978-3-540-88688-
4_48 (https://doi.org/10.1007/978-3-540-88688-4_48)
CrossRef (https://doi.org/10.1007/978-3-540-88688-4_48)
Google Scholar (http://scholar.google.com/scholar_lookup?
title=An%20efficient%20dense%20and%20scale-invariant%20spatio-

temporal%20interest%20point%20detector&author=G.%20Willems&author=T.%20Tuytelaars&author=L.%20Gool&pages=650-663&publication_year=2008)

Copyright information

About this paper

Cite this paper as:

> Bastos I.L.O., Soares L.R., Schwartz W.R. (2018) Pyramidal Zernike Over Time: A Spatiotemporal Feature Descriptor Based on Zernike Moments. In: Mendoza M., Velastín S. (eds) Progress in Pattern Recognition, Image Analysis, Computer Vision, and Applications. CIARP 2017. Lecture Notes in Computer Science, vol 10657. Springer, Cham

- Buy this book on publisher's site
- Reprints and Permissions

Personalised recommendations