Rajat Vikram Singh

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Education

Carnegie Mellon University School of Computer Science
(Aug 2015 – Dec 2016)

Master of Software Engineering
- Intro. to Machine Learning (10-601)
- Intro. to Computer System (15-513)
- Software Architecture (17-655)
- Computer Vision (16-720)
- Deep Learning (36-780)
- Managing Software Development (17-653)

IIIT Delhi
(Sep 2008 – May 2012)

Bachelor of Technology in Computer Science and Engineering (Honors)
- Image Analysis and Machine Intelligence
- Data Analytics

Experience

Siemens Research Vision Technologies and Solutions Group
Princeton, NJ
(Aug 2017 - Present)

Senior Research Engineer – Computer Vision, Perception, Deep Learning
- My responsibilities include utilizing computer vision methods, machine learning and deep learning to research, design, implement algorithms and showcase their results with prototypes, feasibility studies and then productionizing research into efficient and scalable software modules.
- Take a systematic approach to solving engineering needs and writing modular software with proper documentation and unit tests.
- Collaborating with international customers from diverse technical backgrounds to understand their business requirements, propose solutions, engage them throughout the project and deliver high-quality solutions. Currently working on 3 projects with international customers and stakeholders.
- Published 1 paper in CVPR 2019 and 1 paper in ICCV 2019, and filed 9 patents.
- Successfully delivered 2 major business projects in FY 2018 which in turn brought in projects worth USD 250K for FY 2019 to the group.
- As technical lead, I supervise a team of 2 full time engineers and 2 interns.

Carnegie Mellon University Robotics Institute
Pittsburgh, PA
(Apr 2017 – Aug 2017)

Research Associate
Worked under Dr. Kris Kitani on the NavCog project which aims at providing seamless indoor and outdoor navigation for the blind through an iPhone app. My responsibilities included using the iPhone's camera for real time localization and obstacle detection through a deep neural network running locally on the user's phone. TensorFlow was used for this project.

Wazzat Labs.
Hyderabad, India
(Jan 2014 – Mar 2015)

Research Engineer – Computer Vision
Designed a visual search engine for fashion e-commerce websites retrieving apparels visually and categorically similar to the user input. This got accepted in the Target Accelerator Program, 2014.

**Informatica Inc.
ILM Business Unit**
Hyderabad, India
(Jun 2012 – Oct 2013)

Software Engineer
Wrote optimized installers for data intensive products in the Information Lifecycle Management business unit. Also responsible for managing and maintaining the complete CI infrastructure and builds. Constantly a top performer, winner of a spot award and the ILM Hackathon, 2013.

GE Global Research
Bangalore, India
(May 2011 – Jul 2011)

Summer Intern – Medical Image Analysis Lab
Wrote an algorithm to quantitatively analyze and score the results generated by the lab's vertebrae numbering algorithm using spinal MRI images as input.

Skills

Programming Languages	Python, C++, Java, Objective-C, C, C#, Perl, SQL
Tools + Technologies	PyTorch, TensorFlow, Caffe, Keras, OpenCV, PCL, ITK Toolkit, MATLAB, VLFeat, Android SDK, Android NDK, RESTful APIs, Flask, Oracle, MySQL, Git, Perforce, Jenkins, Docker, Maven, Gradle, Linux Shell

Publications

1. L. Wang, Z. Wu, S. Karanam, K.-C. Peng, **R. V. Singh**, B. Liu and D. Metaxas. "Sharpen Focus: Learning with Attention Separability and Consistency", **ICCV, 2019**.
2. P. Dhar*, **R. V. Singh***, K.-C. Peng, Z.Wu, and R. Chellappa. "Learning without Memorizing", **CVPR, 2019**. (*-equal contribution)
3. H. Patel, **R. V. Singh**, V. Aatrey, R. Sundararajan, and V. Vaidya. "Automated Vertebra Numbering and Plane Prescription along the Spine Using a Multi Model Atlas", **ISMRM, 2012**.

Filed Patents

1. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Teacher and Student Based Deep Neural Network Training," International Patent Application PCT/US2019/034841, May 31, 2019.
2. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Attention Loss Based Deep Neural Network Training," International Patent Application PCT/US2019/031507, May 9, 2019.

3. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Attention Distillation for Incremental Learning in Object Classification," US Patent Application 62/683860, June 12, 2018.
4. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Attention Guided Visual Recognition with Inverse Mask Loss," US Patent Application 62/683844, June 12, 2018.
5. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Autoencoder Based Guided Network Augmentation for Incremental Learning," US Patent Application 62/683827, June 12, 2018.
6. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Confusion Reduction with Guided Attention for Incremental Learning in Object Classification," US Patent Application 62/683810, June 12, 2018.
7. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Autoencoder Based Incremental Learning for Classification without Catastrophic Forgetting," US Patent Application 62/683802, June 12, 2018.
8. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Multiple Bounding Box Attention Guidance for Visual Recognition in Images," US Patent Application 62/683791, June 12, 2018.
9. R. Mondal, **R. V. Singh**, K.-C. Peng, Z. Wu, and J. Ernst. "Guided Few-shot Incremental Learning for Classification without Catastrophic Forgetting," US Patent Application 62/683779, June 12, 2018.

Industry Projects @ Siemens

Object Pose Estimation   **Ongoing**

I am the technical lead for this project about object pose estimation for robot pick and place applications, with a specific focus on including new objects with minimal retraining and using their CAD models to simulate the training data.

Local and Global 3D Representation Learning from Depth Data   **Ongoing**

Project lead of this Siemens core research project. In this project we aim to learn local representations through keypoints as well as global representations through pose consistency in the depth modality. The keypoint detector and descriptor thus trained can be used for other geometric problems like pose estimation, 3D reconstruction etc.

3D CAD Model Search and Retrieval   **Ongoing**

Project Manager and technical contributor of an ongoing project from the Siemens Digital Industry business unit. The project aims at learning and representing 3D shapes using local shape descriptors for searching in a database of CAD models. Also, recognizing 3D objects in dynamic factory environments to retrieve similar looking CAD models from a database for verification of digital twin.

Anomaly Detection in Images using Guided Attention   **FY 2018**

Working as a technical contributor, researched different methods to detect anomalies in machines such as misaligned equipment, tools left behind etc. using images, for industrial inspection and safety use-cases. This work is getting extended to localize the anomaly with limited data for anomalous cases and weakly supervised methods.

Attention Modeling and Interpretability   **FY 2018**

Researched capabilities of gradient-based attention maps in deep learning for computer vision. We showed their utility in incremental learning setting by encouraging attention maps to be similar and in improving classification accuracy by encouraging attention separability between classes and consistency within the same class (see: Publications). Exploring future work and extension to other problems.

Academic Projects

3D Object Reconstruction from Hand-Object Interactions   **Computer Vision (16-720) Course Project**

Implemented the 2015 ICCV paper of the same title by Tzionas et al. for the Computer Vision course project. A symmetric, texture-less, feature-less 3D object was reconstructed from RGB-D images of the object being rotated by a hand. The end-effector correspondences were used to register the object point cloud.

Transfer Learning for Object Recognition   **Deep Learning (36-780) Course Project**

Trained a Convolutional Neural Net on CIFAR-10 dataset by fine-tuning a VGG-16 Net pre-trained on the ImageNet dataset. Got a validation accuracy of 97.41% by tuning hyper-parameters and by data augmentation.

Object Recognition using CIFAR-10 dataset   **Machine Learning (10-601) Course Project**

Implemented and evaluated machine learning algorithms to detect objects in the CIFAR-10 dataset – SVMs, Neural Networks, Logistic Regression.

Relevance Feedback using Gesture Recognition   **Undergrad Final Year Project**

Conceptualized and implemented a search engine result optimization module to enhance the relevance of the search results. The query was reformulated based on user feedback gathered non-intrusively through head gesture recognition.

A Mosaicing Scheme for Pose-Invariant Face Recognition   **Undergrad Image Analysis Course Project**

Wrote an image mosaicing scheme for pose-invariant facial recognition algorithms. This was done by stitching facial images taken from multiple poses in the CMU PIE dataset to form a composite facial image.

Supplier – Retailer Shrinkage Management, LH Ventures   **MSE Capstone Project**

Worked with LH Ventures on a software development project in a team of 5. The focus was on learning how to manage software development, acquiring skills like project tracking, designing architecture, managing risk, quality and configuration.