Vinicius Guimaraes Goecks

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Updated on Jan/2017

EDUCATION

Texas A&M University, College Station, TX - USA
Doctor of Philosophy, Aerospace Engineering, Present
Advisor: Dr. John Valasek
GPA: 3.50/4.0
Dissertation: Deep Reinforcement Learning Applied to Heterogeneous Multi-Agent Systems

Texas A&M University, College Station, TX - USA
Master of Science Non-thesis option, Aerospace Engineering, August 2015
Advisor: Dr. John E. Hurtado
GPA: 3.38/4.0
Final Project: Low Cost Spacecraft Attitude Determination for CubeSat Type Missions

Federal Univ. of Mato Grosso do Sul, Campo Grande, MS - Brazil
Bachelor of Science, Electrical Engineering, July 2013
Advisor: Dr. Jair Fiorentino
GPA: 3.80/4.0
Bachelor Thesis: Grid-connected Photovoltaic Microgeneration to Reduce Urban Diurnal Power Peak Demand

EXPERIENCE

Deep Reinforcement Learning Applied to Cooperative Control of Heterogeneous Multi-Agent Systems
Vehicle Systems & Control Laboratory (VSCL)
Nov 2016 - Present — Texas A&M University, USA
Current autonomous systems require multiple highly skilled operators, autonomy is usually tailored to specific missions and cannot be adapted to dynamic environments. On a multi-agent mission scenario, time-delayed, intermittent, limited bandwidth communication limits traditional sequence-based operations of robotic systems. The main contribution is the development of a deep reinforcement learning framework in which the robotic system behavior would adapt by itself according to the present environment, to better represent and share knowledge between heterogeneous multi-agents to accelerate behavior learning, and maximize the long-term goal set for the mission. Current PhD topic. More information upon request.

Deep Learning, Reinforcement Learning, and Artificial Intelligence
Texas A&M University
Jan 2015 - Present — Personal Project
My personal interest for artificial intelligence and autonomous systems lead me to study and implement classical AI, neural networks, reinforcement learning, machine learning, and deep learning algorithms. Problems approached by these techniques range from small proof-of-concept problems, game-playing agents, recognition of patterns and anomalies, computer vision and object recognition, time-series prediction, system modeling, to the training of autonomous agents combining artificial intelligence and control/estimation theory to solve dynamic problems.

Spacecraft Attitude Control and Estimation Test-bed
Land, Air, and Space Robotics (LASR) Laboratory
Aug 2015 - Dec 2016 — Texas A&M University, USA
Open-sourced project: https://github.com/lasr/lasr-lat. The LASR Attitude Test-bed (LAT) was developed to allow spacecraft attitude estimation and control algorithms to be implement and realistically tested on hardware in real-time, on ground. My contribution was to design/build/validate an motor controller to support the start current and constant switching of the three on-board DC motors, to implement/validate

the internal code to handle communication and control, to implement/validate the communication protocol between the platform and the main control computer, to implement/validate a monitor system to recover the most amount of data in real-time from the platform, to implement/validate the interface between the user and the platform in Python and MATLAB, to validate the main estimation algorithm for attitude determination (Multiplicative Kalman Filter), and to organize/publish/maintain the project as an open-source attitude test-bed platform on GitHub.

Computer Vision Aided Robotic Operations on the ISS
NASA Johnson Space Center / AeroSpace, Technology Research and Operations (ASTRO) Center / Land, Air, and Space Robotics (LASR) Laboratory
Jun 2016 - Dec 2016 Texas A&M University, USA
Partial results: https://vimeo.com/176204666. Current International Space Station (ISS) robotic operations are a very labor intensive process, requiring Mission Control involvement and many crew-hours. This project consist of the development of a real-time, video-based, stereo reconstruction of large-scale environments to support robotics operations. My contribution was to reconstruct part of the ISS based on the current view of the static cameras and moving robotic arm using direct SLAM techniques, and to validate the recovered digital reconstruction based on current CAD models. The system is still being developed, but ultimately the software will be ported to a virtual reality headset for intuitive control of the robotic arm by the on-board crew.

SpaceCRAFT Virtual Reality Space Sandbox Environment
AeroSpace, Technology Research and Operations (ASTRO) Center
Jul 2016 - Dec 2016 Texas A&M University, USA
A virtual reality space sandbox environment to develop space missions and test them with high accuracy on long-term simulations. My contribution was to design/implement/ validate a rigid body translation/rotation control base class, to design/implement/ validate a head-up display base class to monitor relevant information inside the platform, and to support/manage/maintain the code library being developed by more than 30 people at the same time on GitHub. The classes that I developed are the main base for the design of more complex missions and are currently being used by the whole team. A demonstration of the system is scheduled for Fall 2016.

