Zhengyi (Zen) Luo

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Research Interests

My research lies at the intersection of computer vision, machine learning, and robotics. Scientifically, I'm particularly interested in the understanding of video signals involving human & object motion, their interactions, and scene understanding. Practically, I am super excited about applying vision to mixed reality (AR/VR).

Education

Carnegie Mellon University   *Advisor: Prof.* **Kris Kitani**

M.S in Robotics, Robotics Institute, School of Computer Science, GPA: 4.25/4.33   *Aug 2019-Present*

University of Pennsylvania   *Advisor: Prof.* **Kostas Daniilidis**

B.S.E in Computer Science, School of Engineering and Applied Science, GPA: 3.94/4.00   *Aug 2015-May 2019*

Publications and Manuscripts

[1] Kinematics-Guided Reinforcement Learning for Object-Aware 3D Ego-Pose Estimation **[paper] [project] [video]**
Zhengyi Luo*, Ryo hachiuma*, Ye Yuan, Shun Iwase, Kris M. Kitani (∗ indicates equal contribution)
In submission, 2020

[2] 3D Human Motion Estimation via Motion Compression and Refinement **[paper] [project] [video]**
Zhengyi Luo, S. Alireza Golestaneh, Kris M. Kitani
Fifteenth Asian Conference on Computer Vision (ACCV), 2020, ***Oral Presentation***

[3] Learning Shape Representations for Clothing Variations in Person Re-Identification **[paper]**
Yu-Jhe Li, **Zhengyi Luo**, Xinshuo Weng, Kris M. Kitani
arXiv:2003.07340, 2020

[4] Cross-Domain 3D Equivariant Image Embeddings **[paper]**
Carlos Esteves, Avneesh Sud, **Zhengyi Luo**, Kostas Daniilidis, Ameesh Makadia
Thirty-seventh International Conference on Machine Learning (ICML), 2019

[5] Cloud Chaser: Real Time Deep Learning Computer Vision on Low Computing Power Devices **[paper][video]**
Zhengyi Luo, Austin Small, Liam Dugan, Stephen Lane
The Eleventh International Conference on Machine Vision (ICMV), 2018

[6] The rural−urban stress divide: Obtaining geographical insights through Twitter **[paper] [project]**
Kokil Jaidka, Sharath Chandra Guntuku, Jane H Lee, **Zhengyi Luo**, Anneke Buffone, Lyle H Ungar
Computers in Human Behavior, 2020: 106544

[7] Visual Analytics Approach to Vessel Behaviour Analysis **[paper]**
Liang Jin*, **Zhengyi Luo***, Shu Gao (∗ indicates equal contribution)
Journal of Navigation, 2018,71(5): 1195-1209

Research Experience

KLab, Carnegie Mellon University   *Pittsburgh, PA*

PI: Prof. **Kris Kitani**   *Sept 2019-Present*
- Researching on the **first work** to estimate **physically valid** 3D human pose and human-object interaction from egocentric videos.
- Proposed coarse-to-fine human pose/motion estimation method that achieved state-of-the-art acceleration error and joint positional error on 3D human pose estimation from videos.
- Worked on using synthetic data for action recognition, achieving 5% accuracy improvement over action classes with scarce data.

GRASP Laboratory, University of Pennsylvania   *Philadelphia, PA*

PI: Prof. **Kostas Daniilidis**   *Jan 2018-May 2019*
- Worked on object pose estimation using 3D rotational equivariant embeddings learned from spherical convolutional networks; applied the learned embeddings to object pose estimation and novel view synthesis.

SIG Center for Computer Graphics, University of Pennsylvania   *Philadelphia, PA*

PI: Prof. **Stephen H. Lane**   *May 2016-Jan 2018*
- Surveyed 3D object pose estimation based on mesh representation; created an interest point detector based on 3D mesh using Harris3D in C; built an interactive app for pediatricians that overlaid a baby manikin with animated 3D models on Microsoft HoloLens.

World Well Being Project, University of Pennsylvania   *Philadelphia, PA*

PI: Prof. **Lyle Ungar**   *Sept 2017-May 2018*
- Measured regional variance of stress based on Twitter Language through Latent Dirichlet Allocation topic modeling, Logistic Regression, and Random Forest.

