Zhenjia Xu

Shanghai Jiao Tong University (ACM Class)
Bachelor of Engineering, 2015/9 - 2019/6

Massachusetts Institute of Technology
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Structure Understanding

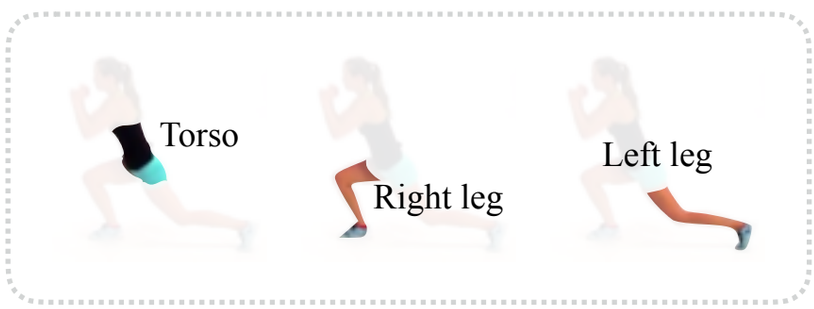
Unsupervised Discovery of Parts, Structure, and Dynamics (P2)

Robot Learning

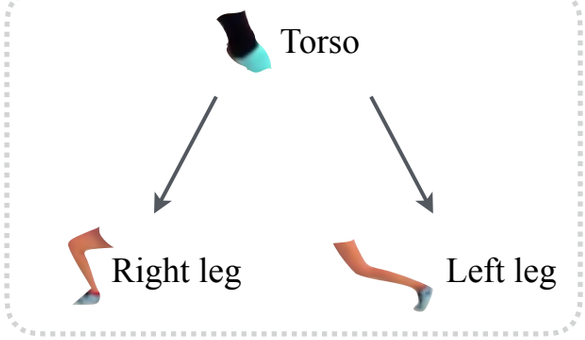
Robot Learning of Physical Object Properties (P6)

Unsupervised Discovery of Parts, Structure, and Dynamics

Visual observations



(a) Part recognition



(b) Hierarchical structure

(c) Motion

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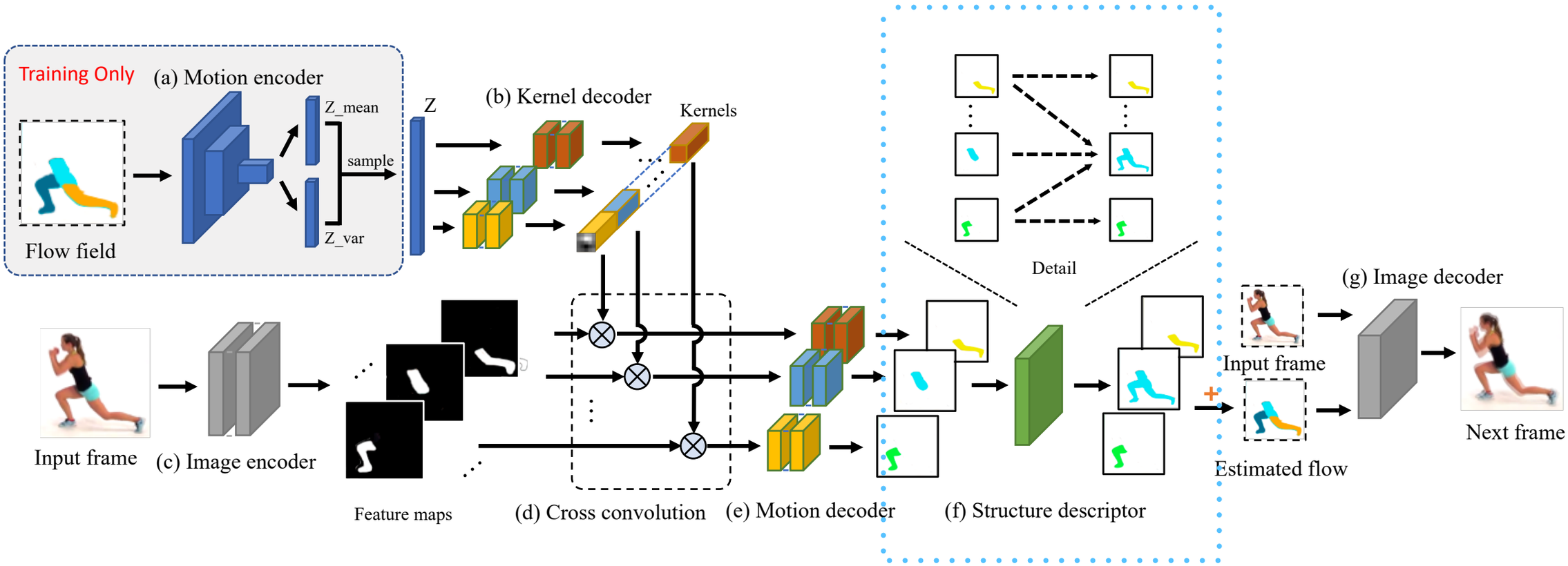
William T. Freeman, Joshua B.Tenenbaum, and Jiajun Wu

