

# Meng Zheng

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Google Scholar: <https://scholar.google.com/citations?user=1D5PfMgAAAAJ&hl=en>

My research focuses on the design and development of interpretable deep learning systems and algorithms for a variety of computer vision and medical imaging applications, with particular focus on automated patient positioning and modeling, video analytics, image retrieval/person re-identification and generative modeling.

## EDUCATION

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### Rensselaer Polytechnic Institute

*PhD in Electrical Engineering, Adviser: Prof. Richard J. Radke, GPA: 3.94*

Troy, NY

May 2020

### Beijing Institute of Technology

*Master of Science in Electrical Engineering, GPA: 3.89*

Beijing, China

March 2016

### Beijing Institute of Technology

*Bachelor of Electrical Engineering, GPA: 3.90*

Beijing, China

March 2013

## WORK EXPERIENCE

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- **UII America, Inc.** **Cambridge MA**  
*Expert Research Scientist* *April 2023 – present*
  - **Image/Video Few Shot Segmentation (FSS) for Smart Annotation Tool**  
Developed a novel Transformer-based deep network with a lightweight multi-agent dense fusion (MADF) module, to extensively identify the complementary and consistent information among multiple supports, for accurately segmenting the object of interest in the query, with +3% mIoU increase on average with virtually no model parameter increase compared to existing state-of-the-art methods on two benchmark FSS datasets. Additionally, we show how our proposed module can be extended to a new under-explored problem, the effective segmentation of an unseen object in a query video given a few support videos, by considering dense appearance as well as motion correspondences. The developed algorithm can be directly applicable for cross-domain 3D segmentation. The proposed paper is under review.
  - **Cross-Modality Domain Adaptation (CMDA) framework for Nighttime Semantic Segmentation**  
Participated in developing a novel unsupervised CMDA framework to leverage multi-modality (Images and Events) information for nighttime semantic segmentation, with only labels on daytime images. In CMDA, we design the Image Motion-Extractor to extract motion information and the Image Content-Extractor to extract content information from images, in order to bridge the gap between different modalities (Images  $\rightleftharpoons$  Events) and domains (Day  $\rightleftharpoons$  Night). Work accepted by *IEEE/CVF International Conference on Computer Vision\* (ICCV) 2023*.
- **UII America, Inc.** **Cambridge MA**  
*Senior Research Scientist* *June 2020 – March 2023*
  - **Contactless Patient Modeling and Positioning System**  
Developed fully automated, contactless patient modeling and positioning systems for different types of medical scanners and smart scanning/operation rooms, e.g. Computed Tomography (CT), Molecular imaging (MI), Magnetic Resonance Imaging (MRI) or Digital subtraction angiography (DSA). The system assists scanners to automatically localize patient and adjust scanner pose for more efficient and accurate medical scanning (comparing to manual operation and competitive solutions), reduced patient's radiation intake, and minimized technician's risks w.r.t infectious diseases.

### - **Self-Supervised 3D Patient Modeling with Multi-modal Attentive Fusion**

Developed a novel 3D patient modeling and positioning deep learning-based algorithm, with a robust multi-modal (RGBD) patient body joint localization module and a self-supervised 3D mesh reconstruction module, which outputs a parameterized mesh representation of the patient body. The algorithm is robust to challenging real-clinical scanning/operating scenarios, e.g. the patient is heavily covered by surgical sheet or lead vest, that most of the existing solutions would significantly be affected due to collapsed visual cues. The developed 3D mesh reconstruction algorithm does not require 3D mesh annotations for deep model training, which are essential to existing solutions and very expensive to collect, thus significantly reduces human labor effort and costs in real-clinical deployment.

### - **Smart Annotation Tool**

Developed a smart medical data annotation system with a novel weakly-supervised few-shot segmentation algorithm module, that is able to automatically propagate annotation from user-annotated data to unlabelled data without requiring intra-domain annotated training data, which sufficiently reduces user labeling time and effort comparing to conventional data annotation tools. The designed annotation algorithm is generic and applicable to different domains of medical data, e.g., brain MRI, lung CT data, etc.

### - **Head Motion Detection and Correction for PET/CT Imaging**

Developed vision-based head motion detection algorithm to automatically detect rigid movements of patient head and magnitude calculation, to diminish and compensate motion artifacts for Positron Emission Tomography - Computed Tomography (PET/CT) imaging and diagnose.

