

# Abhineet Singh

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CONTACT INFORMATION	Robotics & Vision Lab (CSC-351) Computing Science Center University of Alberta Edmonton, AB T6G 2R3 Canada	<i>Phone:</i> (587) 596-0470 <i>E-mail:</i> asingh1@ualberta.ca <i>Web:</i> webdocs.cs.ualberta.ca/~asingh1 <i>Code:</i> github.com/abhineet123
RESEARCH INTERESTS	Computer vision and machine learning in general and application of deep learning to object detection, segmentation and tracking in particular	
EDUCATION	<b>University of Alberta</b> , Edmonton, Alberta, Canada Doctor of Philosophy, Computing Science (CGPA: 4/4) <ul style="list-style-type: none"><li>• Thesis: “End-to-End Multi-Object Tracking”</li><li>• Advisor: Nilanjan Ray and Hong Zhang</li></ul>	Sept 2017 - Present
	<b>University of Alberta</b> , Edmonton, Alberta, Canada Master of Science, Computing Science (CGPA: 3.4/4) <ul style="list-style-type: none"><li>• Thesis: “Modular Tracking Framework: A Unified Approach to Registration-based Tracking”</li><li>• Advisor: Martin Jagersand</li></ul>	Sept 2013 - Feb 2017
	<b>Indian Institute of Information Technology</b> , Allahabad, India Bachelor of Technology, Information Technology (CGPA: 8.21/10) <ul style="list-style-type: none"><li>• Thesis: “Abandoned Object Detection in Video”</li><li>• Advisor: Anupam Agrawal</li></ul>	Jul 2009 - Jun 2013
PUBLICATIONS	<b>To filter prune, or to layer prune, that is the question</b> S. Elkerdawy, M. Elhoushi, A. Singh, H. Zhang and N. Ray	<i>ACCV</i> , Dec 2020
	<b>One-Shot Layer-Wise Accuracy Approximation for Layer Pruning</b> S. Elkerdawy, M. Elhoushi, A. Singh, H. Zhang and N. Ray	<i>ICIP</i> , Oct 2020
	<b>Animal Detection in Man-made Environments</b> A. Singh, M. Pietrasik, G. Natha, N. Ghouaiel, K. Brizel and N. Ray	<i>WACV</i> , Mar 2020
	<b>River Ice Segmentation with Deep Learning</b> A. Singh, H. Kalke, M. Loewen and N. Ray	<i>TGRS</i> , Feb 2020
	<b>Modular Tracking Framework: A Fast Library for High Precision Tracking</b> A. Singh and M. Jagersand	<i>IROS</i> , Sept 2017
	<b>Real-Time Salient Closed Boundary Tracking via Line Segments Perceptual Grouping</b> X. Qin, S. He, C. Quintero, A. Singh, M. Dehghan and M. Jagersand	<i>IROS</i> Sept 2017
	<b>4-DoF Tracking for Robot Fine Manipulation Tasks</b> M. Siam, A. Singh, C. Perez and M. Jagersand	<i>CRV</i> , May 2017
	<b>Unifying Registration based Tracking: A Case Study with Structural Similarity</b> A. Singh, M. Siam and M. Jagersand	<i>WACV</i> , Mar 2017
	<b>Modular Decomposition and Analysis of Registration based Trackers</b> A. Singh, A. Roy, X. Zhang and M. Jagersand	<i>CRV</i> , June 2016

**RKLT: 8 DOF Real-Time Robust Video Tracking Combining Coarse Ransac Features and Accurate Fast Template Registration**

X. Zhang, A. Singh and M. Jagersand

*CRV*, June 2015

**Online signature verification using segment-level fuzzy modelling**

A. Ansari, M. Hanmandlu, J. Kour and A. Singh

*IET Biometrics*, Sept 2014

**An interactive framework for abandoned and removed object detection in video**

A. Singh and A. Agrawal

*INDICON*, Dec 2013

**An Assessment of the Impact of Dimensionality Reduction on the Speed and Accuracy of Hyperspectral Image Classification**

