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Convolutional Robot Perception and Action Learning
My lab’s research focus

Human activity recognition

• Automated annotation of video data
• Ability of understand videos of human motion

Robot action learning

• Visuo-motor policy learning
• Ability to decide the robot’s own motion
Activity recognition

It is a Computer Vision problem.

We focus on continuous videos.

Learning to capture activity hierarchy.

Human activity detection

Sub-event hierarchy learning
Examples of the learned sub-events

Learned (latent) sub-events for different baseball activities

- Learning to focus on different temporal intervals

Hit by pitch:

Hit activity:
We designed a new end-to-end convolutional neural network (CNN) architecture. Our model captures multiple levels of temporal structure using Gaussian Mixtures.
Experimental results: Charades dataset

Compared against many previous works including Google DeepMind’s video CNN from 2017: I3D.

- Random [39]: 2.42
- RGB [39]: 7.89
- Predictive-corrective [38]: 8.9
- Two-stream [39]: 8.94
- Two-stream+LSTM [39]: 9.6
- Sigurdsson et al. [39]: 12.1
- R-C3D [23]: 12.7
- I3D baseline: 17.2
- I3D + 3 temporal conv. layers: 17.5
- I3D + LSTM: 18.1
- I3D + fixed temporal pyramid: 18.2
- I3D + super-events [4]: 19.4
- I3D + 3 TGMs: 20.6
- I3D + 3 TGMs + super-events: 21.8

[Piergivanni & Ryoo, CVPR 2018; arXiv 2018]
Robot action learning

Robot learning from demonstration

- Robots learning to ‘perform’ activities from raw human videos

Problem – Learning the action model $f$: $a_t = f(X_t)$

- Input: image frame $X_t$ (from a robot camera), Output: action $a_t$ (direct motor control)
Learning human activities by modeling hand dynamics

• The model abstracts an image into a hand-based representation $F_t$.
• Our FCN *regresses* future $F_{t+\Delta}$ from current $F_t$.
• **Input:** current image frame
• **Output:** future hand location
Learning Robot Activities from First-Person Human Videos Using Convolutional Future Regression

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THANK YOU

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