Low-cost Sun Sensor for Spacecraft Attitude Determination
Land, Air, and Space Robotics (LASR) Laboratory
Oct 2015 - Feb 2016 Texas A&M University, USA
Spacecrafts rely on the sun, stars, and horizon position for attitude determination. The development of a low-cost sun sensor was necessary to support our low-cost Spacecraft Attitude Control and Estimation Test-bed (LAT). My contribution was to design/build/validate a low-cost sun sensor using commercial-of-the-shelf (COTS) components - Teensy microcontroller and linear CCDs, to design/build the case and attachment mechanics using SolidWorks and 3D printing techniques, and to characterize the error curves for the sensor field of view during sequential on-axis and off-axis maneuvers. The resultant characterization and validation of the sun sensor was relevant for the implementation of the main Multiplicative Kalman Filter for spacecraft attitude estimation on the test-bed.

HOMER - Holonomic Omni-directional Motion Emulation Robot
Land, Air, and Space Robotics (LASR) Laboratory
May - Sep 2015, 2016 Texas A&M University, USA
HOMER supports proximity operation experiments on LASR Lab. It consists of a mobile, planar base accompanied by a micron-class Stewart platform and is capable of manipulating a 10 kg payload through 6-DoF. My contribution was to assemble/test a second HOMER unit, capable of faster maneuvers and to carry heavier payloads. The process included the mechanical assembling of the machined casters to the main robot body, the assembling/calibration of the leg angular encoders, the upgrade of the motor controller boards and general power system of the robot, and the testing/validation

of the new translational and rotational maneuvering capabilities - autonomously and manually controlled.

Grid-connected Photovoltaic Microgeneration
Energisa / Solar Energy do Brasil / Nexsolar
Jun 2012 - Jul 2014 Campo Grande - MS, Brazil
Solar panels are economically viable for the average electricity customer. The impacts of grid-connected photovoltaic microgeneration on the utility grid is a current research. I developed an impact study of multiple solar plants connected to the grid and how it could benefit or damage the grid if precautions were not implemented on the grid's protection and flow control system. I installed a monitor system on a real grid-connected solar microgeneration in partnership with Solar Energy do Brasil and analysed the generated/injected power on the power grid. The data was scaled per area and compared to the power demand data supplied by the utility company Energisa. For Nexsolar I also designed, implemented, and tested photovoltaic installations for residential customers.

Three-Phase Tri-State Boost Current Source Inverter
A.I., Power Electronics and Digital Systems Laboratory (BATLAB)
Jul 2010 - Sep 2011 Federal University of MS, Brazil
The Tri-State Boost Current Source Inverter (CSI) is a one-stage power converter that provides a current level gain followed by a three-phase DC-AC conversion controlled by. A Modified Space Vector PWM controls and generates the switching signals pattern. My contribution was the development/validation of a realistic simulation of the converter topology, from the connections of the solar panel to the connections of the three-phase machine being powered on MATLAB/Simulink. This stage included the modeling of the circuit capacitance, inductance, voltage and current sensors, and transistor switching. Supported the validation of the solar panel model and control logic on Simulink/dSPACE platform. I also contributed on printed circuit board design, manufacturing and soldering, and general hardware work for the final product. This project was presented on the 2011 IEEE International Future Energy Challenge Competition (IFEC'11) Competition, awarded the IES Best Innovative Design of Power Electronic Converters.

Power Substation Engineer
Energisa S.A.
Jul 2013 - Jul 2014 Campo Grande, MS - Brazil
The Energisa S.A. Group manages the generation, distribution, and commercialization of electrical energy for more than sixteen million customers in Brazil, with 2830 MVA of installed power capacity. As a power substation engineer I was responsible to develop studies to expand and design new power substations in 34.5 and 138 kV to attend the power demand of new customers. This included studies for the better connection arrangement in order to minimize the construction costs and planning for future expansions. During my time working for Energisa I was the main developer of a suite of tools to optimize how the resources were allocated for each project and how each expansion should be executed, based on current price of materials and services being offered. This changed the way the company hired external contractors, resulting in savings on the order of one to two millions during the first year it was applied.