International Conference on Learning Representations (**ICLR'19**)

Model: **Parts, Structure, Dynamic (PSD)**

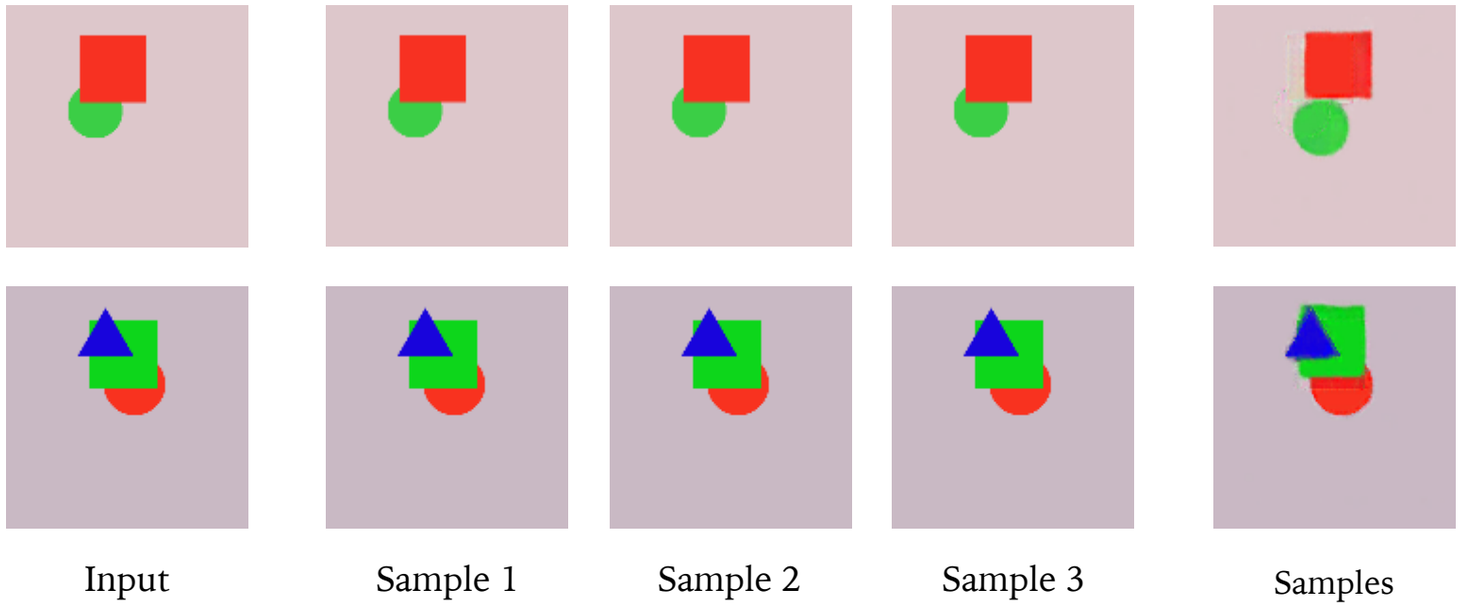


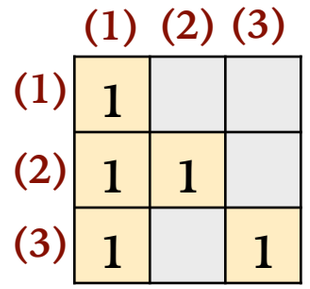
depth-wise convolution
β-VAE

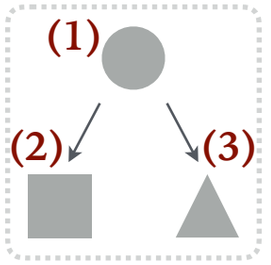
structural descriptor

Result: Synthetic Data (shape)

