Georgios Fainekos

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RESEARCH INTERESTS

Theoretical foundations of *Cyber-Physical Systems (CPS).* **Applications in** *Automated Driving Systems (ADS), mobile robots, and medical devices/systems.* **Model-based design of CPS:** *Formal requirements, model-based testing, formal verification, model checking, control synthesis, nonlinear optimization, simulation, and real-time scheduling.* **Robotics:** *Mission, Motion and Task Planning; Human-Robot Interfaces.* **Automated Driving Systems:** *Safety analysis, adversarial testing, perception, machine learning, and control.*

EDUCATION

- **University of Pennsylvania** (2004 – 2008), Philadelphia, PA, USA
  Doctor of Philosophy in **Computer and Information Science**
  Thesis: Robustness of Temporal Logic Specifications
  Advisor: G. J. Pappas (UPenn) GRASP Lab
  Committee: Rajeev Alur (Chair), Edmund M. Clarke (External), Insup Lee, and Oleg Sokolsky
- **University of Pennsylvania** (2002 – 2004), Philadelphia, PA, USA
  Master of Science in Engineering in **Computer and Information Science**
- **National Technical University of Athens** (1996 – 2001), Athens, Greece
  Diploma (Master of Science in Engineering) in **Mechanical Engineering**; Major in **Design & Control**;
  Rank in graduating class: 11/137
  Thesis: Ant Colony Optimization: Applications to discrete and continuous problems
  Advisor: K. Giannakoglou (NTUA) Lab of Thermal Turbomachines
  Committee: K. Giannakoglou (Chair), K. Mathioudakis, K. Papailiou
- **University of Patras** (1995 – 96), Patra, Greece
  Mathematics
- **2nd High School of Agios Dimitrios** (Graduation 1995), Athens, Greece

ACADEMIC EMPLOYMENT

- **Associate Professor**, Aug. 2015 – up to now
  Arizona State University, Tempe, USA
  Appointment: School of Computing, Informatics and Decision Systems Engineering.
  Director: Cyber-Physical Systems Laboratory (CPSLab)
  Affiliation: NSF I/UCRC Center for Embedded Systems (CES)
  Chairing & co-chairing rights: Computer Science, Computer Engineering, Electrical Engineering.
- **Assistant Professor**, Aug. 2009 – 2015
  Arizona State University, Tempe, USA
  Appointment: School of Computing, Informatics and Decision Systems Engineering.
  Director: Cyber-Physical Systems Laboratory (CPSLab)
  Affiliation: NSF I/UCRC Center for Embedded Systems (CES)
  Chairing & co-chairing rights: Computer Science, Computer Engineering, Electrical Engineering.

PROFESSIONAL EMPLOYMENT

- **Postdoctoral Researcher**, NEC Laboratories America, Oct. 2008 – Aug. 2009, USA
  Principal researcher for the project Tessa (Techniques for Embedded System and Software Assurance): see Research Experience section.
- **Mechanical Engineer**, Jet Engineering ltd, Nov. 2001 – Jul. 2002, Greece
  Part of an engineering team working on the design, verification, validation and manufacturing of tank trailers and tank containers for hazardous materials. Successfully designed (using SolidWorks) three out of the four tank models of the company's current production line. Design for adherence to international standards: ADR, PrEN-13094, PrEN-14025, DIN-4100 and EN-288. Trained in verification using finite element methods and in experimental validation (data acquisition from the prototype tank vehicles).
- **Intern**, Microfluidics Laboratory, Purdue University, Aug. – Dec. 2000, USA
  Part of a group of students working on the design of a manifold supporting a model (microchip) of the choroidal vasculature. Responsibilities: Design of the model in Pro Engineer; Web page development.
- **Intern**, Engines Maintenance Unit, Hellenic Aerospace Industry ltd, Mar. – Jul. 2000, Greece
  Development of an automated Local Heat Treatment (LHT) unit for military engine parts. Trained on LHT processes for aerospace materials. Successfully designed and implemented in Visual Basic a software package for the control of LHT processes. Tuning of the PID controllers. Selected components and designed procedures in accordance with military specifications. Final report (in Greek) co-supervised by Dr. Freskos (HAI) and Dr. Giannakoglou (NTUA): *Local Heat Treatment Processes: Development of computer software for Control and Data Acquisition.*
- **Intern**, Current Technology ltd, 1996 – 99, Greece
  Participated in various posts in summer internships in CT ltd which is specialized in the design and production of industrial automations and CNC machines. Sample projects: plasma cutting and milling CNC machines, foam cutting machines, jet-engine testing facilities.

AWARDS AND HONORS

- At Arizona State University:
  - Best Paper award at the 22nd IEEE Intelligent Transportation Systems Conference (ITSC 2019) for the paper titled "*Rapidly-exploring Random Trees for Testing Automated Vehicles*"
  - Best Repeatability Evaluation Award at the 22nd ACM International Conference on Hybrid Systems: Computation and Control (HSCC 2019) for the paper titled "*Gray-box Adversarial Testing for Control Systems with Machine Learning Components*"
  - Best Paper Honorable Mention at the 17th ACM-IEEE International Conference on Formal Methods and Models for System Design (MEMOCODE 2019) for the paper titled "*Encoding and Monitoring Responsibility Sensitive Safety Rules for Automated Vehicles in Signal Temporal Logic*"
  - 2019 Top 5% Best Teachers Award, SCIDSE, ASU
  - 2014 technological breakthrough nomination by the industry for CES-funded research outcomes.
    `http://faculty.washington.edu/scottcs/NSF/2014/NSF_Compendium_2014.pdf`
  - 2013 NSF CAREER Award for the project titled: "*Robustness Guided Testing and Verification for Cyber-Physical Systems.*"
    Citation from NSF website: "*The Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.*"
    `http://www.nsf.gov/awardsearch/showAward?AWD_ID=1350420`
  - 2013 Best Researcher Junior Faculty award for the School of Computing Informatics and Decision Systems Engineering at Arizona State University

  - 2012 technological breakthrough nomination by the industry for CES-funded research outcomes.
    `http://faculty.washington.edu/scottcs/NSF/2012/NSF_Compendium_2012-WEB.pdf`

- By my students:
  - Dr. Hoxha received the Best CS PhD student of the Year 2017 Award
  - Honorable Mention at Cornell Cup 2014 to the NAO Navigators team (ASU SCIDSE Undergraduates: Mila Arezina, Joe Boeding, Bijan Fakhri, Sami Mian, Ryan James Sterry, and Cameron Stewart).
    `https://www.facebook.com/pages/Cornell-Cup-USA-presented-by-Intel/115084925265002`
  - Finalist for the Best Student Paper Award (ASU students Houssam Abbas and Bardh Hoxha) at the 2014 IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (CYBER) for the paper titled "*Robustness-Guided Temporal Logic Testing and Verification for Stochastic Cyber-Physical Systems.*"

- As a student:
  - 2008 Frank Anger Memorial ACM SIGBED/SIGSOFT Student Award
    Citation from the SIGBED website: "*The Frank Anger Memorial Award is a student award in the name of late Dr. Frank Anger to promote cross-disciplinary research between embedded systems and software engineering.*"
    `http://sigbed.blogspot.com/p/awards.html`
  - Finalist for the Best Student Paper Award (student authors Hadas Kress-Gazit and Georgios Fainekos) at the 2007 IEEE International Conference on Robotics and Automation (ICRA) for the paper titled "*Where's Waldo? Sensor-Based Temporal Logic Motion Planning.*"
  - Best Poster Award at the 2005 Graduate Research Symposium at the University of Pennsylvania for the poster titled "*Temporal Logic Motion Planning for Mobile Robots.*"
  - 2002 – 08: Graduate Research Fellowship (University of Pennsylvania).
  - Award for academic excellence in engineering sciences for the academic year 2000-2001.
    Awarded by the Technical Chamber of Greece and it is given to the top 5 students of every year in each department: for my class that corresponds to top 4% (96 percentile).
  - Several awards for "Best academic performance in class" and "Overall high GPA" during middle school and high school in Greece.

