

AMMAR HUSAIN

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U.S. CITIZEN

INTERESTS – Autonomy systems, Artificial Intelligence, Machine Learning, Planning under uncertainty, Collaboration for Multi-Agent systems, Robot Perception, Grasping and Manipulation

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

MAY 2011

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

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 texton bag of words. Achieved a 38% improvement with perceptually learning slip compared with an average learned slip model on local testing sites. 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.

GENERAL ELECTRIC – HEALTHCARE

Summer 2009

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 the \$180k contract to build an entirely 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 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

HYBRID HARD DRIVE OPTIMIZATION USING AI: 2 Members advised by Prof. Gerald Dejong

- Goal of the research was to incorporate learning algorithms to dynamically place actively seeked files on the SSD portion of a hybrid disk in order to optimize speed and energy consumption
- Created hierarchical Bayesian networks with multiple parameters to predict future use of a file
- Ran simulations for 7 years of OS data and achieved up to 39.8% time savings compared with regular drives

PROJECT EXPERIENCE

HERB – Home Exploring Robotic Butler (with Barrett Arms)

Spring 2012

- Implemented arm planning algorithms such as Joint space planning, Jacobian control Work-Space, biDirectional 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, ESC's, sonar, GPS, Hokuyo LiDAR sensors. ([Video](#))
- Wrote software for quadrotor control, obstacle avoidance, subject detection and visual odometry and HIL Simulation.
- 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.

TECHNOLOGY SKILLS

- Languages: C ++, MATLAB, Python, Java, HTML, C, Visual Basic
- Frameworks: ROS, OpenCV, OpenRAVE, wxPython, Visual Studio, DreamWeaver, Xcode, NetBeans, Qt
- Experience in Amazon Web Services (EC2), NX Protocol, LAMP, Django, Apache Tomcat, Java Servlets
- Operating Systems: Linux (Ubuntu, CentOS, Fedora), Macintosh, Windows

GRADUATE COURSE WORK

- Machine Learning Theory (15-859(B) : Current) • 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: HERB, ArduCopter, LAGR, Pioneer, Mobipulator

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

BACKGROUND

- Travel enthusiast: Grew up in India and backpacked almost 20 countries in the Middle East, Asia, Africa and Americas