(a) Future Prediction

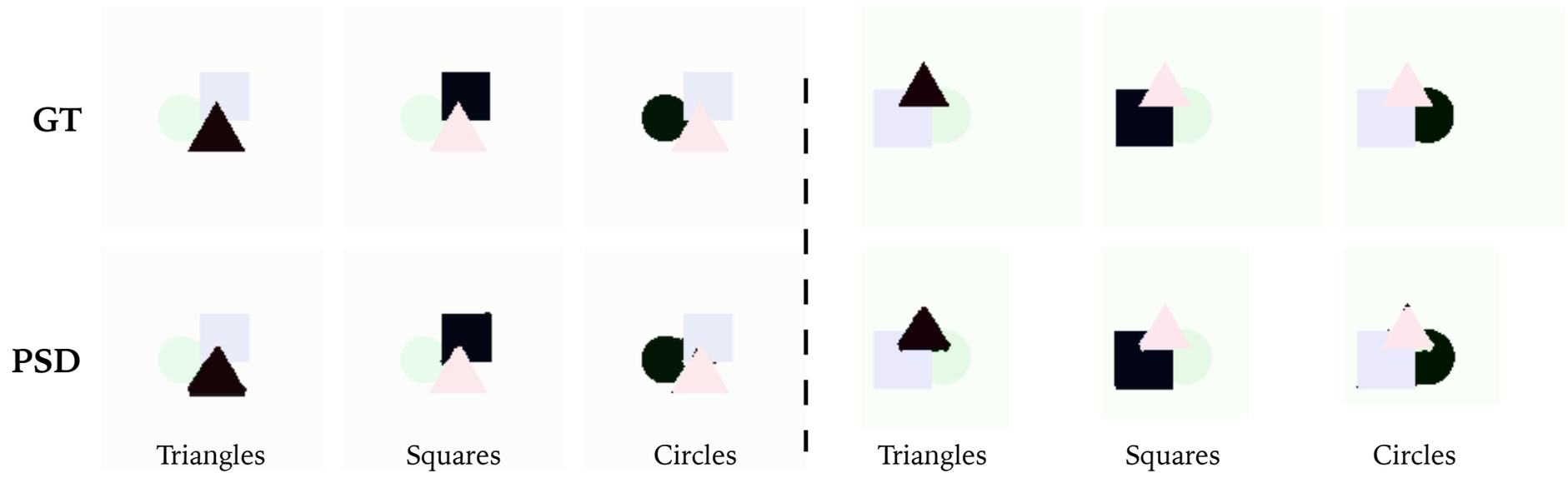






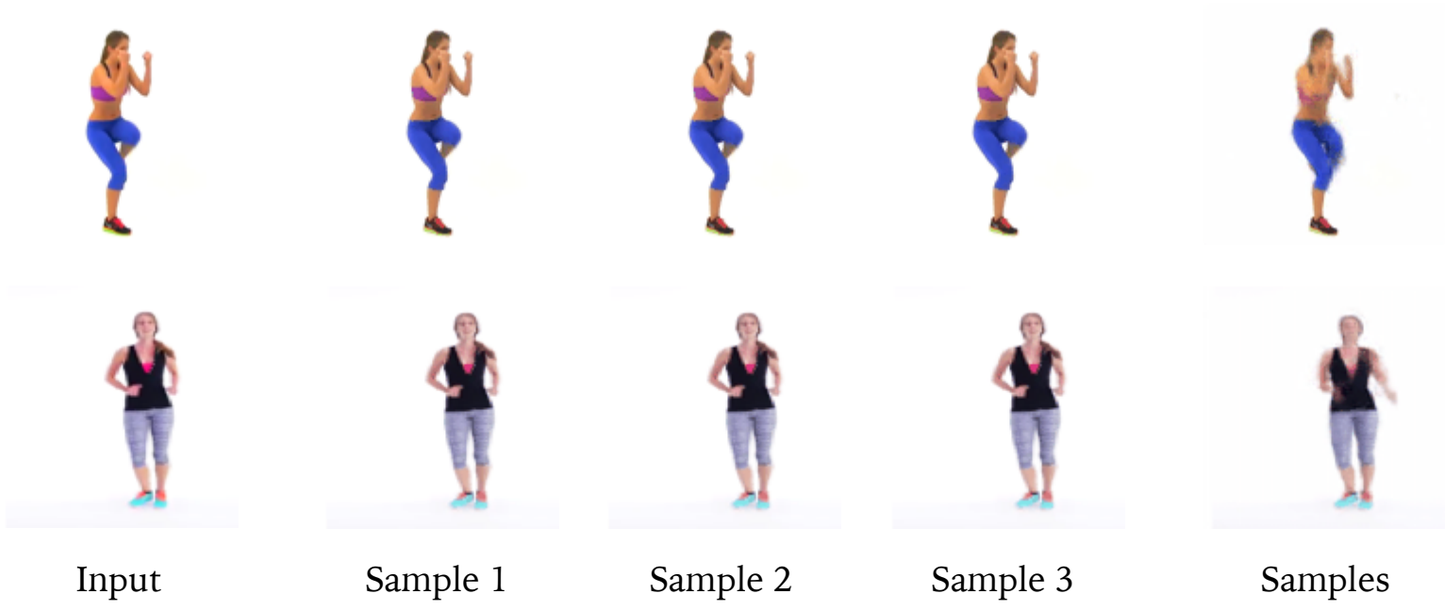
(c) Structure

(b) Segmentation



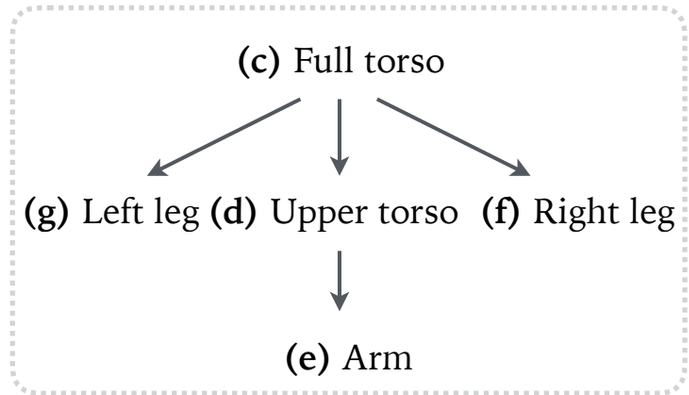
Result: Real Data (exercise)