IN THE NEWS

- ASU Full Circle, Mar. 28, 2019: "*Enhancing the safety and reliability of smart technologies*" by Joe Kullman
  `https://fullcircle.engineering.asu.edu/faculty/enhancing-safety-reliability-smart-technologies/`
- USC Viterbi News, Mar. 28, 2019: "*How to Make Self-Driving Cars Safer on Roads*" by Caitlin Dawson
  `https://viterbischool.usc.edu/news/2019/03/how-to-make-self-driving-cars-safer-on-roads/`
- ASU Full Circle, Jun. 24, 2014: "*ASU team's robot driver in top 10 at Cornell Cup competition*" by Mayank Prasad
  `http://fullcircle.asu.edu/2014/06/10746/`
- ASU Full Circle, Mar. 3, 2014: "*Fainekos' work on embedded cyber-physical systems earns NSF CAREER award*" by Joe Kullman
  `http://fullcircle.asu.edu/2014/03/10207/`
- Embedded Computing Design, Feb. 12th, 2014: "*Improving automotive safety system effectiveness with model-based development*" by Monique Devoe
  `http://embedded-computing.com/articles/improving-system-effectiveness-model-based-development/`

RESEARCH ACTIVITIES AND EXPERIENCE

- **Associate Professor**, SCIDSE, Arizona State University, Aug. 2015 – to date, USA
  Further information can be found at:
  `http://www.public.asu.edu/~gfaineko/research.html`.

  Active research programs

(AP1) **NSF: CPS: Medium: Collaborative Research: Learning and Verifying Conformant Data-Driven Models for Cyber-Physical Systems**, **PI (at ASU): G. Fainekos**; Co-PI (at ASU): H. Ben Amor; Funding source: National Science Foundation (NSF), Award # 1932068, Period: Oct. 2019 - Sep. 2022, **Total Award: $599,724.00, recognized amount: $ 305,859.24**. (Collaborative with Sriram Sankaranarayanan, University of Colorado, Total award among all institutions for period Oct. 2019 - Sep. 2022: $1,191,953.00)

Brief Description: The research combines falsification methods for exposing failure to conform with verification approaches for rigorously proving conformance. Furthermore, approaches for learning models of dynamical systems from data and imposing core cyber-physical domain knowledge are under investigation. The project is applying these data-driven models with conformance guarantees to the design of safe controllers for autonomous vehicles, models of human insulin glucose regulation and robotic swarms. The effort is advancing CPS education by creating a framework for distance education focused on CPS. The researchers are developing a series of low cost hardware testbeds and self-paced learning tasks that will expose students to the process of building highly reliable and safety critical CPS.

(AP2) **CES: Requirements driven testing for autonomous systems with NN in the loop**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Bosch, Period: Aug. 2019 – Jul. 2020, **Total amount: $95,000**.

Brief Description: This project develops a testing framework for Cyber-Physical Systems (CPS) with Neural Networks (NN) in the loop. The specific focus of the project will be on utilizing the new specification language for vision-based perception systems, i.e., Timed Quality Temporal Logic (TQTL), for test case generation and robustness analysis in Automated Driving Systems (ADS). The project will address the specific concern of how well the perception system performs in the context of Automated Vehicles (AV). The resulting framework will not be applicable to AV, but also to warehouse robotics systems as well as Advanced Driver Assistance Systems (ADAS).

(AP3) **CES: Comparison and Evaluation of Different AV Simulators for Benchmark Development**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Period: Aug. 2019 – Jul. 2020, **Total amount: $30,000**.

Brief Description: In the past 2-3 years, there has been a proliferation of simulation environments for Autonomous Vehicles (AV). These simulation environments have different strengths and weaknesses and different capabilities, which makes timely the evaluation of their suitability for adversarial test generation frameworks like Sim-ATAV. This project compares the technical suitability of the following simulators: LGSVL, Carla, Webots and Gazebo in the context of requirements driven adversarial testing. The outcome of the project will be a benchmark library of test scenarios in the simulation framework that offers the best support for adversarial testing.

(AP4) **NSF: Convergence Accelerator Phase I (RAISE): Safe Skill-Aligned On-The-Job Training with Autonomous Systems**, PI: S. Srivastava, ASU; **co-PIs:** E. Chiou, **G. Fainekos**, I-H. Hsiao, K. VanLehn, ASU; Senior personnel: D. Bowman, N. Cooke, S. Kambhampati, K. Michael, ASU. Funding source: National Science Foundation (NSF), Award # 1936997, Period: Sep. 2019 - May 2020, **Total Award: $ 998,588.00, recognized amount: $ 119,830.56**.

Brief Description: This project aims to initiate the invention, development and evaluation of intelligent training systems and self-explaining autonomous systems for providing safe on-the-job training for work with autonomous systems. Although autonomous systems have immense potential for empowering a highly productive workforce, this potential cannot be realized with the current state of the art. This interdisciplinary project will utilize safe and taskable self-explaining autonomous

systems to develop a new class of intelligent tutoring systems that provide on-the-job training for work with autonomous systems. In the process, it will also advance methods for creating self-explaining autonomous systems, for the automated synthesis of task-specific robot behavior that is safe and compliant with workplace regulations, and for the evaluation of collaborative human-autonomy teamwork.

(AP5) **NSF: CAREER: Robustness Guided Testing and Verification for Cyber-Physical Systems**, **Single PI: G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 1350420, Period: Aug. 2014 - Jul. 2020, **Total Award: $ 436,857.00**.

Brief Description: Developing a comprehensive theory for testing and verification in all the stages of a Model Based Development process for a Cyber-Physical System. The ultimate goal is to support component reuse, incremental system improvements and modular design. The project's research comprises three components: development of conditions on the algorithms and on the structure of the CPS for inferring finite-time guarantees on the randomized testing process; the study of testing methods that can support modular and compositional system design; and investigation of appropriate notions of conformance between two system models and between a model and its implementation on a computational platform.

Completed research programs

(CP2.1) **Intel-ASU Initiative**, PI: L. Karam, ASU; **co-PIs:** R. Bassi, H. Ben Amor, **G. Fainekos**, K. Kaloush, G. Marchant, A.R. Mayyas, A. Shrivastava, ASU; Funding source: Intel, Period: May. 2018 – Aug. 2019, **Total amount: $400,000, recognized amount: $60,000**.

