

AMMAR HUSAIN

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U.S.CITIZEN

Code Repository: github.com/ammarhusain

EDUCATION

CARNEGIE MELLON UNIVERSITY

DECEMBER 2012

MS in Robotic Systems Development –School of Computer Science

Research Topic: Prototype of an autonomous aerial search and rescue platform

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

MAY 2011

BS in General Engineering - Robotics (*Honors*),

GPA: 3.7/4.0

PRINCESS SUMAYA UNIVERSITY OF TECHNOLOGY

SUMMER 2008

Amman, Jordan: Undergraduate Exchange Program

EMPLOYMENT

APPLE

Jan 2015 – Current

Software Engineer, Special Projects Group, Cupertino, CA

- Given the nature of the project, most of my specific work at Apple is highly confidential. More broadly though, I work in the core algorithms group building software libraries (in C & C++) for algorithms in fields such as computer vision, computational geometry and a few others.

NATIONAL ROBOTICS & ENGINEERING CENTER (CMU)

Jan 2013 – Dec 2014

Robotics Software Engineer, Pittsburgh, PA

- **Perceptual Boosting:** Autonomous robots driving off-roads or at high speeds are prone to slipping. Slip is a characteristic of certain properties of the terrain in addition to the vehicle's interaction with it. Goal was to learn models of slip for an entire terrain by driving on only 10% of it. I developed algorithms to correlate vehicle slip behavior with perceptual cues. Implemented a Naïve Bayes classifier with a Gaussian mixture assumption for supervised learning and Gaussian Mixture Models for unsupervised learning. Features included L*, a*, b* color and texon bag of words. Achieved ~30% improvement in prediction error on heterogeneous terrains and ~38% improvement on separated homogeneous terrains. This provides enormous benefits in path planning for autonomous vehicles. Software design involved processing over 10k images.
- **Mapping:** Wrote several functions for filtering point clouds using PCL through change detection, radius outlier search etc. Implemented capability to transform, align and merge different point clouds. Added unit tests for several modules for mine mapping library.

BANK OF AMERICA (MERRILL LYNCH)

Software Engineering Intern, Chicago, IL

Summer 2010

- Wrote tools to automate the process of submitting and approving trades from the Front to Middle and Back offices for the capital derivatives business. Collaborated with a global team of traders and developers from London, Charlotte and Hyderabad.

GENERAL ELECTRIC – HEALTHCARE

Software Engineering Intern, Barrington, IL

Summer 2009

- Created software tools like widgets for production planning & triggering, thereby saving time & waste. Eliminated a manual error checking process in manufacturing work orders guaranteeing over 95% accuracy up from 65%.

AMERICA READS PROGRAM

Tutor - Leal Elementary School, Urbana, IL

Spring 2007 (Part-time)

SELECTED RESEARCH

ASTROBOTIC TECH – PLANETARY ROBOTICS – advised by Prof. William “Red” Whittaker
MULTI-ROBOT COLLABORATION FOR LUNAR SUBSURFACE EXPLORATION

- NASA has identified caves & skylights on the moon and Mars as scientific features of interest. Project entailed

- demonstrating exploration and modelling of lunar caves using a team of collaborative heterogeneous robots.
- Technology development lead for \$180k contract to build a distributed multi-robot collaboration routine. Capabilities included mixed initiative planning, information sharing & learning cost metrics.
 - Designed an entire Robot Operating System (ROS) based software architecture in C++ and Python that handled generic robot tasks such as on-board perception, path planning and inter robot communication for a team of robots.
 - Formulated a novel algorithm for robots to probabilistically trade tasks on market based distributed systems, based on Distributed Constraint Optimization (DCOP). Each robot attempts to maximize individual reward while optimizing the overall utility function of the team.
 - **Publication** - IEEE Aerospace Conference 2013 (First Author): Mapping Planetary Caves with an Autonomous, Heterogeneous Robot Team

ESTIMATE MISSING DEPTH VALUES IN KINECT: 2 Members advised by Prof. Derek Hoiem

- Used an iterative diffusion method that accounts for both the known depth values and RGBD segmentation results to recover missing depth information
- Derived a version of the Hough voting scheme in order for the existing depth values to vote for missing depth pixels

PROJECT EXPERIENCE

HERB – Home Exploring Robotic Butler (with Barrett Arms)

Spring 2012

- Implemented arm planning algorithms such as Joint space planning, Jacobian control workspace planning, biDirectional Rapidly-Exploring Random Tree (RRT) using OpenRAVE plugin for ROS.
- Developed holonomic and non-holonomic discrete search planners to move the wheel base for HERB.
- Programmed the robot to play Tic-Tac-Toe with a human by gesturing an X or O on a projected gameboard. Entirely ROS based system involving arm planning, human gesture recognition, action server and game display.

AUTONOMOUS AERIAL SEARCH & RESCUE PLATFORM: 3 Members

2011-2012

- Built a functioning quadrotor using an ArduPilot Mega controller, frame, IMU sensor shield, brushless motors, electronic speed controllers, sonar, GPS and a Hokuyo Lidar sensor.
- Wrote software for quadrotor navigation, obstacle avoidance, subject detection and visual odometry.
- Mounted a servo motor based rescue platform to deploy when subject is detected.
- Achieved complete mission autonomy except for take-off and landing in a semi-cluttered environment.

COMPUTER GRAPHICS - RAYTRACER

- Developed a recursive raytracing renderer that handles reflection, refraction and shadows. Blinn-Phong shading model was used for color computation. Implemented loop subdivision algorithm for refining meshes.

SKILLS

- **Languages:**
Skilled- C ++, C, MATLAB *Proficient-* Python, LaTeX, Bash *Experience-* Java, HTML
- **OS, Libraries and Tools:**
Skilled - Linux, Git, OpenCV, C++ STL, Emacs
Proficient - Robot OS (ROS), Point Cloud Library (PCL), CGAL, Boost, CMake, Qt, Mercurial, GDB
Experience - OpenGL, wxPython, DreamWeaver, Amazon Webservices EC2, Django, Netbeans

GRADUATE COURSE WORK

- Computational Learning Theory (15-859(B)) • Machine Learning (10-701) • Robot Autonomy (16-662)
- Statistical Techniques in Robotics (16-831) • Sensing & Sensors (16-722) • Artificial Intelligence (CS440 UIUC)
- Manipulation, Mobility & Control (16-642) • WebApp Development (15-637) • Computer Vision (CS543 UIUC)

LEADERSHIP & HONORS

- Kenneth Hamming Scholarship – **2008**, Industrial Enterprise and Systems Engineering Service Award - **2007 & 2009**
- Dean's List of Students: 2007-2010, Faculty chair of Gamma Epsilon Honors society
- Winner Idea2Product competition, UIUC regional

REFERENCES

ROBOTS: Husky, HERB, ArduCopter, LAGR, Pioneer, Mobipulator

HUMANS: Prof. William "Red" Whittaker, Prof. Hagen Schempf, Prof. John Dolan (contacts provided upon request)