(a) Future Prediction

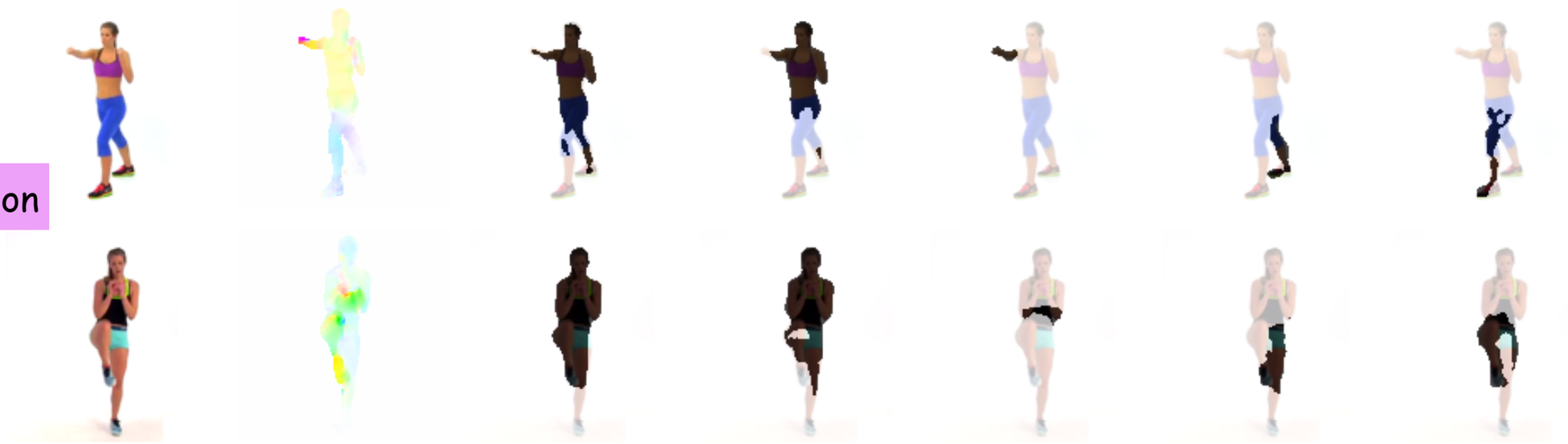


Input Sample 1 Sample 2 Sample 3 Samples

(c) Structure

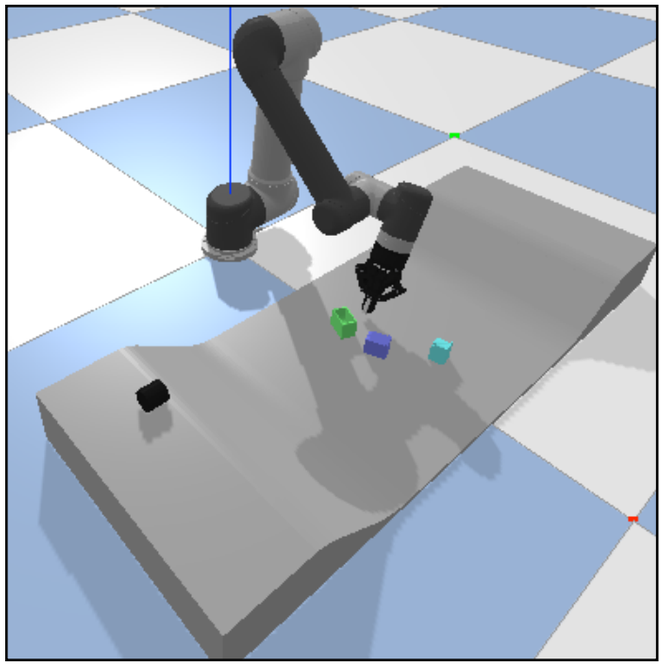


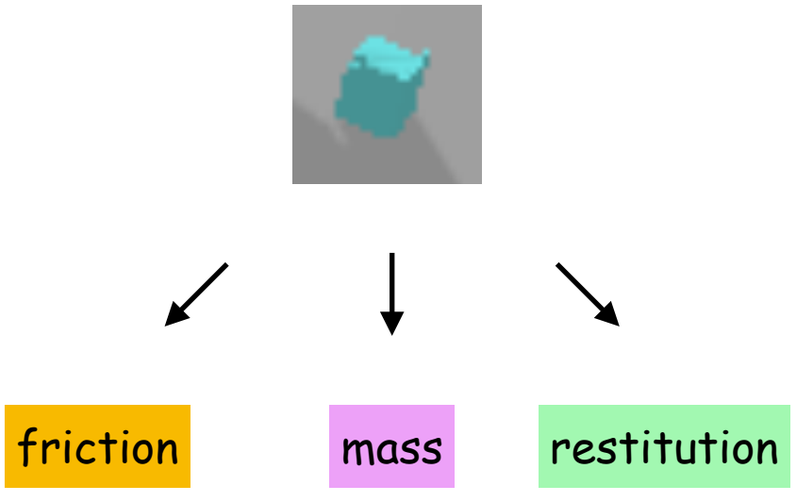
(b) Segmentation



(a) Input frame **(b)** Flow field **(c)** Full torso **(d)** Upper torso **(e)** Arm **(f)** Right leg **(g)** Left leg

DensePhysNet: Learning Dense Physical Object Representations via Multi-step Dynamic Interactions