Brief Description: Research on legal, governmental, safety, and requirements related issues concerning automated driving systems. Role: Lead investigator for the project titled: "*Encoding in Signal Temporal Logic the assumptions and guarantees of Responsibility-Sensitive Safety (RSS) model*". The basic premise of RSS model developed by Intel Mobileye is that if all the road vehicles drive according to the RSS model, then all the vehicle interactions on the roads will be safe. In other words, it is possible to formalize what behaviors an AV should exhibit in order to never cause an accident. This project encodes in formal logic (requirements) the RSS model. The formal requirements can then be used in monitoring, test generation, and theorem proving. For this project, we monitored the RSS requirements over naturalistic driving data from freeways.

(CP2.2) **Design and Analysis of Collision Risk Assessment and Collision Avoidance System for Automobiles**, **PI: G. Fainekos**, ASU; **co-PI:** H. Ben Amor, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Bosch, Period: Aug. 2017 – Jul. 2019, **Total amount: $83,369, recognized amount: $35,945** (Administratively another co-PI is the CES director Dr. Vrudhula).

Brief Description: Develop a perceptual anticipation model for abnormal driving conditions / behaviors using a deep convolutional recurrent network. The search based test generation framework S-TaLiRo will also be used to search for false positives and false negatives using artificially generated data through a physics simulator. Finally, the collision risk analysis framework will be integrated with a basic control algorithm proposing collision avoidance actions when appropriate.

(CP2.3) **Coverage guarantees for requirements guided falsification**, **PI: G. Fainekos**, ASU; **co-PI:** G. Pedrielli, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Bosch, Period: Aug. 2018 – Jul. 2019, **Total amount: $47,500, recognized amount: $23,750**.

Brief Description: The purpose of this project is to develop testing techniques for Cyber-Physical Systems (CPS) that provide coverage guarantees for falsification methods based on stochastic optimization. The project focuses on systems which are modeled within the Simulink/Stateflow environment or by Hybrid Automata. Both models are characterized by continuous as well as discrete dynamics. This project will focus on coverage guarantees of the continuous space as well as the discrete space.

(CP2.4) **CPS: Synergy: Collaborative Research: Collaborative Vehicular Systems**, **PI: G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 1446730, Period: Jan. 2015 -

Dec. 2018, **Award: $294,136**. (Collaborative with Umit A Ozguner, Ohio State University, Total award: $979,036)

Brief Description: As self-driving cars are being introduced into road networks, the overall safety and efficiency of the resulting traffic system must be guaranteed. This project developed methods to analyze and coordinate networks of fully and partially self-driving vehicles that interact with conventional human-driven vehicles on intelligent road grids. Among the outcomes of this project were: (1) theoretical foundations and algorithms for requirements driven model-based testing for automated vehicles; (2) specification languages for monitoring reliability of vehicle perception systems with machine learning components; (3) modeling languages for reconfigurable networks of automated vehicles; (4) theory and algorithms for multi-vehicle path and motion planning problems in confined spaces, e.g., parking areas, and under different priorities, e.g., passenger vehicle vs ambulance.

(CP2.5) **Automated Testing for Functional Coverage for Cyber-Physical Systems**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Bosch, Award # A1.Y6.GF, A1.Y7.GF, A1.Y8.GF, Period: Aug. 2014 – Jul. 2018, **Total amount: $295,131, recognized amount: $195,066** (Administratively the co-PI is the CES director Dr. Vrudhula).

Brief Description: The project develops automated testing methods for Cyber-Physical Systems (CPS). The focus is on systems which are modeled within the Simulink/Stateflow environment and which are characterized by both continuous and discrete dynamics. The goal is to develop methods that guarantee coverage of the state space induced by the discrete system dynamics.

(CP2.6) **Analysis of Clinical Decision Support Systems using Formal Methods: A case study**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Cognitive Medical Systems, Period: Aug. 2017 – Jul. 2018, **Award: $61,750**.

Brief Description: Developed a methodology utilizing Satisfiability Modulo Theory (SMT) solvers to detect and resolve some common inconsistencies that can emerge in complex Clinical Decision Support (CDS) systems.

(CP2.7) **Summer of Innovation: Specification-based Testing and Planning for UxAS**, **Single PI: G. Fainekos**, ASU; Funding source: Wright Brothers Institute (WBI) and Air Force Research Labs (AFRL), Period: summer 2017, **Award: $76,867**.

Brief Description: The goal of the project was to apply existing tools and develop new functionality for the AFRL UxAS (Unmanned Systems Autonomy Services). UxAS is a collection of software services that automate mission-level decision making (task assignment, cooperative control, sensing, path planning, etc). It is utilized for experiments and demonstrations of cooperative control and human-machine teaming. The ASU team primarily participated in two threads of the Summer of Innovation program: (1) Test Generation Group, and (2) Mission Planning Group. Within the test generation group, in collaboration with University of Colorado, Boulder, we utilized S-TaLiRo and discovered unknown bugs in the path planning service (UAVs could enter no fly zones even in ideal operating conditions). In the mission planning group, in collaboration with Vanderbilt, we expanded the mission specification language of UxAS to support synchronization among multiple UAVs.

(CP2.8) **CSR: Small: Collaborative Research: Gray Box Testing of Complex Cyber-Physical Systems Using Optimization and Optimal Control Techniques**, **Single PI at ASU: G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 1319560, Period: Oct. 2013 - Sep. 2017, **Award: $249,998.00**. (Collaborative with Sriram Sankaranarayanan, University of Colorado, Total award among all institutions for period Oct. 2013 - Sep. 2016: $499,374.00)

Brief Description: Developing new methodologies for gray-box testing models of Cyber-Physical Systems. Ideas from optimization and optimal control theory are employed in order to drive the process of state-space exploration for system verification. The driving factor of the project is to utilize the minimum possible information from the models.

- **Assistant Professor**, SCIDSE, Arizona State University, Aug. 2009 – Aug. 2015, USA

Completed research programs

(CP1.1) **CSR: Small: Model Exploration for Cyber-Physical Systems & REU supplement**, **Single PI: G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 1116136, Period: Aug. 2011 - Jul. 2015, **Award: $390,998.00**.

Brief Description: Developing a general theory for property exploration of systems. Property exploration attempts to discover the properties that are satisfied by the system. The theory can address finite state models, continuous models and hybrid models (both discrete and continuous) using either model-based analysis or black-box techniques. The properties being discovered are restricted in the class of linear-time (metric or not) temporal logics. The project outcomes are being implemented in various software tools depending on the application domain.

(CP1.2) **Parallelization of Embedded Control Applications on Multi-core Architectures: A Case Study**, **PI: G. Fainekos**, ASU; **co-PI:** Yann-Hang Lee, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Award # A2.Y5.GF.YHL & TBD.Y6.GF.YHL, Period: Aug. 2013 – Jul. 2015, **Total amount: $94,231, recognized amount: $32,039** (Administratively another co-PI is the CES director Dr. Vrudhula).

Brief Description: Studying the parallelization of embedded control applications on multi-core architectures. Developing algorithms for mapping sequential programs to multi-core platforms within a Model-Based Development framework. Building experimental testbeds for evaluation.

(CP1.3) **I-Corps: Formal Specification Driven Verification and Validation Framework for Cyber-Physical Systems**, **Single PI: G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 1454143, Period: Sep. 2014 - Feb. 2015, **Total Award: $ 50,000.00**.

