

AMMAR HUSAIN

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U.S.CITIZEN
Code Repository: github.com/ammарhusain

INTERESTS – Autonomous systems, Artificial Intelligence, Machine Learning, Robot Perception, Vision & Graphics

EDUCATION

CARNEGIE MELLON UNIVERSITY

DECEMBER 2012

MS in Robotic Systems Development – Robotics Institute, School of Computer Science
Research Topic: Prototype of an autonomous aerial search and rescue platform

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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

MAY 2011
GPA: 3.64/4.0

PRINCESS SUMAYA UNIVERSITY OF TECHNOLOGY

SUMMER 2008

Amman, Jordan: Undergraduate Exchange Program

EMPLOYMENT

NATIONAL ROBOTICS & ENGINEERING CENTER (CMU)

January 2013 - Current

Robotics Engineer (Software), 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. Position prediction error was compared using an average terrain slip model against visually aided terrain models. 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.
- **Data collection:** We are building a data driven simulator for testing autonomy platforms. This involves collecting large amounts of LiDar, camera and mobility data using a custom sensor head to build virtual models. I am heavily involved in several field exercises for data gathering, the most exciting being at a defunct nuclear weapons facility. I developed an interactive user interface for the data logging system to initiate sensors and monitor system health.
- **Mapping:** Wrote several tools for filtering point clouds using PCL through change detection, radius outlier search etc. Added unit tests for several modules for mine mapping library.

GENERAL ELECTRIC – HEALTHCARE

Summer 2009

Software Engineering Intern, Barrington, IL

- 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%.

CATERPILLAR INC.

Machine Designer - Champaign Simulation Center, U of I Research Park

2008-2010 (Part-time)

- Design, analyze and update models of CAT parts and assemblies using Pro-Engineer

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*

- Caves & skylights on the moon and Mars have been identified as scientific features of interest by NASA. Project entailed demonstrating exploration and modelling of lunar caves using a team of collaborative heterogeneous robots.
- Technology development lead for \$180k contract to build an entirely Robot OS (ROS) based distributed multi-robot

- collaboration routine. Capabilities included mixed initiative planning, information sharing & learning cost metrics.
- 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

MOBIPULATOR ROBOT BUILD: 2 Members advised by Prof. Seth Hutchinson and Prof. Tim Bretl

- Assembled a dual differential drive concept car that uses its wheels for locomotion and manipulating desktop objects
- Devised control policies under two separate system constraints that achieve the most optimized mobile manipulation
- Proposed a Reeds-Shepp based planning scheme to move paper from user specified initial to final configuration

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. ([Video](#))
- 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, SMACH, action server and game display.

AUTONOMOUS AERIAL SEARCH & RESCUE PLATFORM: 3 Members

2011-2012

- Built a functioning quadrotor from scratch using an ArduPilot Mega controller, frame, IMU sensor shield, brushless motors, electronic speed controllers, sonar, GPS, Hokuyo LiDAR sensors. ([Video](#))
- 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 program that handles reflection, refraction and shadows. Blinn-Phong shading model was used for color computation. ([Images](#)). Implemented loop subdivision algorithm for refining meshes.

TECHNOLOGY SKILLS

- **Languages:** *Expert*- C ++, MATLAB; *Proficient*- Python, C, LaTeX ; *Used*- Java, HTML, Visual Basic
- **OS, Libraries and Tools:**
 - Expert* - Linux, Mercurial, OpenCV, Emacs ;
 - Proficient* - Mac OSX, Windows, Git, ROS, Point Cloud Library (PCL), Qt ;
 - Experience* - wxPython, DreamWeaver, Amazon Webservices EC2, Django, Netbeans

GRADUATE COURSE WORK

- Machine 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 Schempff, Prof. John Dolan (contacts provided upon request)