Zhenjia Xu, Jiajun Wu, Andy Zeng, Joshua B.Tenenbaum, and Shuran Song

Robotics: Science and Systems Conference (**RSS'19**), *Submission*

Motivation: Learning Physics Properties via Interaction

Physics Property

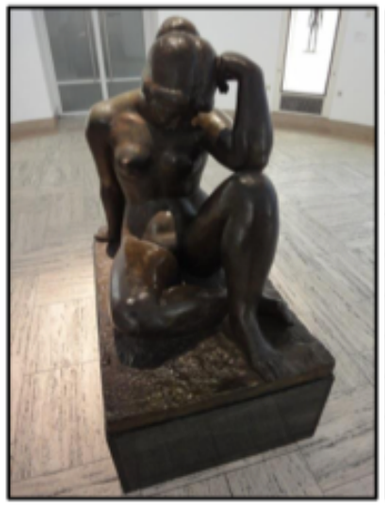
Heavy or Light

Coarse or Smooth

VS

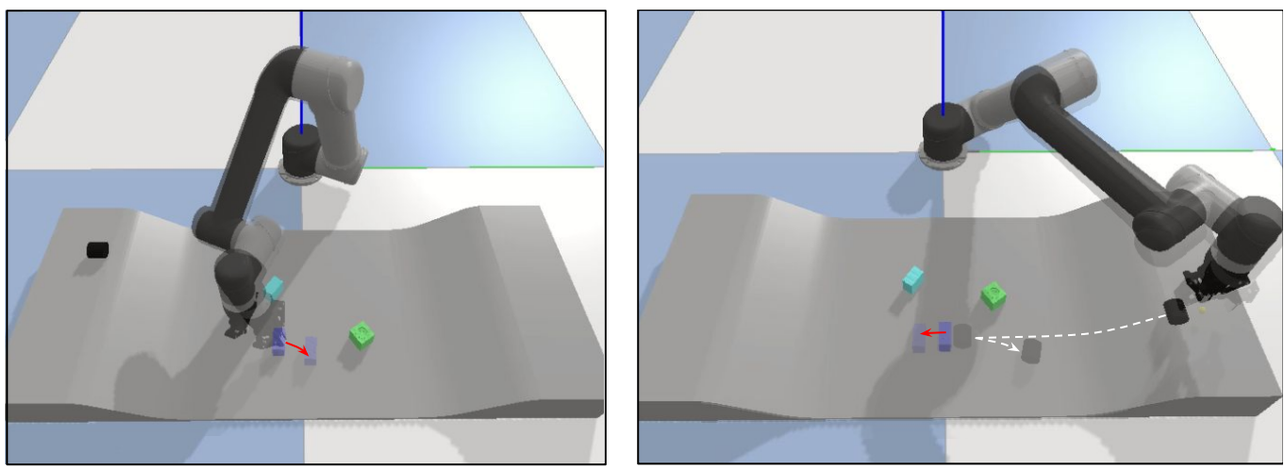
Visual Appearance

Planar ✗
Non-Planar ✓
Cylindrical ✓
Rough Surf ✗
Pnt/L Contact ✗
Mult. Contact ✗
Empty ✗
Mult. Pieces ✗
Holes ✗
Thin ✗
Mirror Sym. ✓
Cubic Aspect ✗