Brief Description: This project aims to commercialize the academic tool S-TaLiRo, a software tool for the verification and testing of Cyber-Physical Systems (CPS). S-TaLiRo provides such capabilities by enabling automatic test generation and verification guided by formal specifications expressed in temporal logics. It can analyze large and complex Simulink models, user-defined functions and blackbox models. S-Taliro provides functionality for specification falsification, parameter estimation, conformance testing and runtime specification monitoring.

(CP1.4) **Collaborative Research: Consortium for Embedded Systems: REU supplement**, PI: Sarma K Vrudhula, ASU; **co-PI G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 0856090, Period: Sept. 2012 - Aug. 2013, **Total amount: $15,923, recognized amount: $15,764**.

Brief Description: The project supports undergraduate students for research in the PI Fainekos' projects funded by the Center for Embedded Systems (CES) at Arizona State University (ASU).

(CP1.5) **Visual Interface for Metric Temporal Logic Specifications**, **PI: G. Fainekos**, ASU; **co-PI:** Yoshihiro Kobayashi, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Award # A1.Y5.GF.YK, Period: Aug. 2013 – Jul. 2014, **Total amount: $48,231, recognized amount: $16,399** (Administratively another co-PI is the CES director Dr. Vrudhula).

Brief Description: Developing graphical user interfaces for stating Metric Temporal Logic specifications. The graphical user interface is needed in order to enable the use of S-TaLiRo tools by non-expert logic users.

(CP1.6) **Temporal Logic Testing for Stochastic Cyber-Physical Systems**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Award # A1.Y4.GF, Period: Aug. 2012 – Jul. 2013, **Total amount: $47,000, recognized amount: $23,500** (Administratively the co-PI is the CES director Dr. Vrudhula).

Brief Description: Developed a framework for robustness-guided model checking for Stochastic Cyber-Physical Systems with respect to Metric Temporal Logic specifications. The results were incorporated in the Matlab/Simulink toolbox S-TaLiRo.

(CP1.7) **Parallelization of Embedded Control Applications on Multi-core Architectures: A Case Study**, **PI: G. Fainekos**, ASU; **co-PI:** Karam S. Chatha, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member:

Toyota, Award # A2.Y4.KC.GF, Period: Aug. 2012 – Jul. 2013, **Total amount: $47,000, recognized amount: $15,980** (Administratively another co-PI is the CES director Dr. Vrudhula).

Brief Description: Developed a theory for quantifying the approximate functional equivalence between two Cyber-Physical Systems. Stochastic optimization methods are utilized in order to compute the approximate distance between two systems. The framework has been incorporated into S-TaLiRo and it can be utilized for studying the functional equivalence between a sequential and a parallelized version of an embedded control system.

(CP1.8) **Statistical Techniques for Property Exploration of Cyber-Physical Systems**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Award # A2.Y3.GF, Period: Aug. 2011 – Jul. 2012, **Award: $45,915.00**.

Brief Description: Developed black-box property exploration methods for Cyber-Physical Systems. Property exploration attempts to derive the properties that are satisfied by the system. The framework utilized parametric temporal logics and randomized falsification methodologies. The focus was on systems modeled within the Matlab/Simulink environment and the project outcomes were incorporated in the S-TaLiRo toolbox.

(CP1.9) **SHF: Small: Collaborative Research: Statistical Techniques for Verifying Temporal Properties of Embedded and Mixed-Signal Systems**, **Single PI at ASU: G. Fainekos**, ASU; Funding source: National Science Foundation (NSF), Award # 1017074, Period: Aug. 2010 - Jul. 2013, **Award: $239,319.00**. (Collaborative with Sriram Sankaranarayanan, University of Colorado, Total award among all institutions for period Aug. 2010 - Jul. 2013: $488,921.00)

Brief Description: Developed the theory of robustness-guided model checking for black-box models of Cyber-Physical Systems. Formal specifications in Metric Temporal Logic are given quantitative interpretation which acts as a cost function for an optimization problem. Minimizing the quantitative interpretation is equivalent to detecting the least robust system behavior with respect to the specification. Developed algorithms with formal guarantees on the testing and verification performance. Developed the Matlab/Simulink toolbox S-TaLiRo.

(CP1.10) **Robust Testing for Reconfigurable Networked Control Systems and Mixed-Signal Systems**, **Single PI: G. Fainekos**, ASU; Funding source: Center for Embedded Systems (CES) at Arizona State University (ASU), Main supporting CES industry member: Toyota, Awards # A2.Y1.GF and A2.Y2.GF.C, Period: Jan. 2010 – Dec. 2011, **Award: $69,497.00**.

Brief Description: Developed model-based testing and verification techniques for Networked Control Systems (NCS) and Mixed-Signal Systems. The developed framework utilized the theory of robust testing, i.e., a single trajectory represents a neighborhood of system trajectories, and randomized falsification methodologies based on stochastic optimization methods.

- **Postdoctoral Researcher**, NEC Laboratories America, Oct. 2008 – Aug. 2009, USA
  - *Tessa: Techniques for Embedded System and Software Assurance*

    Research on verification and testing of embedded systems software. Developed a framework for the robustness analysis of Simulink simulations and models using self-validated arithmetics (interval and affine arithmetic). The goal of the project was to study the robustness and correctness of Simulink simulations under system uncertainties, numerical errors and floating point rounding errors. The outcome of the project was the Matlab toolbox RobSim which can analyze continuous-time, discrete-time and mixed-signal systems.

- **Research Assistant**, GRASP Lab, University of Pennsylvania, 2002 – 2008, USA
  - *Formal Methods for Testing and Verification of Hybrid and Dynamical Systems*

    Developed a theory for the robustness of temporal logic specifications over discrete and continuous time signals in metric spaces. Built a software toolbox for analyzing the robustness of temporal logic specifications over discrete time signals. Developed a framework for reasoning in continuous time using discrete time methods. Applied the theory to the analysis of continuous – discrete time systems with metric state spaces. Built a software toolbox for testing hybrid systems.

- *Controller Design Using Temporal Logic Specifications*
  Developed a framework for deriving controller specifications from temporal logic formulas. Built a toolbox that synthesizes hybrid systems from temporal logic specifications.
- *From Structured English to Path Planning for Mobile Robots*
  Developed a framework for deriving hybrid controllers for path planning for mobile robots from structured English. The framework uses as intermediate formalism linear temporal logic and applies to motion planning of both dynamic and kinematic models of robots.
- *Modeling and Development of Unmanned Aerial Vehicles (UAV)*
  Developed aerodynamic and structural models of the Penn UAV platform. Designed and built parts of the Penn UAV platform.

- **Research Assistant**, Lab of Thermal Turbomachines, NTUA, Jan. – Nov. 2001, Greece
  - *Inverse design of airfoils using Ant Colony Optimization algorithms*
    Extended the discrete ant colony optimization algorithm to handle continuous optimization problems. Built a software toolbox for the application of the method to the problem of inverse design of airfoils.

PUBLICATIONS

Most of my publications are available on line at `http://www.public.asu.edu/~gfaineko/papers.html` through links to publishers and/or to preprint PDF files.