Industry Experience

Apple Inc.   *Cupertino, CA*

3D Software Engineer Intern, TDG (Apple's AR Group), Applied Research Team for Reality Composer   *May 2019-Aug 2019*
- Built a physics-based motion controller for physical realistic humanoids using Bullet Physics and deep reinforcement learning, capable of switching/blending between motion on demand and changing directions (steerable).
- Prototyped architecture for motion composition and blending, goal-based heading, and lookahead trajectory projection.

Apple Inc.   *Cupertino, CA*

3D Software Engineer Intern, TDG (Apple's AR Group), Applied Research Team for Reality Composer   *May 2018-Aug 2018*

- Built CNN-based sentence intent evaluator; developed a pos tagger and grammar-based keyword extractor; designed word2vec, phonetics, and ConceptNet-based context awareness engine.
- Prototyped system for a 3D voice command system capable of intent evaluation, keyword extraction, and context awareness.

Bentley Systems   *Philadelphia, PA*

Software Engineer Intern, Strategic Advancement Group   *May 2017-Aug 2017*

- Prototyped Distributed Schema Editing (create, read, update, remove) backend API for proprietary Building Information Modeling (BIM) schemas through iModelHub (powered by Azure) Services, supported commit, push, pull, and merge workflow with fully covered API proving functionality including test and error paths, using C++.

Projects

Parts-based 3D Object Pose Estimation   *Jan 2020-May 2020*

Investigated using parts-based decomposition of 3D objects to aid 6 degrees-of-freedom (dof) pose estimation; decomposed 3D objects into superquadratics and trained the 6 dof pose estimator using superquadratics as target. [This project is part of Ziad Ben Hadj-Alouane's Master's thesis at UPenn]. **[thesis] [code] [project]**

Unsupervised Visual Learning – Final Project for 10701 (PhD-level Machine Learning) at CMU   *Feb 2020-May 2020*

Studied state-of-the-art unsupervised computer vision methods (simCLR, Capsule Networks, InfoGAN); analysis of their run-time, accuracy, and generalization; generated a synthetic 3D object classification dataset from Shapenet to further test each method's robustness. **[report] [code] [project]**

Rotation Representations in Deep Learning – Final Project for 16720 (Computer Vision) at CMU   *Oct 2019-Dec 2019*

Studied rotation representation's (Quaternion, Euler angles, Axis-angle, 6 dof representation) effectiveness in deep learning; generated a synthetic 3D object pose estimation dataset from Shapenet to study each method's robustness.
Project ranked 3rd on the CIS department-wide senior design competition.[report] [project]

Scene++: Making AR Immersive – Senior design for undergraduate degree at UPenn   *Oct 2018-Nov 2018*

Developed a method to enhance AR immersion by utilizing cloud-based object-detection to provide 3D object detection and localization for HTC Vive; adapted the Cloud Chaser framework for low-computing device (ZED Camera & HTC Vive). **[report] [project]**

Faster R-CNN and Mask R-CNN – Final Project for CIS 680 (Vision & Learning) at UPenn   *Oct 2018-Nov 2018*

Implemented CNN architectures, ROI pooling, and per-pixel classification for Faster R-CNN & Mask R-CNN in PyTorch.

Mini Minecraft – Final project for CIS 460 (Grad-level Computer Graphics) at UPenn   *Sept 2016-Dec 2016*

Mini version of Minecraft with block building/removing, weather system, terrain generation, AI/NPCs, built using Qt with C++.

Teaching Experience

Teaching Assistant

Computer Vision (16-720B), CMU	Instructors: Kris Kitani & Srinivasa Narasimhan	*Fall 2020*
Deep Learning (CIS-700), UPenn	Instructors: Konrad Kording	*Spring 2019*
Data Structures and Algorithms (CIS-121), UPenn	Instructors: Rajiv Gandhi	*Fall 2016 & Spring 2017*

Awards

PENNAPPS XVII, Ranked 1/160, Grand Prize, Best Use of Cloud: Cloud Chaser

Philadelphia, PA, Jan 2018

Raspberry Pi based robot that utilizes cloud computing for real time deep learning object detection in 15 FPS

Skills & Interests

Programming Languages:	Python, C++, C, Swfit, Java, C#, Javascript, SQL, OCaml, MATLAB
Platforms & Tools:	PyTorch, TensorFlow, Spacy, Unity3D, Hololens, xcode, Raspberry Pi, Android Studio, Git, Solidworks
Interests:	Sci-Fi, Biographies, Cooking , Cycling, Tech Gadgets
Organizations:	Eta Kappa Nu (IEEE-HKN), UPenn Lambda Chapter; Tau Beta Pi, UPenn Delta Chapter