#### ○ **UII America, Inc.**

*Research Intern*

**Cambridge MA**

*May – August 2019*

- Proposed the first gradient-based visual explanation technique for similarity CNN models, which can be applicable to a variety of vision-related applications including improved image retrieval, weakly-supervised few shot segmentation and automated patient pose guidance. The proposed method is generic and extensible in principle to any feature embedding CNN model.
- Designed the first deep architecture able to visually explain the model prediction of a certain patient pose (for positioning applications) as “correct” or “incorrect” to the reference poses.
- Designed a novel workflow to provide guidance to the patient to adjust their pose according to the selected scanning protocols for better medical imaging quality based on the generated visual explanations.

#### ○ **Rensselaer Polytechnic Institute**

*Graduate Research & Teaching Assistant*

**Troy NY**

*Aug 2016 – May 2020*

- Substantial experience in building practical real-world systems for the problem of person re-identification (re-id)
- Designed new re-id algorithms to recover person trajectories in a multi-camera network, learning temporal models corresponding to inter-camera transition patterns, thereby improving accuracy in conjunction with novel search space pruning strategy to improve re-identification accuracy.
- Designed a novel video-based re-id CNN model with 3D gradient-based attention; this was the first 3D CNN-based architecture able to generate spatiotemporal localization given person class label information.
- Designed a novel two-branch architecture for image-based re-id that produces attentive regions during training without requiring any additional supervision other than identity labels or any specially-designed architecture for modeling attention.
- My work also involved collecting and annotating new datasets for the use of the research community; collected a new multi-shot multi-camera large scale re-id dataset, called RPIfield, which provides explicit time-stamp information for each candidate. The RPIfield dataset allows the study of re-id algorithms in a more general context, especially with respect to temporal aspects.
- For practical applicability, I extensively studied temporal aspects of the person re-id problem;

Developed a new evaluation methodology for re-id called the Rank Persistence Curve (RPC), which provides temporal rank information derived by a re-id algorithm, showing how long a correct match to the probe is likely to stay in the rank-k shortlist

- Also have experience in the design and development of generative models; extensively studied various learning and inference algorithms for deep regression Bayesian networks under both supervised and unsupervised settings for image inpainting, image denoising, and head pose and eye gaze estimation.

## SELECTED PUBLICATIONS

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### Journal papers

- J. Wu, Y. Xia, X. Wang, Y. Wei, A. Liu, A. Innanje, **M. Zheng**, L. Chen, J. Shi, L. Wang, Y. Zhan, X. S. Zhou, Z. Xue, F. Shi, D. Shen, "uRP: An integrated research platform for one-stop analysis of medical images", *Frontiers in Radiology*, 2023.
- X. Gong, L. Song, R. S. Vedula, A. Sharma, **M. Zheng**, B. Planche, A. Innanje, T. Chen, J. Yuan, D. Doermann, Z. Wu. "Federated Learning with Privacy-Preserving Ensemble Attention Distillation", to appear in *IEEE Transactions on Medical Imaging*, 2022.
- **M. Zheng**, S. Karanam, R. Radke. "Towards Automated Spatio-Temporal Trajectory Recovery in Wide-Area Camera Networks", *IEEE Transactions on Biometrics, Behavior, and Identity Science*, 2021.
- S. Nie, **M. Zheng**, Q. Ji, "The Deep Regression Bayesian Network and Its Applications: Probabilistic Deep Learning for Computer Vision", *IEEE Signal Processing Magazine\**, Vol. 35, Issue: 1, Pages: 101-111, 2018.
- **M. Zheng**, L. Lin. Design of Digital Temperature and Humidity Instrument Based on AT89C51, *Industry and Mine Automation*, No. 6, Pages: 103-105, 2012.