My own name appears in boldface. After my graduation in 2008: Graduate students whose thesis I supervise/ed or whose research I funded, appear in boldface and underlined. Undergraduate students whose thesis I supervise/ed or whose research I funded, appear in boldface and double underlined. The names of industrial collaborators are indicated with a †. Other students that I have collaborated with are indicated by a ‡.

For citation information see `http://scholar.google.com/citations?user=WGRYgBEAAAAJ&hl=en`.

Thesis

(Th1) **Georgios Fainekos**, Robustness of Temporal Logic Specifications, PhD Thesis, Department of Computer and Information Science, University of Pennsylvania, August 2008; Advisor: George J. Pappas; Committee: Rajeev Alur (Chair), Edmund M. Clarke (External), Insup Lee, and Oleg Sokolsky.

(Th2) **Georgios Fainekos**, Ant Colony Optimization: Applications to discrete and continuous problems, Diploma Thesis, Department of Mechanical Engineering, National Technical University of Athens, September 2001 (in Greek); Committee: K. Giannakoglou (Chair/Advisor), K. Mathioudakis, K. Papailiou.

Editorials

(E1) A. Abate and **G. Fainekos**, Proceedings of the 19th ACM International Conference on Hybrid Systems: Computation and Control, 2016

- A. Abate and **G. Fainekos**, Conference report: 19th ACM International Conference on Hybrid Systems: Computation and Control, *IEEE Control Systems*, 36 (5), 94-95, 2016

(E2) **G. Fainekos**, E. Goubault, F. Ivancic and S. Sankaranarayanan, Guest editors for the special issue on Numerical Software Verification of Cyber-Physical Software Systems in *ACM Transactions on Embedded Computing Systems*, V 11, I S2, Aug 2012

(E3) **G. Fainekos**, E. Goubault, S. Putot and S. Ratschan, Guest editors for the special issue on Numerical Software Verification in *Mathematics in Computer Science*, Vol. 5, N. 4, Springer 2011

Book Chapters

(BC1) E. Bartocci, J. Deshmukh, A. Donze, **G. Fainekos**, O. Maler, D. Nickovic, and S. Sankaranarayanan. Specification-based Monitoring of Cyber-Physical Systems: A Survey on Theory, Tools and Applications, *Lectures on Runtime Verification - Introductory and Advanced Topics*, LNCS 10457, pp 128-168, Springer, 2018

Peer-Reviewed Journal Publications

(J1) **Cumhur Erkan Tuncali**, **Georgios Fainekos**, Danil Prokhorov, Hisahiro Ito, James Kapinski, Requirements driven Test Generation for Autonomous Vehicles with Machine Learning Components. *IEEE Transactions on Intelligent Vehicles*, DOI 10.1109/TIV.2019.2955903, 2019.

(J2) **Shakiba Yaghoubi** and **Georgios Fainekos**, Worst-case Satisfaction of STL Specifications Using Feedforward Neural Network Controllers: A Lagrange Multipliers Approach. *ACM Transactions on Embedded Computing Systems*, V18, 5S, 2019.

(J3) **Adel Dokhanchi**, **Bardh Hoxha**, and Georgios Fainekos, Formal Requirement Debugging for Testing and Verification of Cyber-Physical Systems. *ACM Transactions on Embedded Computing Systems*, V17, I2, A34, 2018

(J4) **Bardh Hoxha**, **Adel Dokhanchi** and Georgios Fainekos, Mining Parametric Temporal Logic Properties in Model Based Design for Cyber-Physical Systems. *International Journal on Software Tools for Technology Transfer*, V20, I1, pp 79—93, 2018

(J5) **Cumhur Erkan Tuncali**, Georgios Fainekos and Yann-Hang Lee, Automatic Parallelization of Multi-rate Block Diagrams of Control Systems on Multi-core Platforms. *ACM Transactions on Embedded Computing Systems*, V16, I1, 2016

(J6) **Kangjin Kim**, **Georgios Fainekos** and Sriram Sankaranarayanan, On the Minimal Revision Problem of Specification Automata, *International Journal of Robotics Research*, vol. 34, no. 12, pp 1515-1535, October 2015

(J7) **H. Abbas**, **G. Fainekos**, S. Sankaranarayanan, F. Ivancic†, and A. Gupta†, Probabilistic Temporal Logic Falsification of Cyber-Physical Systems, *ACM Transactions on Embedded Computing Systems*, V 12, I S2, May 2013

(J8) **G. Fainekos** and G. J. Pappas, Robustness of temporal logic specifications for continuous-time signals. *Theoretical Computer Science*, Elsevier, V 410, N 42, pp 4262-4291, 2009.

(J9) **G. Fainekos**, A. Girard, H. Kress-Gazit and G. J. Pappas, Temporal Logic Motion Planning for Dynamic Mobile Robots. *Automatica*, Elsevier, V 45, N 2, pp 343-352, 2009.

(J10) H. Kress-Gazit, **G. Fainekos** and G. J. Pappas, Temporal Logic-based Reactive Mission and Motion Planning. *IEEE Transactions on Robotics*, IEEE, V 25, N 6, pp 1370-1381, 2009.

(J11) H. Kress-Gazit, **G. Fainekos** and G. J. Pappas, Translating Structured English to Robot Controllers. *Advanced Robotics*, VSP\Brill Academic Publishers, V 22, N 12, pp 1343-1359, 2008. **(Invited paper)**

(J12) **G. Fainekos** and K. C. Giannakoglou, Inverse Design of Airfoils Based on a Novel Formulation of the Ant Colony Optimization Method. *Inverse Problems in Engineering*, Taylor & Francis, V 11, N 1, pp 21-38, 2003.

Peer-Reviewed Conference and Workshop Papers with Indexed Proceedings

(C1) **Sai Krishna Bashetty**, Heni Ben Amor, and **Georgios Fainekos**, DeepCrashTest: Turning Dashcam Videos into Virtual Crash Tests for Automated Driving Systems. *International Conference on Robotics and Automation (ICRA)*, 2020

(C2) **Cumhur Erkan Tuncali** and **Georgios Fainekos**, Rapidly-exploring Random Trees for Testing Automated Vehicles. *IEEE Intelligent Transportation Systems Conference (ITSC)*, 2019 **(Best paper award)**

(C3) **Mohammad Hekmatnejad**, **Shakiba Yaghoubi**, Adel Dokhanchi, Heni Ben Amor, Aviral Shrivastava, Lina Karam and **Georgios Fainekos**, Encoding and Monitoring Responsibility Sensitive Safety Rules for Automated Vehicles in Signal Temporal Logic, *17th ACM-IEEE International Conference on Formal Methods and Models for System Design (MEMOCODE)*, 2019 **(Nominated for best paper award)**

(C4) **Shakiba Yaghoubi** and **Georgios Fainekos**. Gray-box Adversarial Testing for Control Systems with Machine Learning Components, *ACM International Conference on Hybrid Systems: Computation and Control (HSCC)*, 2019 **(Best repeatability award)**

(C5) Logan Mathesen‡, **Shakiba Yaghoubi**, Giulia Pedrielli, and **Georgios Fainekos**. Falsification of Cyber-Physical Systems with Robustness Uncertainty Quantification Through Stochastic Optimization with Adaptive Restart, *IEEE International Conference on Automation Science and Engineering (CASE)*, Aug. 2019

