Satwik Kottur

B10 Porter Hall, 5000 Forbes Avenue, Pittsburgh, PA-15213.

Curriculum Vitae *Last updated: November 25, 2015*

CONTACT INFORMATION

Ph.D. Student
Department of Electrical and Computer Engineering
Carnegie Mellon University

+1-412-557-1267
skottur@andrew.cmu.edu
https://satwikkottur.github.io/

EDUCATION

Carnegie Mellon University, Pittsburgh, USA

Ph.D. Student, Department of Electrical and Computer Engineering, **2014 - present**

- Advisor: Prof. José M. F. Moura
- Interests: Computer Vision and Machine Learning
- GPA: 4.00/4

Indian Institute of Technology Bombay, Mumbai, India

Bachelor of Technology, Department of Electrical Engineering, **2010 - 2014**

- Advisor: Prof. Subhasis Chaudhuri
- **Honors** in Electrical Engineering, **Minor** in Computer Science and Engineering
- GPA: 9.52/10

Research

PUBLICATIONS

- **Satwik Kottur**, Ramakrishna Vedantam, José M. F. Moura, Devi Parikh,
  Visual Word2Vec (vis-w2v): Learning Visually Grounded Word Embeddings from Abstract Scenes, *(submitted to IEEE Conference on Computer Vision and Pattern Recognition, 2016)*

- Manzil Zaheer, Micheal Wick, **Satwik Kottur**, Jean-Baptiste Tristan,
  Comparing Gibbs, EM and SEM for MAP Inference in Mixture Models, *OPT: NIPS Workshop on Optimization for Machine Learning, 2015.*

- Evgeny Toropov, Liangyan Gui, Shanghang Zhang, **Satwik Kottur**, José M. F. Moura,
  Traffic Flow from a Low Frame Rate City Camera, *Big Data Processing and Analysis (special session) in IEEE International Conference on Image Processing (ICIP), 2015.*

RESEARCH EXPERIENCE

Learning Visually Grounded Word Embeddings

Guide: Prof. José M. F. Moura and Prof. Devi Parikh **Fall '15**

Formulated a method to learn visually grounded word embeddings that capture visual semantics using abstract scenes. Showed improvements in tasks that are ostentatiously in text but benefit from semantic relationedness learnt from visual grounding. This work has been submitted to IEEE conference on Computer Vision and Pattern Recognition (CVPR), 2016.

Traffic Flow from a Low Frame Rate City Camera

Guide: Prof. José M. F. Moura **Spring '15**

Traffic flow is a rich source of information about cities, that are being instrumented with video cameras. Formulated an approach consisting of background subtraction, scene geometry, car detection, and car counting, to detect traffic flow from an online low quality, low frame rate city video camera. A prototype approach has been accepted in IEEE International conference on Image Processing (ICIP), 2015.

Static Vehicle Detection and Analysis in Aerial Imagery
Computer Vision Lab, IRIS, University of Southern California, Los Angeles, USA
Guide: Prof. Gerard Medioni **Summer '13**

Proposed and implemented a vehicle detection algorithm using depth features in an urban landscape. The algorithm uses Haar-like features on depth maps back-projected via the 3-D model obtained from simultaneous dense reconstruction and camera calibration with multi-view stereo. To improve detection accuracy, validation is added using 2-D image features that scores gradient saliency, comparing it with a projected wire-frame model.

Human Activity Recognition
Vision and Image Processing Lab, IIT Bombay, Mumbai, India
Guide: Prof. Subhasis Chaudhuri **Fall '13**

Due to increasing need for security and surveillance, human activity recognition and prediction is gaining importance. Proposed a pipeline of detecting humans using Deformable Part Models, predicting their motion and interaction based on the past observations using linear cyclic pursuit model, in a social gathering with a single, calibrated camera.

Multiple Platform based Parallel Hardware Simulation
High Performance Computing Lab, IIT Bombay, Mumbai, India
Guide: Prof. Sachin Patkar **Summer '12 - Spring '13**

To improve performance and speedup, developed algorithms to identify and systematically partition single clock structural/behavioral hardware designs into smaller independent, functional components. Simulated these components as parallel threads on multi-core platforms for faster computations. As a proof of concept, tested benchmark algorithms like matrix multiplication, binary search and bubble sort. Awarded the Undergraduate Research Award (URA-01) in appreciation for contribution to research at IIT Bombay.

Technical Experience

AUVSI and ONR'S International Robosub Competition
SSC Pacific TRANSDEC, San Diego, USA
Design and Development of Autonomous Underwater Vehicle (AUV), IIT Bombay
Guides: Prof. Hemendra Arya and Prof. Leena Vachhani **Spring '12 - Spring '13**

Leading the Vision subsystem, I have designed and implemented robust algorithms for processing underwater images to aid navigation via visual feedback through on-board cameras. These real-time algorithms are devised constrained to the limited on-board computation power. The approaches formulated include adaptive identification and correction of color casts in images, edge-saliency based color segmentation and adaptive enhancement based on corrected color cast.