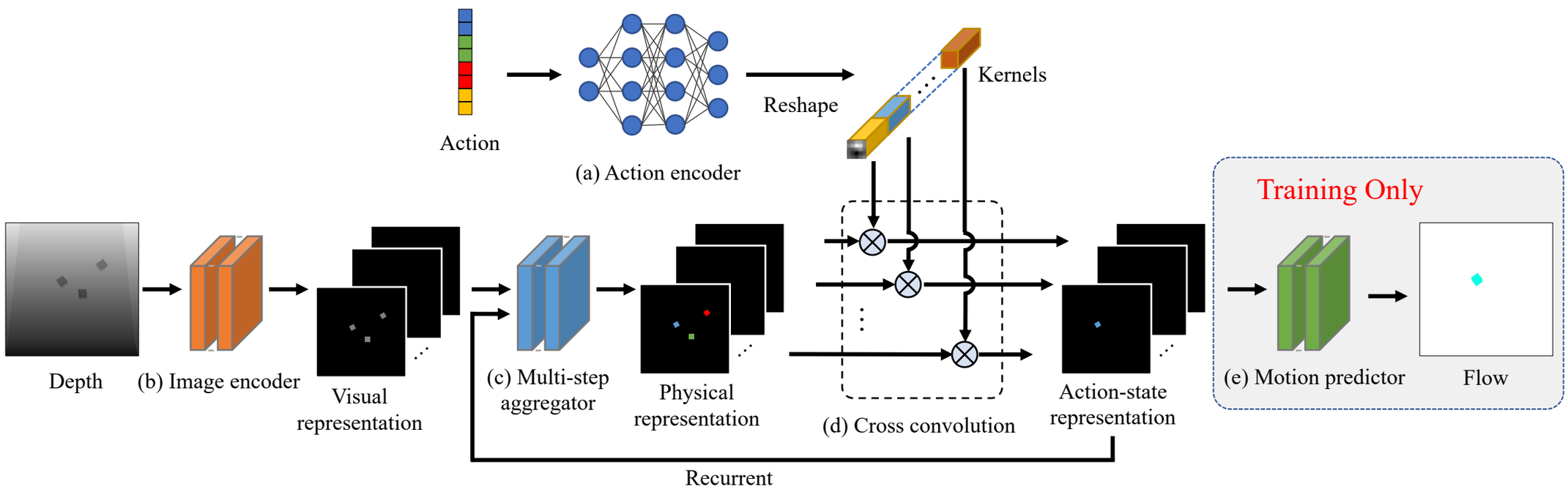
Planar ✗
Non-Planar ✓
Cylindrical ✗
Rough Surf ✗
Pnt/L Contact ✗
Mult. Contact ✓
Empty ✗
Mult. Pieces ✓
Holes ✓
Thin ✗
Mirror Sym. ✗
Cubic Aspect ✓