(C6) **Mohammad Hekmatnejad**, Giulia Pedrielli, and **Georgios Fainekos**. Optimal Task Scheduling with Nonlinear Costs using SMT Solvers, *IEEE International Conference on Automation Science and Engineering (CASE)*, Aug. 2019

(C7) Alireza Inanlouganji‡, Giulia Pedrielli, **Georgios Fainekos**, and Sebastian Pokutta. Continuous simulation optimization with model mismatch using Gaussian process regression, *Winter Simulation Conference (WSC)*, IEEE, Dec. 2018

(C8) Adel Dokhanchi, Heni Ben Amor, Jyotirmoy V. Deshmukh, **Georgios Fainekos**. Evaluating Perception Systems for Autonomous Vehicles using Quality Temporal Logic, *Runtime Verification (RV)*, LNCS 11237, Springer, Nov. 2018

(C9) **Shakiba Yaghoubi** and **Georgios Fainekos**. Falsification of Temporal Logic Requirements Using Gradient Based Local Search in Space and Time, *IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)*, July 2018

(C10) Luan V Nguyen‡, Bardh Hoxha, Taylor T Johnson and **Georgios Fainekos**. Mission Planning for Multiple Vehicles with Temporal Specifications using UxAS, *IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)*, July 2018

(C11) **Cumhur Erkan Tuncali**, **Georgios Fainekos**, Hisahiro Ito, and James Kapinski. Simulation-based Adversarial Test Generation for Autonomous Vehicles with Machine Learning Components, *IEEE Intelligent Vehicles Symposium (IV)*, June 2018

(C12) **Mohammad Hekmatnejad** and **Georgios Fainekos**. Optimal LTL Planning for Multi-Valued Logics, *American Control Conference (ACC)*, Milwaukee, WI, June 2018

(C13) Mark Strickland‡, **Georgios Fainekos**, and Heni Ben Amor. Deep Predictive Models for Collision Risk Assessment in Autonomous Driving, *IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018

(C14) **Cumhur Erkan Tuncali**, Bardh Hoxha, Guohui Ding‡, **Georgios Fainekos**, and Sriram Sankaranarayanan, Experience Report: Application of Falsification Methods on the UxAS System, 10th NASA Formal Methods (NFM), LNCS 10811, Springer, Apr. 2018

(C15) **Adel Dokhanchi**, **Shakiba Yaghoubi**, **Bardh Hoxha,** and **Georgios Fainekos**, Vacuity Aware Falsification for MTL Request-Response Specifications, *IEEE International Conference on Automation Science and Engineering*, Xian, China, Aug. 2017 **(Invited paper)**

(C16) **Cumhur Erkan Tuncali**, **Shakiba Yaghoubi**, Theodore P. Pavlic, and **Georgios Fainekos**. Functional Gradient Descent Optimization for Automatic Test Case Generation for Vehicle Controllers, *IEEE International Conference on Automation Science and Engineering*, Xian, China, Aug. 2017 **(Invited paper)**

(C17) **Georgios Fainekos** and Herbert Glenn Tanner. Temporal Logic Control under Incomplete or Conflicting Information, *American Control Conference*, Seattle, WA, May 2017 **(Invited paper)**

(C18) **Shakiba Yaghoubi** and **Georgios Fainekos**. Hybrid Approximate Gradient and Stochastic Descent for Falsification of Nonlinear Systems, *American Control Conference*, Seattle, WA, May 2017

(C19) **Adel Dokhanchi**, **Bardh Hoxha**, **Cumhur Erkan Tuncali**, and **Georgios Fainekos**, An efficient algorithm for monitoring practical TPTL specifications. *14th ACM-IEEE International Conference on Formal Methods and Models for System Design*, Kanpur, India, November 2016 (**20% Acceptance Rate for regular papers**)

(C20) **Cumhur Erkan Tuncali**, Theodore P. Pavlic, and **Georgios Fainekos**, Utilizing S-TaLiRo as an Automatic Test Generation Framework for Autonomous Vehicles. *19th IEEE Intelligent Transportation Systems Conference*, Rio de Janeiro, Brazil, Nov. 2016

(C21) **Joseph Campbell**, Heni Ben Amor, Marcelo H. Ang Jr., and **Georgios Fainekos**, Traffic Light Status Detection Using Movement Patterns of Vehicles. *19th IEEE Intelligent Transportation Systems Conference*, Rio de Janeiro, Brazil, Nov. 2016

(C22) **Joseph Campbell**, **Cumhur Erkan Tuncali**, Peng Liu[‡], Theodore P. Pavlic, Umit Ozguner, and **Georgios Fainekos**, Modeling Concurrency and Reconfiguration in Vehicular Systems: A π-calculus Approach, *IEEE International Conference on Automation Science and Engineering*, Fort Worth, Texas, August 2016

(C23) **Wei Wei**, **Kangjin Kim**, and **Georgios Fainekos**, Extended LTLvis Motion Planning Interface. *IEEE International Conference on Systems, Man, and Cybernetics*, Budapest, Hungary, Oct. 2016

(C24) **Adel Dokhanchi**, **Bardh Hoxha**, and **Georgios Fainekos**, Metric Interval Temporal Logic Specification Elicitation and Debugging. In the proceeding of *13th ACM-IEEE International Conference on Formal Methods and Models for System Design*, Austin, Texas, September 2015

(C25) **Bardh Hoxha**, Nikolaos Mavridis, and **Georgios Fainekos**, VISPEC: A graphical tool for elicitation of MTL requirements. Proceedings of the *IEEE/RSJ International Conference on Intelligent Robots and Systems*, Hamburg, Germany, September 2015

(C26) **K. Kim**, **J. Campbell**, **W. Duong**, Y. Zhang, and **G. Fainekos**, DisCoF$^+$: Asynchronous DisCoF with Flexible Decoupling for Cooperative Pathfinding in Distributed Systems. *IEEE International Conference on Automation Science and Engineering*, Gothenburg, Sweden, August 2015

(C27) **C. E. Tuncali**, **G. Fainekos**, Y.-H. Lee, Automatic Parallelization of Simulink Models for Multi-core Architectures. 12th IEEE International Conference on Embedded Software and Systems, New York, NY, August 2015

(C28) **Houssam Abbas**, Hans Mittelmann and **Georgios Fainekos**, Formal property verification in a conformance testing framework. In the Proceedings of the *12th ACM-IEEE International Conference on Formal Methods and Models for System Design*, Lausanne, Switzerland, October 2014 (**28% Acceptance Rate for regular papers**)

(C29) **Adel Dokhanchi**, **Bardh Hoxha** and **Georgios Fainekos**, On-Line Monitoring for Temporal Logic Robustness, In the Proceedings of the *Runtime Verification*, Toronto, Canada, September 2014 (**30% Acceptance Rate**)

(C30) Yu Zhang, **Kangjin Kim** and **Georgios Fainekos**, DisCoF: Cooperative Pathfinding in Distributed Systems with Limited Sensing and Communication Range, In the Proc. of the *International Symposium on Distributed Autonomous Robotic Systems*, Daejeon, Korea, Nov 2014

(C31) **Kangjin Kim** and **Georgios Fainekos**, Revision of Specification Automata under Quantitative Preferences, In the Proc. of the *IEEE International Conference on Robotics and Automation*, Hong Kong, China, June 2014