A. Singh, S. Verma, M. Raj and A. Agrawal

*IJACR*, Sept 2013

PROJECTS

**Rock detection in fields**

Sept 2021 - Present

Supervisor: Mojtaba Hedayatpour, Mojow Autonomous Solutions

- Developing a rock detector capable of real-time operation on low-power mobile computing devices
- Creating a synthetic data generation pipeline to increase training data variance

**Stem Cell Viability Prediction from Time-Lapse Microscopy Images** May 2021 - Present

Supervisors: Nilanjan Ray and Nidheesh Dadheech, University of Alberta

- Developing a deep learning pipeline to determine the viability of Inducible Pluripotent Stem Cells (iPSCs) to develop into insulin producing islet cells for type 1 diabetes patients
- Localizing individual cells and colonies using panoptic segmentation and tracking
- Classifying these through temporal analysis with sequential networks like transformers

**Deep MDP**

May 2019 - Apr 2021

Supervisor: Nilanjan Ray, University of Alberta

- Attempted to improve the performance of the MDP multi-object tracking system and reduce its dependency on handcrafted features and heuristics using deep learning
- Created an elegant abstraction to generalize this framework to incorporate deep learning-based trackers, feature extractors and classifiers and make end-to-end training feasible
- Developed a parameter specification and parsing library for deeply nested and modular systems

**Fence Damage Detection with Laser Imaging**

Sept 2020 - Mar 2021

Supervisor: Ken Brizel, ACAMP

- Extracted binary masks for fence sections by applying edge detection to stitched laser line images
- Used autoencoders and other unsupervised methods to detect fence anomalies including holes

**Title Block Detection in Construction Documents**

Aug 2018 - Present

Supervisors: Nilanjan Ray and Yasser Mohammad, University of Alberta

- Helped develop a deep learning pipeline for classifying and extracting information from scanned construction documents

**River Ice Segmentation with Deep Learning**

Jan - Apr 2018

Supervisors: Nilanjan Ray and Mark Loewen, University of Alberta

- Adapted 4 state of the art architectures - UNet, SegNet, Deeplab and DenseNet - for dense pixelwise segmentation of river ice images and videos into frazil and anchor ice
- Devised a new metric for unsupervised evaluation of video segmentations

**Animal and Human Detection with Deep Learning**

May - Aug 2018, Jan - Apr 2019

Supervisors: Nilanjan Ray, University of Alberta and Nehla Ghouaiel, ACAMP

- Trained a variety of deep detectors - Faster RCNN, RFCN, SSD, YOLOv3 - for detecting humans and 8 types of animals
- Trained several instance segmentation models - Mask RCNN, Sharpmask, FCIS - and integrated them within a user-friendly GUI to generate realistic synthetic data
- Developed efficient ways to get compressed video data from ATV to GPU server in real time

**Improving model-based RL with Adaptive Rollout** Jan - Apr 2018

Supervisor: Martha White, University of Alberta

- Helped develop an algorithm to improve model based RL by automatically selecting the imagination rollout length for planning

**Vehicle and Pedestrian Tracking for Intersection Traffic Analysis** Mar 2017 - Jan 2018

Supervisor: Nilanjan Ray, University of Alberta

- Created a system for tracking vehicles and pedestrians in road traffic videos captured from UAVs and pole mounted cameras at intersections and roundabouts
- Converted Matlab implementation of the MDP tracker to Python and made it an order of magnitude faster to allow real time deployment

**Modular Tracking Framework** May 2014 - Feb 2017

Supervisor: Martin Jagersand, University of Alberta

- Devised a novel way to study registration based trackers by decomposing them into three constituent sub-modules: appearance model, search method and state space model
- Created a highly efficient tracking library in C++ with MATLAB and Python bindings

**3D Object Recognition using Deep Learning** Jan - Apr 2014

Supervisor: Dale Schuurmans, University of Alberta

- Developed and tested several variants of the 6 hidden layer LeNet-5 architecture for classifying handwritten digits and 3D real world objects

**Abandoned Object Detection in Video** Jan - Jul 2013

Supervisor: Anupam Agrawal, IIT Allahabad

- Created a complete modular framework for detecting abandoned and removed objects in video streams using C++ with OpenCV