### Conference papers

- R. Xia, C. Zhao, **M. Zheng**, Z. Wu, Q. Sun and Y. Tang, "CMDA: Cross-Modality Domain Adaptation for Nighttime Semantic Segmentation", *IEEE/CVF International Conference on Computer Vision\* (ICCV)*, 2023.
- X. Gong, L. Song, **M. Zheng**, B. Planche, T. Chen, Y. Song, D. Doermann and Z. Wu, "Progressive Multi-view Human Mesh Recovery with Self-Supervision", *Association for the Advancement of Artificial Intelligence\* (AAAI)*, oral, 2023.
- **M. Zheng**, B. Planche, X. Gong, F. Yang, T. Chen and Z. Wu, "Self-supervised 3D Patient Modeling with Multi-modal Attentive Fusion", *International Conference on Medical Image Computing and Computer Assisted Intervention\* (MICCAI)*, 2022. **Early accept** (top 13% of submissions received a provisional accept recommendation).
- **M. Zheng**, S. Karanam, T. Chen, R. J. Radke and Z. Wu. "Visual Similarity Attention", *International Joint Conference on Artificial Intelligence\* (IJCAI)*, 2022.
- X. Gong, **M. Zheng**, B. Planche, S. Karanam, T. Chen, D. Doermann and Z. Wu, "Self-supervised Human Mesh Recovery with Cross-Representation Alignment", *European Conference on Computer Vision\* (ECCV)*, 2022.
- Q. Liu, **M. Zheng**, B. Planche, S. Karanam, T. Chen, M. Niethammer and Z. Wu, "PseudoClick: Interactive Image Segmentation with Click Imitation", *European Conference on Computer Vision\* (ECCV)*, 2022.
- H. Guo, B. Planche, **M. Zheng**, S. Karanam, T. Chen, Z. Wu, "SMPL-A: Modeling Person-Specific Deformable Anatomy", *IEEE Conference on Computer Vision and Pattern Recognition\* (CVPR)*, 2022.
- L. Song, X. Gong, B. Planche, **M. Zheng**, D. Doermann, J. Yuan, T. Chen, and Z. Wu, "PREF: Predictability Regularized Neural Motion Fields", *European Conference on Computer Vision\* (ECCV)*, oral, 2022.
- F. Yang, S. Karanam, **M. Zheng**, T. Chen, H. Ling, Z. Wu, "Multi-Motion and Appearance Self-Supervised Moving Object Detection", *IEEE/CVF Winter Conference on Applications of Computer Vision\* (WACV)*, 2022.

- R. Li, S. Karanam, **M. Zheng**, T. Chen and Z. Wu, "Everybody Is Unique: Towards Unbiased Human Mesh Recovery", *The British Machine Vision Conference\* (BMVC)*, 2021.
- A. Aich, **M. Zheng**, S. Karanam, T. Chen, A. K. Roy-Chowdhury and Z. Wu, "Spatio-temporal representation factorization for video-based person re-identification", *IEEE/CVF International Conference on Computer Vision\* (ICCV)*, 2021.
- Y. Ge, Y. Xiao, Z. Xu, **M. Zheng**, S. Karanam, T. Chen, L. Itti and Z. Wu, "A Peek Into the Reasoning of Neural Networks: Interpreting with Structural Visual Concepts", *IEEE Conference on Computer Vision and Pattern Recognition\* (CVPR)*, 2021.
- W. Liu, R. Li, **M. Zheng**, S. Karanam, Z. Wu, B. Bhanu, R. J. Radke and O. Camps. "Towards Visually Explaining Variational Autoencoders", *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2020.
- **M. Zheng**, S. Karanam, Z. Wu, R. J. Radke. "Re-Identification with Consistent Attentive Siamese Networks", *IEEE Conference on Computer Vision and Pattern Recognition\* (CVPR)*, 2019.
- **M. Zheng**, S. Karanam, R. J. Radke. "RPIfield: A New Dataset for Temporally Evaluating Person Re-Identification", *IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPR-W)*, 2018.
- **M. Zheng**, W. Liu, Y. Xiang. "Subdomain clutter reduction method for imaging near surface target", *IET International Radar Conference*, 2015.
- W. Liu, **M. Zheng**, Y. Xiang. "An autofocusing imaging algorithm for wall penetrating SAR", *IET International Radar Conference*, 2015.
- W. Liu, W. Wei, **M. Zheng**. "A near-field back-projection algorithm for wall penetrating SAR", *IET International Radar Conference*, 2015.
- X. Wang, H. Liu, **M. Zheng**. "A clutter suppression method of ground penetrating radar for detecting shallow surface target", *IET International Radar Conference*, 2015.

\**IEEE Signal Processing Magazine*: **JCR Impact Factor 12.551**.

**CVPR**, **ICCV**, **BMVC** and **WACV** are top conferences in computer vision research field. CVPR, ICCV are ranked # 4 and # 31 respectively on Google Scholar Metrics overall top publications ranking. CVPR, ICCV, BMVC and WACV are ranked # 1, # 3, # 10 and # 12 respectively on Computer Vision and Pattern Recognition top publications. **MICCAI** and **IJCAI** are top conferences in radiology and medical imaging, and artificial intelligence research field. MICCAI is ranked #6, IJCAI is ranked #9 in Google Scholar top publications in radiology and medical imaging, and artificial intelligence category respectively.

