

Background:



J. Shotton et al., CVPR'11

> 3D action recognition based on skeletal data





Lie group representation of moving skeletons





- Two Motivations
 - Speed variations (Temporal misalignment)
 - Compute a nominal curve and warp all the curves to this nominal using dynamic time warping (DTW) [*M. Muller, 2007*]

 $3^*3^*2 * C_M^2$ combinations/rotations* FrameNum



- Lie group representations for action recognition tend to be extremely high-dimensional
- Adopt PCA-like method to learn compact and discriminative features



Deep Learning on Lie Groups for Skeleton-based Action Recognition Zhiwu Huang, Chengde Wan, Thomas Probst, Luc Van Gool



Evaluation:

- Three datasets

Method	G3D-Gaming	Method	HDM05	Method	RGB+D-subject	RGB+D-view
RBM+HMM [32]	86.40%	SPDNet [18]	61.45%± 1.12	HBRNN [13]	59.07%	63.97%
SE [41]	87.23%	SE [41]	70.26%±2.89	Deep RNN [37]	56.29%	64.09%
SO [42]	87.95%	SO [42]	71.31%±3.21	Deep LSTM [37]	60.69%	67.29%
LieNet-0Block	84.55%	LieNet-OBlock	71 26%+ 2 12	PA-LSTM [37]	62.93%	70.27%
LieNet-1Block	85.16%	LieNet-1Block	73.35%+1.14	SI-LSIM [20]	69. 2%	11.1%
LieNet-2Blocks	86.67%	LieNet-2Blocks	75 78% + 2 26	SE[41]	50.08%	52.76%
LieNet-3Blocks	89.10%			JiaNat OPlash	52.1370	54 7907
RBM+HMM [31}; S. Nie and Q. Ji , ICPR'14				Lienet-UDIOCK	56 35%	34.78%
				LieNet-2Blocks	58.02%	62.52%
5E[41]: R. Vemulapalli et al., CVPR 14				LieNet-3Blocks	61.37%	66.95%

SE[42]: R. Vemulapalli et al., CVPR'16 SPDNet [18]: Z.Huang et al., AAAI'17 HBRNN [13]: Y. Du et all., CVPR'15





- > Summary

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G3D-gaming [V. Bloom et al., CVPR'12 workshop]: 663 sequ., 20 motions HDM05 [M. Muller et al., Tech.'07]: 2337 sequences, 130 actions NTU RGB+D [A. Shahroudy et al., CVPR'16]: 56,000 seque., 60 motions

> Deep RNN/ISTM/PA-LSTM [37]: A. Shahroudy et al., CVPR'16 ST-ISTM [26]: J. Liu et al., ECCV'16

A manifold network structure to deeply learn Lie group representations ✤ A paradigm to incorporate the Lie group structure into deep learning ✤ A generalization of stochastic gradient descent optimization to Lie group