Professional Internship
Energisa S.A.
Jun 2012 - Jul 2013 Campo Grande, MS - Brazil
The Energisa S.A. Group manages the generation, distribution, and commercialization of electrical energy for more than sixteen million customers in Brazil, with 2830 MVA of installed power capacity. During my internship I developed studies of the impact of grid-connected photovoltaic microgeneration to the company's grid, which later led to the development of my Bachelor's thesis. I worked with industry partners to develop standards for residential installation of photovoltaic systems and connection to the

utility grid. This work resulted on the company's first set of procedures allowing customers to install these systems and sell the generated energy to the grid.

Undergraduate Researcher
Undergrad Researcher
Jul 2009 - Jul 2010 Federal University of Mato Grosso Sul
Working on my Bachelor's in Electrical Engineering on the A.I., Power Electronics and Digital Systems Laboratory (BATLAB) I implemented on simulation and validated on hardware many of the controllers taught on the undergraduate courses (PI, PD, PID) for motor/illumination control, and developed minor automation projects using digital and power electronics, relays, and microcontroller programming.

COMPUTER SKILLS

Programming Languages
Strong knowledge of Python developed through the implementation of reinforcement learning agents, training and prediction of models using deep neural networks, implementation of estimation and control algorithms, computer vision and stereo reconstruction, and scientific computation (solving differential equations and dynamics simulation). Main packages include Numpy, Matplotlib, Keras, TensorFlow, Theano, OpenAI-Gym, Scikit-Learn, and OpenCV.

Amazon Web Services - EC2 (CPU and GPU instances) used to train deep learning networks and high-dimensional reinforcement learning agents. Intermediate experience using Lambda instances to interface with web and mobile applications.

Strong knowledge of MATLAB/Simulink developed through the implementation of estimation and control algorithms for robotics and aerospace systems, modeling dynamical systems and electrical circuits, and scientific computation (solving differential equations and dynamics simulation).

Advanced knowledge of C/C++ developed through the implementation of real-time robotics and communication (UDP/TCP protocols), low-level hardware and microcontroller programming, and scientific computation (solving differential equations and dynamics simulation). Main packages include Cmake, OpenCV, Eigen, and Boost library - including creation of Makefiles for projects with numerous files and dependencies.

Advanced knowledge of LaTeXdeveloped writing periodic progress reports, conference publications, thesis/dissertation, research proposals, white papers, and this Curriculum Vitae.

Intermediate knowledge of Robot Operating System (ROS) for computer vision applications using LSD-SLAM (Large-Scale Direct Monocular Simultaneous Localization and Mapping) and managing different sensors on robotics agents (subscribing/publishing).

Intermediate knowledge of HTML5, CSS, Django, JSON templates, JavaScript, and Node.js for full-stack development of web applications, databases, interfacing with Amazon Web Services and other cloud services, and deploying machine learning algorithms. Experience also derived from participation in multiple Major League Hacking (MLH) hackathons.

Experience developing software using the "Agile Software Development" principles.

Basic knowledge of Lisp, Fortran, and Visual Basic.

Embedded Computing, Applications and Operating Systems
Advanced knowledge of embedded computing systems, robotics, and sensor integration. This includes real-time Linux robots/machines, RaspberryPis, Arduinos, NVIDIA TK1, RGB-D cameras, and diverse range of sensors and inertial measurement units (IMU).

Advanced knowledge of development on Linux and code management using Git, in which most of my relevant work has been done.

Advanced knowledge of the Nexus and Tracker Motion Capture Software (by VICON) for motion capture and rigid body tracking in a laboratory environment.

Advanced knowledge of Eagle Software for printed circuit board design, manufacturing, and testing. Intermediate knowledge using OrCAD and Proteus platforms for the same purpose.

Advanced knowledge of Microsoft Windows and its Office package (Word, Excel, PowerPoint).

Intermediate knowledge of 3D CAD design on SolidWorks and 2D on AutoCAD for laser-cutting and 3D printing.

Familiar with developing applications on Unreal Engine for dynamics simulations.

HARDWARE SKILLS

Advanced knowledge of printed circuit board manufacturing. Including through-hole soldering and surface mount (SMD) integrated circuits.

Advanced knowledge of computer and robot assembly and maintenance.

Advanced knowledge on 3D-printer operation/calibration and intermediate knowledge operating laser cutter machines.

Confident using mechanical fabrication equipment and shop machines (drill and hydraulic press, metal-cutting bandsaw, rotary power tools, etc), general tools (wrenches, drivers, etc) and painting.

PUBLICATIONS

Conference Papers:

1. Vinicius Goecks, Austin Probe, Robyn Woollands, John E. Hurtado, and John L. Junkins, "Spacecraft Attitude Estimation for Low Cost CubeSat Missions". AAS Guidance, Navigation, and Control Conference. Breckenridge, CO, February, 2016.