**Multi Object Recognition in an Indoor Environment** Jul - Nov 2012

Supervisor: U.S. Tiwary, IIT Allahabad

- Created an object recognition system based on a hierarchical model of visual processing in the human visual cortex

**Online Signature Verification using Segment-Level Fuzzy Modeling** May - Jul 2011, 2012

Supervisor: Madasu Hanmandlu, IIT Delhi

- Used geometric extrema to segment the signature, dynamic time warping to match segments of different samples and Mamdani fuzzy model to compare matching segments

**Dimensionality Reduction and Classification of Hyper-Spectral Images** Jan - Jun 2012

Supervisor: Anupam Agrawal, IIT Allahabad

- Used PCA and ICA for dimensionality reduction and SVM with sequential minimal optimization algorithm for classification of 224 band AVIRIS and 210 band HYDICE remote sensing images

**Object Based Change Detection in Multi-Temporal Satellite Images** Jul - Nov 2011

Supervisor: Anupam Agrawal, IIT Allahabad

- Extended a multi-feature fusion based change detection system with a hierarchical clustering and tested on Google Earth images of IIT-A taken in 2004 and 2008

ACADEMIC  
EXPERIENCE

**Graduate Courses:** Optimization Principles for Reinforcement Learning, Visual Recognition, Reinforcement Learning for AI, Autonomous Robot Navigation, Computational Neuroscience, Representational Learning, Computer Graphics, Online Learning

**Teaching Assistant:** Digital Image Processing, Visual Recognition, Computer Vision, Introduction to Computer Graphics, Introduction to the Foundations of Computation

**Research Assistant** Summer 2017, 2019, 2020, 2021

Supervisor: Nilanjan Ray, University of Alberta

- Created a vehicle and pedestrian tracking system and extended it with deep learning
- Worked on a cell tracking and segmentation project for IPSC growth prediction

**Research Assistant** Summer 2014, 2015, 2016

Supervisor: Martin Jagersand, University of Alberta

- Created a modular system for registration based tracking and implemented 13 appearance models, 12 state space models, 10 search methods and 3 illumination models

INDUSTRY  
EXPERIENCE

**ACAMP** May - Aug 2018, Jan - Apr 2019, Sept 2020 - Mar 2021

- Worked on the vision and AI aspects of an autonomous ATV patrolling the perimeter at Edmonton International Airport

**Mojow Autonomous Solutions** Sept 2021 - Present

- Working on a variety of farming related visual recognition tasks including rock detection, field boundary detection, road detection and 3D pose estimation

SCHOLASTIC TESTS

- **CELPPI General Test** Aug 2017  
Listening: Level 11, Reading: Level 12, Writing: Level 9, Speaking: Level 8
- **Graduate Aptitude Test in Engineering (CS & IT):** 99.96 percentile Jan 2013
- **GRE revised general test** Nov 2012  
Verbal Reasoning: 165, Quantitative Reasoning: 169, Analytical Writing: 4.5
- **TOEFL iBT** Nov 2012  
Listening: 29, Reading: 29, Writing: 30, Speaking: 26
- **eLitmus pH test:** 99.97 percentile July 2012
- **All India Engineering Entrance Examination:** 99.11 percentile Apr 2009
- **National Talent Search Examination:** Qualified Stage I Nov 2006

TECHNICAL SKILLS

- **Languages:** C/C++, Python, C#, Java, MATLAB, HTML, JavaScript, Prolog, SOAR, Lex-Yacc, Assembly (8086)
- **Software:** MS Visual Studio, Netbeans, Eclipse, Code::Blocks, PyCharm, Intel Parallel Studio, ERDAS Imagine, ITTVIS ENVI, CLIPS, Adobe Photoshop
- **Libraries:** PyTorch, Tensorflow, MXNet, Keras, Theano, CUDA, OpenAI Gym, OpenGL, OpenCV, ViSP, Eigen, Intel TBB, OpenMP, GSL, ROS, Weka, LibSVM, VLFeat
- **Operating Systems:** Linux (Ubuntu, Fedora), Windows, macOS, iOS, Android