## AWARDS

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- Allen B. Dumont Prize – Rensselaer Polytechnic Institute, 2020. This prize is awarded to a graduate student who has demonstrated high scholastic ability and has made a substantial contribution to that field.
- Outstanding Graduates – Beijing Institute of Technology, 2013.
- Outstanding Student – Beijing Institute of Technology, 2012.
- Outstanding Student Scholarship – Beijing Institute of Technology, 2009, 2010, 2011, 2012.
- Talent Class Scholarship – Beijing Institute of Technology, 2009, 2010, 2011, 2012.
- Excellent Class Performance scholarship – Beijing Institute of Technology, 2009, 2010, 2011.

## PATENTS

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- - Z. Wu, S. Karanam, **M. Zheng**, A. Sharma, R. Li. "Automating a medical environment", US20220125400A1, 2022.
- A. Sharma, **M. Zheng**, S. Karanam, Z. Wu, A. Innanje, T. Chen. "Abnormality detection within a

- defined area", US11386537B2, 2022.
- Published – Pending
  - **M. Zheng**, E. Zhao, S. Karanam, Z. Wu, T. Chen, "Interactive Contour Refinements for Data Annotation", US 17/560,492, 2023.
  - Z. Wu, S. Karanam, **M. Zheng**, A. Sharma, "Automated collision avoidance in medical environments", US 17/564,919, 2023.
  - Z. Wu, S. Karanam, **M. Zheng**, A. Sharma, "Automated calibration and validation of sensor network", US 17/564,792, 2023
  - **M. Zheng**, S. Karanam, Z. Wu, "HUMAN MODEL RECOVERY USING DEEP LEARNING TECHNIQUES", US 17/559,364, 2023.
  - Z. Wu, S. Karanam, **M. Zheng**, A. Sharma, "Automatic organ geometry determination", US 17/538,232, 2023.
  - **M. Zheng**, A. Sharma, S. Karanam, Z. Wu "Automated patient modeling and positioning", US 17/525,488, 2023
  - S. Karanam, **M. Zheng**, Z. Wu, "Systems and methods for personalized patient body modeling", US 17/513,392, 2023
  - S. Karanam, **M. Zheng**, Z. Wu, Multi-view patient model construction, US 17/513,534, 2023
  - A. Sharma, **M. Zheng**, S. Karanam, Z. Wu, A. Innanje, T. Chen. "Abnormality detection within a defined area", US20210272258A1, 2019.

## ACADEMIC EXPERIENCES

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- **Researcher**, U.S. Department of Homeland Security, Center of Excellence - SENTRY, June 2023 - present.
  - Expect to research and design anomaly detection and threat risk assessment algorithms for real-world homeland security applications.
- **Affiliated Student Researcher**, U.S. Department of Homeland Security, Center of Excellence - ALERT, August 2018 to May 2020.
  - Member of the Human Detection & Re-Identification for Mass Transit Environments project.
  - Research and design human re-identification algorithms for real-world homeland security applications.

## SYNERGISTIC ACTIVITIES

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- **Reviewer**
  - IEEE Signal Processing Letters\*
  - IEEE Transactions on Neural Networks and Learning Systems\*
  - IEEE Transactions on Circuits and Systems for Video Technology\*
  - IEEE Access\*
  - European Conference on Computer Vision\* (ECCV)
  - IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)
  - IEEE Conference on Computer Vision and Pattern Recognition\* (CVPR)
  - IEEE/CVF International Conference on Computer Vision\* (ICCV)
  - International Conference on Medical Image Computing and Computer Assisted Intervention\* (MICCAI)
  - IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshop
  - AAAI Conference on Artificial Intelligence (AAAI) Workshop
- **Program Committee**
  - Artificial Intelligence with Biased or Scarce Data (AIBSD), in conjunction with 36th AAAI

Conference on Artificial Intelligence\* 2022.

*\*IEEE Transactions on Neural Networks and Learning Systems: JCR Impact Factor 8.793. \*IEEE Transactions on Circuits and Systems for Video Technology: JCR Impact Factor 5.859. IEEE Signal Processing Letters: JCR Impact Factor 4.68. IEEE Access: JCR Impact Factor 3.367.*

**CVPR, ECCV, ICCV, and AAAI** are top conferences in computer vision and artificial intelligence research field. CVPR, ICCV, ECCV and AAAI are ranked # 4, #17, # 27 # 59 respectively on Google Scholar Metrics overall top publications ranking. CVPR and ECCV are ranked # 1, and # 2 respectively on Computer Vision and Pattern Recognition top publications. AAAI are ranked # 4 on Artificial Intelligence top publications.

## **MEDIA COVERAGE**

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- o ALERT Center of Excellence of DHS, From PhD Candidates to Professionals, ALERT Trio Continues to Collaborate.