Co-authored *'System Design and Implementation of Autonomous Underwater Vehicle'* for
- Presentation at American Society of Mechanical Engineers(ASME), International Undergraduate Research and Design Expo 2012, Houston, USA
- AUVSI and ONRs 15^{th}, 16^{th} Robosub Competition Journal Paper (2012, 2013)

Academic Experience and Achievements

Scholastic Achievements

- Awarded Carnegie Institute of Technology Dean's Fellowship to pursue graduate studies
- Awarded Viterbi-India Scholarship to pursue research in summer at Viterbi School of Engineering
- Won bronze medal at International Olympiad for Astronomy and Astrophysics (2010), Beijing
- Secured AIR 6 in IITJEE - 2010 (achieved the best score in physics) among 4.7 Lakh students
- Selected for Orientation-Cum-Selection camp for International Junior Science Olympiad (IJSO-2008) and International Astronomy Olympiad (IAO-2009), in top 30 among 45 thousand students
- Secured High Distinction in Australian National Chemistry Olympiad (2008,2009)

Key Course Projects

Stochastic Expectations Maximization for Latent Variable Models
Instructor: Prof. Ryan Tibshirani (10-725 Convex Optimization) **Fall '15 (ongoing)**
Working on variant of expectation-maximization algorithm making it asynchronous and embarrassingly parallel and thus useful for latent variable models. Desiging inference procedure capable of leveraging modern computational resources like GPUs or cloud computing offering massive parallelism. Currently, looking at theoretical guarantees to obtain convergence bounds.

Non-smooth Stochastic Optimization for MCMC
Instructor: Prof. Eric Xing (10-708 Probabilistic Graphical Models) **Spring '15**
Proposed techniques to handle and sample from non-smooth energy functions in stochastic gradient Hybrid Monte Carlo (HMC), without losing the benefits of stochasticity especially for large datasets. Studied and analyzed the properties both theoretically and empirically.

Movie Recommendations based on Collaborative Topic Modeling
Instructor: Prof. Geoff Gordon and Prof. Aarti Singh (10-701 Machine Learning) **Fall '14**
Traditional collaborative filtering relies on viewer ratings in the movie-watching community to make recommendations to the user. Combined this approach with probabilistic topic modeling techniques to make recommendations that consist not only of movies that are popular in the community, but also those similar in content to movies that a user has enjoyed in the past.

Detecting Text in Natural Images
Instructor: Prof. Martial Hebert (16-720 Computer Vision) **Fall '14**
Intelligent systems often need to read text in their surroundings. Studied an algorithm to locate and identify image regions containing text, that uses stroke width transform, and analyzed the success and failure cases to get a clearer understanding.

Relevant Courses

- **Graduate:** Introduction to Machine Learning, Computer Vision, Probabilistic Graphical Models, Geometry-based methods in Vision, Convex Optimization, Intermediate Statistics.
- **Undergraduate:** Pattern Recognition, Machine Learning, Advanced Computer Graphics, Image Processing, Digital Signal Processing, Advanced topics in Signal Processing, Speech Processing, Graph Theory, Data Structures and Algorithms.

Technical Skills

- *Languages:* C/C++, Python, Java, Verilog, HTML, CSS, JavaScript
- *Packages:* OpenCV, OpenGL, OpenCL, CUDA, MySQL, MATLAB
- *Operating System:* ROS (Robot Operating System), GNU/Linux, Windows

Extracurricular Activities

Music

- Trained in Indian Classical and Western Classical Violin for 12 years and performed over hundred concerts in Birmingham (U.K.), Beijing, Pittsburgh, New Delhi, Pune, Bangaluru, etc.
- Secured Distinction in Certificate course (South Indian Classical Violin) for overall excellence
- Lead violinist of musical band Saptak and have won People's Choice Award, Mumbai and Battle of the Bands, IIT Bombay as the best musical group
- Performed in events like Institute Classical Night, Institute Cultural Night, Swar Sandhya, Surbahaar and Performing Arts Festival (PAF) which see huge audience from students, faculty and employees of IIT Bombay

Mentorship

Department Academic Mentorship Program, Electrical Engineering, IIT Bombay
Selected from over 50 applicants from the department on the basis of balanced academics, extracurriculars and mentoring skills. Counseling students with severe academic problems to surmount emotional and social difficulties and improve overall performance.

Speaker

Conducted various sessions on Image Processing and OpenCV at beginner, intermediate and advanced levels for undergraduate and graduate students at IIT Bombay