(C32) **Houssam Abbas**, Andrew Winn[‡], **Georgios Fainekos**, and A. Agung Julius, Functional Gradient Descent Method for Metric Temporal Logic Specifications, In the Proceedings of the *American Control Conference*, Portland, OR, June 2014, (**Invited paper**)

(C33) **Houssam Abbas**, **Bardh Hoxha**, **Georgios Fainekos** and Koichi Ueda[†], Robustness-Guided Temporal Logic Testing and Verification for Stochastic Cyber-Physical Systems, In the Proceedings of the *IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems*, Hong Kong, China, June 2014 (**Finalist for Best Student Paper**)

(C34) **Houssam Abbas** and **Georgios Fainekos**, Computing Descent Direction of MTL Robustness for Non-Linear Systems, In the Proceedings of the *American Control Conference*, Washington DC, June 2013, (**Invited paper**)

(C35) **S. Srinivas**, **R. Kermani**, **K. Kim**, Y. Kobayashi and **G. Fainekos**, A Graphical Language for LTL Motion and Mission Planning, In the Proc. of the *IEEE International Conference on Robotics and Biomimetics*, Shenzen, China, Dec. 2013

(C36) **Kangjin Kim** and **Georgios Fainekos**, Minimal Specification Revision for Weighted Transition Systems, In the Proc. of the *IEEE International Conference on Robotics and Automation*, Karlsruhe, Germany, May 2013

(C37) **Hengyi Yang**, **Bardh Hoxha** and **Georgios Fainekos**, Querying Parametric Temporal Logic Properties on Embedded Systems, *Int. Conference on Testing Software and Systems*, Lecture Notes in Computer Science, Vol. 7641, pp 136-151, Springer 2012 **(33% Acceptance Rate)**

(C38) **Kangjin Kim** and **Georgios Fainekos**, Approximate Solutions for the Minimal Revision Problem of Specification Automata, In the Proc. of the *IEEE/RSJ International Conference on Intelligent Robots and Systems*, Vilamoura Algarve, Portugal, Oct. 2012

(C39) Sriram Sankaranarayanan and **Georgios Fainekos**, Simulating Insulin Infusion Pump Risks by In-Silico Modeling of the Insulin-Glucose Regulatory System, In the Proc. of the *10th Conference on Computational Methods in Systems Biology*, Lecture Notes in Computer Science, Vol. 7605, pp 322-341, Springer 2012

(C40) **Kangjin Kim**, **Georgios Fainekos** and Sriram Sankaranarayanan, On the Revision Problem of Specification Automata, In the Proceedings of the *IEEE Conference on Robotics and Automation*, St. Paul, Minnesota, May 2012, **(Invited paper)**

(C41) **Georgios Fainekos**, Sriram Sankaranarayanan, Koichi Ueda[†] and Hakan Yazarel[†], Verification of Automotive Control Applications using S-TaLiRo, In the Proceedings of the *American Control Conference*, Montreal, Canada, June 2012, **(Invited paper)**

(C42) Sriram Sankaranarayanan and **Georgios Fainekos**, Falsification of Temporal Properties of Hybrid Systems Using the Cross-Entropy Method, In the Proceedings of the *ACM International Conference on Hybrid Systems: Computation and Control*, Beijing, China, Apr. 2012

(C43) A. Chakarov[‡], S. Sankaranarayanan, and **G. Fainekos**, Combining Time and Frequency Domain Specifications For Periodic Signals, In the Proc. of *Runtime Verification*, Lecture Notes in Computer Science, Vol. 7186, pp 294-309, Springer 2012

(C44) **H. Abbas** and **G. Fainekos**, Linear Hybrid System Falsification Through Local Search, In the Proc. of *Automated Technology for Verification and Analysis*, Lecture Notes in Computer Science, Vol. 6996, pp 503-510, Springer 2011

(C45) Truong Nghiem[‡] and **Georgios E. Fainekos**, Computing Schedules for Time-Triggered Control using Genetic Algorithms, In the *Proceedings of the 18th IFAC World Congress*, Milan, Italy, Aug. 2011

(C46) **G. E. Fainekos**, Revising Temporal Logic Specifications for Motion Planning. In the *Proceedings of the 2011 IEEE International Conference on Robotics and Automation*, Shanghai, China, May 2011

(C47) **Y. S. R. Annapureddy** and **G. E. Fainekos**, Ant Colonies for Temporal Logic Falsification of Hybrid Systems, In the *Proceedings of the 36th Annual Conference of IEEE Industrial Electronics*, pp. 91-96, Glendale, AZ, Nov. 2010

(C48) Truong Nghiem[‡], S. Sankaranarayanan, **G. Fainekos**, F. Ivancic, A. Gupta and G. Pappas, Monte-Carlo Techniques for Falsification of Temporal Properties of Non-Linear Systems, In the *Proceedings of the 13th ACM Conference on Hybrid Systems: Computation and Control*, Stockholm, Sweden, Apr. 2010 **(28% Acceptance Rate)**

(C49) **G. E. Fainekos**, S. Sankaranarayanan, F. Ivancic and A. Gupta, Robustness of Model-based Simulations. *IEEE Real-Time Systems Symposium*, pp 345 - 354, Washington DC, Dec. 2009 **(21% Acceptance Rate)**

(C50) **G. E. Fainekos** and G. J. Pappas, MTL Robust Testing and Verification for LPV Systems. In the *Proceedings of the 2009 IEEE/AACC American Control Conference*, pp 3748 - 3753, St. Louis, Missouri, June 2009

(C51) **G. E. Fainekos** and G. J. Pappas, Robust Sampling for MITL Specifications. *In the 5th Inter. Conference on Formal Modeling and Analysis of Timed Systems*, Lecture Notes in Computer Science, Vol. 4763, pp 147-162, Springer 2007

(C52) **G. E. Fainekos**, A. Girard and G. J. Pappas, Hierarchical Synthesis of Hybrid Controllers from Temporal Logic Specifications. *Hybrid Systems: Computation and Control*, Lecture Notes in Computer Science, Vol. 4416, pp 203-216, Springer 2007 **(25% Acceptance Rate)**

(C53) A. A. Julius, **G. E. Fainekos**, M. Anand, I. Lee and G. J. Pappas, Robust test generation and coverage for hybrid systems. *Hybrid Systems: Computation and Control*, Lecture Notes in Computer Science, Vol. 4416, pp 329-342, Springer 2007 **(25% Acceptance Rate)**

(C54) H. Kress-Gazit, **G. E. Fainekos** and G. J. Pappas, From Structured English to Robot Motion. In the *Proceedings of the 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 2717-2722, San Diego, California, October 2007

(C55) H. Kress-Gazit, **G. E. Fainekos** and G. J. Pappas, Where's Waldo? Sensor-Based Temporal Logic Motion Planning. In the *Proceedings of the 2007 IEEE International Conference on Robotics and Automation*, pp. 3116-3121, Rome, Italy, April 2007 **(Finalist for best student paper, Invited paper)**

(C56) **G. E. Fainekos**, A. Girard and G. J. Pappas, Temporal Logic Verification Using Simulation. *In the 4th Inter. Conference on Formal Modeling and Analysis of Timed Systems*, Lecture Notes in Computer Science, Vol. 4202, pp 171-186, Springer 2006