Action Space and Our Model

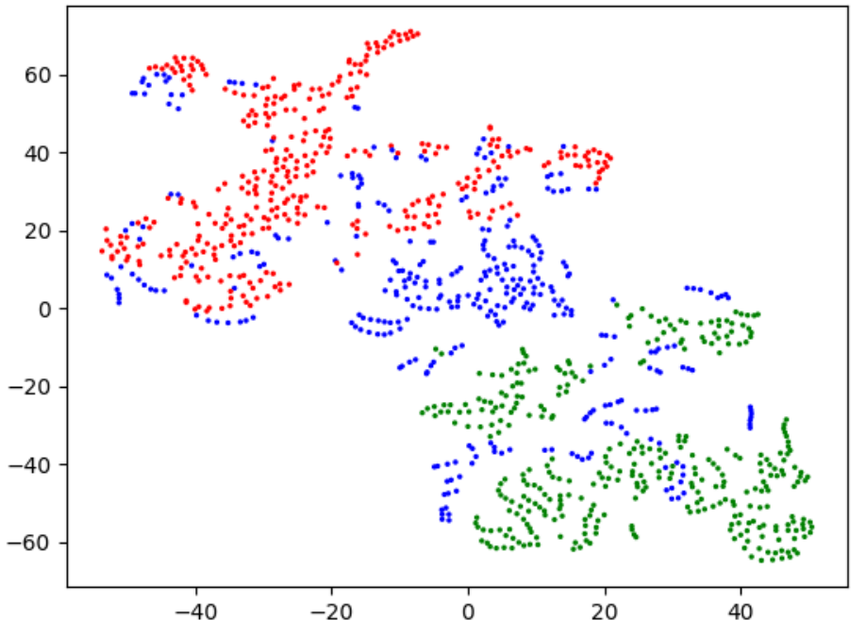


(a) High Speed Planar Push

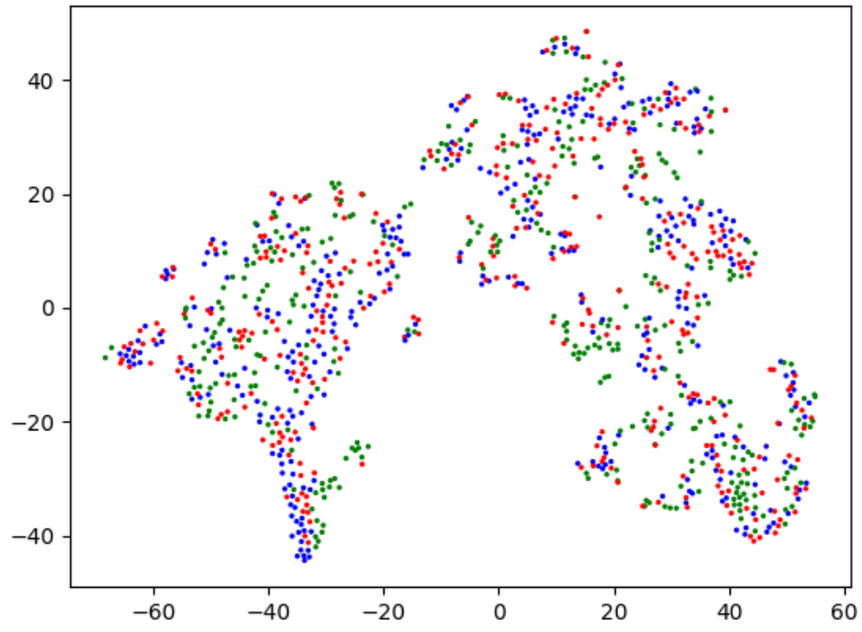
(b) Collide with auxiliary object



Visualization (unsupervised)

