Muhammad Usman Rafique

CONTACT INFORMATION

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RESEARCH AREAS

Computer Vision, Machine learning

RESEARCH AND TEACHING EXPERIENCE

University of Kentucky, USA
Research Assistant, Computer Science **May 2018 - present**

- Multimodal Vision Research Lab (Dr. Nathan Jacobs)
  - A novel fully convolutional network that synthesizes how images would look like from any novel viewpoint. The proposed method gets state-of-the-art results on KITTI and our own datasets (outdoor imagery of Brooklyn). Accepted to BMVC 2020.
  - A fusion method that combines multiple noisy overhead images to make a single cloud-free weakly image. CVPR Workshops, 2019.
  - A weakly supervised algorithm for dense, pixel-wise segmentation of buildings from aerial images. IGARSS 2019.

Research and Teaching Assistant, Electrical Engineering **Aug 2016 - April 2018**

- Multimedia Analysis Lab (Dr. Samson Cheung)
  - Research on machine learning based tools that preserve the privacy of training data. Our proposed transformations remove the private data but transformed images can still be used by standard deep-learning algorithms for learning purposes.

The Hong Kong Polytechnic University, Hong Kong
Research Assistant, Department of Computing **June 2015 - Aug 2016**
Research on software defined battery and control of manipulators using recurrent neural networks.

Air University, Pakistan
Lecturer **Sep 2010 - June 2015**
Teaching undergraduate courses of Mechatronics Engineering, supervision of senior design and research projects, organization of robot competitions and administrative duties.

SUPARCO, National Space Agency of Pakistan
Research and Development Engineer **July, 2007 - Aug 2008**
Worked in Attitude and Orbit Control System (AOCS) Lab.

EDUCATION

Ph.D. Electrical Engineering **2016 - present**
University of Kentucky, USA

MS Mechatronics Engineering **2008 - 2010**
National University of Sciences and Technology (NUST), Pakistan

BE Mechatronics Engineering **2003 - 2007**
National University of Sciences and Technology (NUST), Pakistan

SKILLS AND TOOLS

- Computer Vision and Deep Learning
  - Expertise in taking a research problem from conception to achieve state of the art results. Demonstrated by publications in top ranked computer vision conferences.

- Implemented several modern papers to reproduce results
- Formulated and implemented custom loss functions in PyTorch and Keras
- Experience with various classification, segmentation, view synthesis/flow prediction, and weakly-supervised CNNs.
- Privacy Preserving Transforms, Object recognition, Background Subtraction, Multi-view Geometry
- Tools: PyTorch, Keras (with TensorFlow backend), Python, MATLAB, C/C++, OpenCV

- Robotics
  - Localization (Particle and Kalman Filter), 2D and 3D SLAM, Motion Planning (Bug algorithm, artificial potential field, probabilistic road map, VFH, velocity obstacle and MTSG)
  - Control: Closed loop control of differential drive and Ackermann steering mobile robots, PID control of navigation of self designed mobile robots
  - Estimation and Control (Kalman and Extended Kalman Filter, H_∞ and Particle Filter), Optimization (Particle Swarm Optimization, Convex Optimization using LMI)
- Embedded Systems
  - Worked on several microcontrollers (PIC, Atmel, Arduino), FPGA boards (Altera). Altera FPGA: Verilog HDL and NIOS II Soft Processor

Selected Publications

Full list of publications available at google scholar: https://goo.gl/LDgdAp

M. Usman Rafique, H. Blanton, N. Snavely, N. Jacobs, "Generative Appearance Flow: A Hybrid Approach for Outdoor View Synthesis," The British Machine Vision Conference (BMVC), 2020. Accepted.

M. Usman Rafique, H. Blanton, N. Jacobs, "Weakly Supervised Fusion of Multiple Overhead Images," IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops, 2019.

M. Usman Rafique, N. Jacobs, "Weakly Supervised Building Segmentation from Aerial Images," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), 2019.

N. Jacobs, A. Kraft, **M. Usman Rafique**, R. D. Sharma, "A Weakly Supervised Approach for Estimating Spatial Density Functions from High-Resolution Satellite Imagery," The 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, pp. 33-42. ACM, 2018.

S. C. Cheung, **M. Usman Rafique**, and W. T. Tan, "Privacy-Preserving Distributed Deep Learning with Privacy Transformation," IEEE International Workshop on Information Forensics and Security (WIFS), 2018.

M. Usman Rafique, S. C. Cheung, "Tracking Attacks on Virtual Reality Systems", IEEE Consumer Electronics Magazine (CEM), 2019.

P. C. Su, J. Shen, **M. Usman Rafique**, "RGB-D Camera Network Calibration and Streaming for 3D Telepresence in Large Environment", 2017 IEEE Third International Conference on Multimedia Big Data (BigMM), pp. 362-369, 2017.

S. Li, H. Wang, **M. Usman Rafique**, "A Novel Recurrent Neural Network for Manipulator Control with Improved Noise Tolerance", IEEE Transactions on Neural Networks and Learning Systems, 2017.

PEER REVIEWER

- The British Machine Vision Conference (BMVC) 2020
- IEEE Transactions on Image Processiong (TIP)
- IEEE Transactions on Multimedia (TMM)
- IEEE Embedded Systems Letters (ESL)
- International Conference on Acoustics, Speech, and Signal Processing (ICASSP) 2019

Achievements

- Nominated by the department of Electrical and Computer Engineering for the College of Engineering Outstanding PhD student award, 2020.
- Recipient of graduate fellowship by department of Electrical and Computer Engineering, University of Kentucky, 2016.
- Received President's Gold Medal in MS Mechatronics Engineering 2008 - 2010 batch with CGPA of 3.95 / 4.00, 2010
- Won travel grant by government of Pakistan to present paper in ICCAR 2015 in Singapore, 2015
- Organized Robotic Competitions in Air University: 2010, 2012, 2013 and 2014.
- Completed industry funded project "Autonomous Airship" in collaboration with East West Infiniti Pvt. Ltd., 2012
- Won university grant of 5,000 USD for Electrical Car "Markhor", 2015
- Participated in Shell Eco-Marathon Asia in Philippines, 2015
- Won grant of 7,500 USD from Higher Education Commission (government) and Air University for electrical car "Air-X", 2011
- Participated in Shell Eco-Marathon Asia in Malaysia, 2011
- Won 1st Prize in the National Engineering Robotics Contest 2006 (NERC)
- Won Higher Education Commission grant of 18,500 USD for Final Year Project in Bachelors of Engineering at NUST, 2006
- Received Academic Scholarship during Bachelors of Engineering at NUST, 2006