2. Austin Probe, Vinicius Goecks, and John E. Hurtado. "Low Cost Satellite Attitude Hardware Test bed". ASEE Annual Conference & Exposition. New Orleans, LA, June 2016.

3. Vinicius Goecks, Stoian Borissov, Austin Probe, Gregory Chamitoff. "Toward Controlling A Robotic Arm in Space with Virtual Reality And Multi-view Stereo Reconstruction". AIAA SciTech 2017, Accepted.

4. Vinicius Goecks, Robyn Woollands, J. Humberto Ramos, and John E. Hurtado. "Reconfigurable Low Cost Testbed for SmallSat Mission Attitude Control". AAS Guidance, Navigation, and Control Conference, Submitted.

5. Bharat Mahajan, Vinicius Goecks, John E. Hurtado, and Srinivas R. Vadali. "Robust Attitude Determination and Tracking System for CubeSats". AAS Guidance, Navigation, and Control Conference, Submitted.

6. Ruben B. Godoy, Douglas B. Bizarro, Edson S. L. Junior, Marcos R. Oshiro, Vinicius Goecks. "Three-Phase, Tri-State, Current Source Inverter Applied to Photovoltaic Powered Pumping and Filtration Systems". 63a Brazilian Society for Science Progress, Brazil, 2011.

RELEVANT COURSES

Spacecraft Dynamics and Control
Optimal Spacecraft Attitude and Orbital Maneuvers
Modern Control of Aerospace Systems
Artificial Intelligence, Pattern Recognition, Machine Learning with Networks
Microprocessors, Power Electronics and Converters
Probability, Statistics, and Numerical Methods
Continuum Mechanics and Aerospace Structural Analysis
Fluid Mechanics, Heat Transfer and Viscous Flows

LEADERSHIP AND MENTORING

Special Training Program
2010 - 2013 Federal University of Mato Grosso Sul
The Special Training Program is an undergraduate program present in the main universities in Brazil. Its main goal is to train undergraduate students by promoting knowledge share between them through workshops and seminars. Coordinated for three years the Electrical Engineering branch of the program, I lectured for multiple times MATLAB/Simulink and Printed Circuit Boards design courses, hosted class help sections and test reviews (Calculus, Physics, and Circuits Analysis), mentored high school students from the local community studying to apply to university, and lectured on events promoting electricity safety awareness and smart consume.

Zero Robotics
2015, 2016 Texas A&M University
Zero Robotics is a robotics programming competition where the robots are SPHERES (Synchronized Position Hold Engage and Reorient Experimental Satellites) inside the International Space Station. Students from high and middle school learn how to code routines to the robots on a simulated environment. During the final competition the finalist codes are uploaded to the real hardware at the ISS. The competition happens at both national and international level. My main role was to mentor middle school students from Texas during the 5-weeks program, not only supporting them on the code development, but also on academic and space-related questions.

Aerospace Graduate Student Council
2016 - Present Texas A&M University
The Aerospace Graduate Student Council is the channel between the Aerospace graduate students and the department at Texas A&M Univeristy. Its main goal is to promote workshops and social events to share knowledge between the students and integrate them to the academic environment. All the members of the Graduate Student Council contribute bringing the students' suggestions to the department, organizing events and workshops.

SOCIETIES

The American Institute of Aeronautics and Astronautics - AIAA, Student Member
The Institute of Electrical and Electronics Engineers - IEEE, Student Member
The IEEE Computational Intelligence Society - IEEE-CIS, Student Member
The American Society for Engineering Education - ASEE, Student Member
Society for Industrial and Applied Mathematics - SIAM, Student Member
Sigma Gamma Tau - Aerospace Engineering Honor Society - SGT
Aggie Artificial Intelligence Society - AAIS
Aggie Coding Club - ACC
Students for the Exploration and Development of Space - SEDS

HONORS

CAPES/Laspau - PhD Scholarship, 2014-2018
CAPES - Federal Agency for Support and Evaluation of Graduate Education, sponsored by the Government of Brazil.
Laspau - affiliated with Harvard University - connects ideal candidates to Universities throughout the Americas.

IEEE International Future Energy Challenge - IES Best Innovative Design of Power Electronic Converters Award, 2011

Texas A&M University - College of Engineering (COE) Travel Award, 2015
Texas A&M University - College of Engineering (COE) Travel Award, 2016

LANGUAGES

English: bilingual proficiency
Portuguese: bilingual proficiency
Spanish: professional working proficiency
German: elementary proficiency