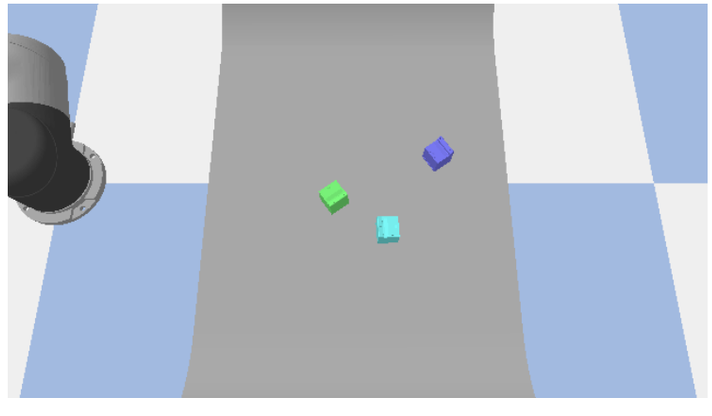


t-SNE of physical representation

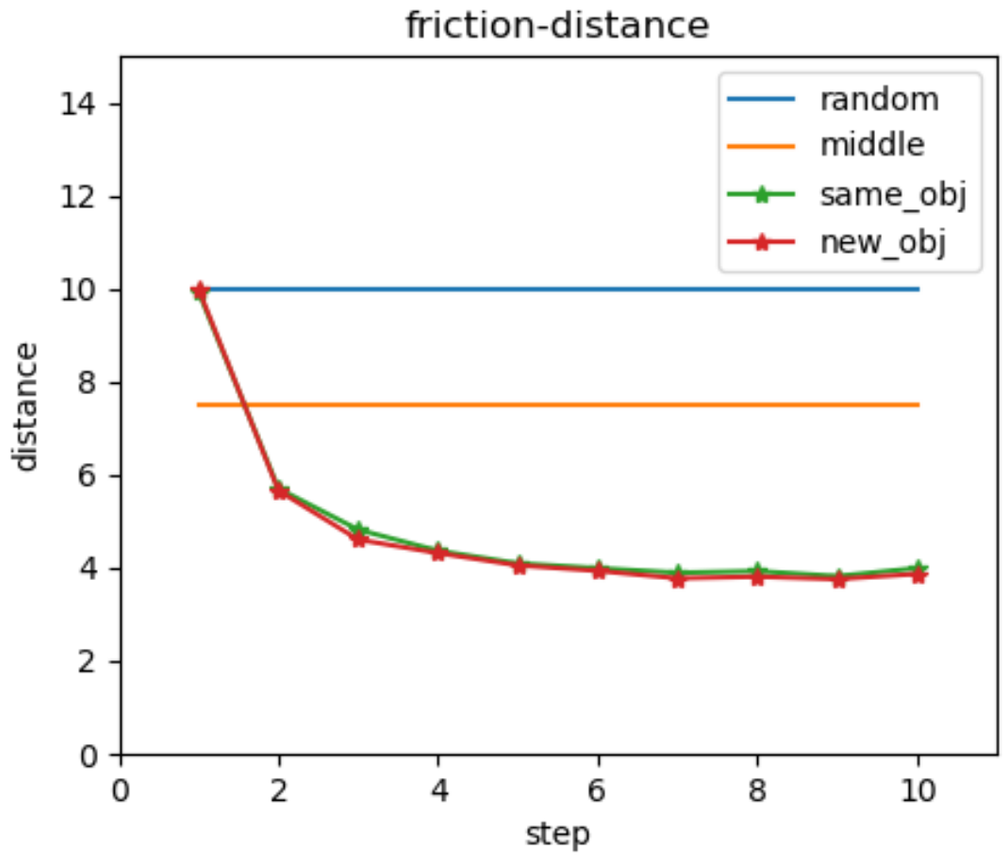


t-SNE of visual representation

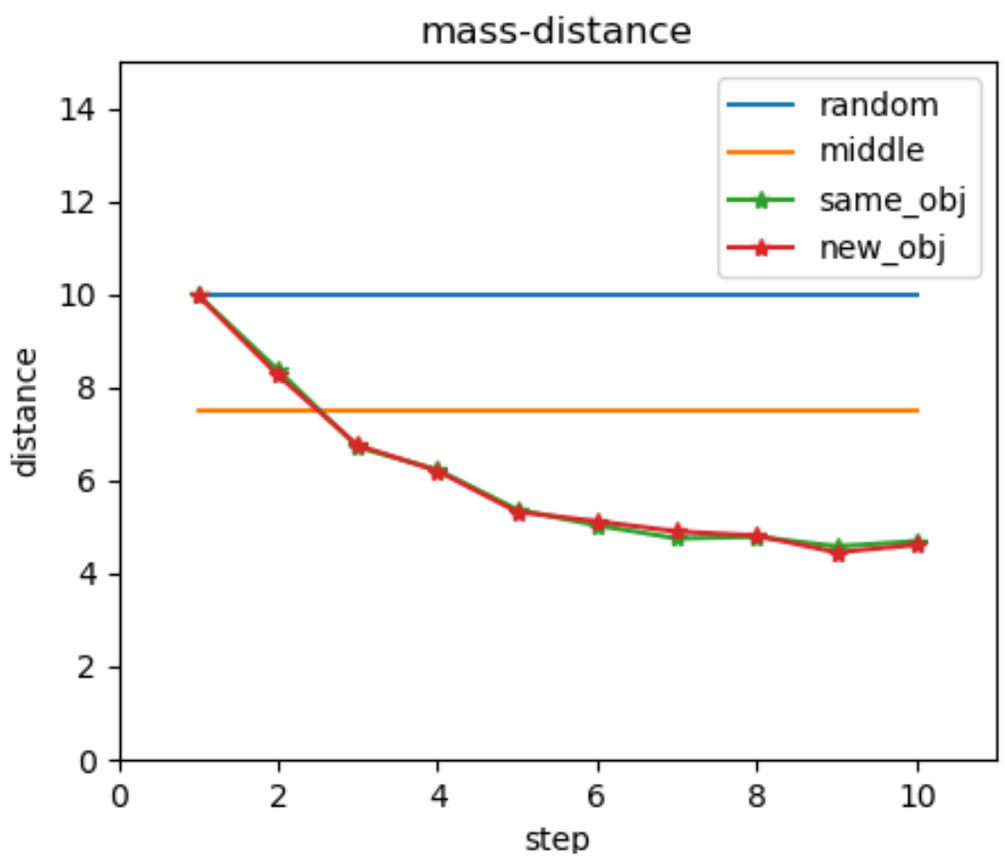
	Friction	Mass
plastic	S	S
metal	S	L
wood	L	S



Physical Property Regression (supervised)



Friction



Mass

Thank you!