(C57) **G. E. Fainekos** and G. J. Pappas, Robustness of Temporal Logic Specifications. *In the Workshop on Formal Approaches to Testing and Runtime Verification*, Lecture Notes in Computer Science, Vol. 4262, pp 178-192, Springer 2006

(C58) **G. E. Fainekos**, S. G. Loizou, G. J. Pappas, Translating temporal logic to controller specifications. In the *Proceedings of the 45th IEEE Conference on Decision and Control*, pp. 899-904, San Diego, California, December 2006

(C59) **G. E. Fainekos**, H. Kress-Gazit and G. J. Pappas, Hybrid Controllers for Path Planning: A Temporal Logic Approach. In the *Proceedings of the 44th IEEE Conference on Decision and Control*, pp. 4885-4890, Seville, Spain, December 2005

(C60) **G. E. Fainekos**, H. Kress-Gazit and G. J. Pappas, Temporal Logic Motion Planning for Mobile Robots. In the *Proceedings of the IEEE International Conference on Robotics and Automation*, pp. 2020-2025, Barcelona, Spain, April 2005

(C61) S. Bayraktar, **G. E. Fainekos** and G. J. Pappas, Experimental Cooperative Control of Fixed-Wing Unmanned Aerial Vehicles. In the *Proceedings of the 43rd IEEE Conference on Decision and Control*, pp. 4292-4298, The Bahamas, December 2004 **(Invited paper)**

Other Peer-Reviewed Publications

This category includes peer-reviewed: (1) software tool papers; (2) single or two day workshops; (3) tutorials and surveys for conference presentation; and (4) extended abstracts.

(W1) **Shakiba Yaghoubi** and **Georgios Fainekos**. Local Descent for Temporal Logic Falsification of Cyber-Physical Systems, *7th Workshop on Design, Modeling and Evaluation of Cyber Physical Systems (CyPhy 2017)*, LNCS 11267, pp 11-26, Springer 2019

(W2) **Cumhur Erkan Tuncali**, **Georgios Fainekos**, Hisahiro Ito, and James Kapinski. Sim-ATAV: Simulation-Based Adversarial Testing Framework for Autonomous Vehicles, 21st International Conference on Hybrid Systems: Computation and Control (HSCC), Apr. 2018

(W3) S. Sankaranarayanan, S. A. Kumar, F. Cameron, B. W. Bequette, **Georgios Fainekos** and D. Maahs, Model-Based Falsification of an Artificial Pancreas Control System, *ACM SIGBED Review - Special Issue on Medical Cyber Physical Systems workshop (MedicalCPS'16)*, V14, N2, pp 24-33, 2017

(W4) **Bardh Hoxha** and **Georgios Fainekos**, Planning in Dynamic Environments Through Temporal Logic Monitoring, *Workshops of the 30th AAAI Conference on Artificial Intelligence: Planning for Hybrid Systems*, Phoenix, Arizona, Feb. 2016

(W5) **Joseph Campbell**, **Cumhur Erkan Tuncali**, Theodore P. Pavlic and **Georgios Fainekos**, Toward Modeling Concurrency and Reconfiguration in Vehicular Systems. *9th Interaction and Concurrency Experience (ICE)*, Heraklion, Greece, June 2016

(W6) J. Deshmukh†, **G. Fainekos**, J. Kapinski†, S. Sankaranarayanan, A. Zutshi‡, Beyond single shooting: iterative approaches to falsification, In the Proceedings of the *American Control Conference*, July 2015

(W7) **B. Hoxha**, **H. Bach**, **H. Abbas**, **A. Dokhanchi**, Y. Kobayashi and **G. Fainekos**, Towards Formal Specification Visualization for Testing and Monitoring of Cyber-Physical Systems, *International Workshop on Design and Implementation of Formal Tools and Systems*, Lausanne, Switzerland, October 2014

(W8) **H. Abbas**, **B. Hoxha**, **G. Fainekos**, J. V. Deshmukh†, J. Kapinski†, and K. Ueda†, WiP Abstract: Conformance Testing as Falsification for Cyber-Physical Systems. In the Proceedings of the *ACM/IEEE 5th International Conference on Cyber-Physical Systems*, Berlin, Germany, April 2014

(W9) **Bardh Hoxha**, **Houssam Abbas** and **Georgios Fainekos**, Benchmarks for Temporal Logic Requirements for Automotive Systems, In the Proceedings of the *Applied Verification for Continuous and Hybrid Systems*, Berlin, Germany, April 2014

(W10) **Bardh Hoxha**, **Houssam Abbas** and **Georgios Fainekos**, Using S-TaLiRo on Industrial Size Automotive Models, In the Proceedings of the *Applied Verification for Continuous and Hybrid Systems*, Berlin, Germany, April 2014

(W11) **Y. S. R. Annapureddy**, **C. Liu**, **G. E. Fainekos** and S. Sankaranarayanan, S-TaLiRo: A Tool for Temporal Logic Falsification for Hybrid Systems, In the Proc. of *Tools and algorithms for the construction and analysis of systems (TACAS)*, LNCS, Vol. 6605, pp 254-257, Springer 2011

(W12) D. Del Vecchio, E. A. Lee, J.-F. Raskin, G. J. Pappas, **G. E. Fainekos**, D. Caveney and L. Caminiti, Partial Order Techniques for the Analysis and Synthesis of Hybrid and Embedded Systems. In the *Proceedings of the 46th IEEE Conference on Decision and Control*, pp. 156-170, New Orleans, Louisiana, December 2007

Invited Conference Papers (No peer review)

(I1) **Georgios Fainekos**, Bardh Hoxha and Sriram Sankaranarayanan, Robustness of Specifications and its applications to Falsification, Parameter Mining, and Runtime Monitoring with S-TaLiRo. *Runtime Verification (RV)*, LNCS 11757, pp 27-47, Springer 2019

(I2) Anand Balakrishnan‡, Aniruddh G. Puranic‡, Xin Qin‡, Adel Dokhanchi, Jyotirmoy V. Deshmukh, Heni Ben Amor, and **Georgios Fainekos**. Specifying and Evaluating Quality Metrics for Vision-based Perception Systems, *Design, Automation and Test in Europe (DATE)*, 2019

(I3) Houssam Abbas, Indranil Saha, Yasser Shoukry, Rudiger Ehlers, **Georgios Fainekos**, Rajesh Gupta, Rupak Majumdar, and Dogan Ulus. Embedded Software for Robotics: Challenges and Future Directions, *Embedded Software (EMSOFT)*, ACM, Oct. 2018

(I4) Fraser Cameron, **Georgios Fainekos**, David M. Maahs and Sriram Sankaranarayanan, Towards a Verified Artificial Pancreas: Challenges and Solutions for Runtime Verification, Proceedings of *Runtime Verification*, LNCS 9333, pp 1—15, Springer, 2015

(I5) **A. Dokhanchi**, A. Zutshi‡, **R. T. Srinivasa**, S. Sankaranarayanan, and G. Fainekos, Requirements driven falsification with coverage metrics. In the Proceedings of *Embedded Software (EMSOFT)*, Amsterdam, The Netherlands, Oct. 2015

(I6) S. Sankaranarayanan, C. Miller‡, R. Raghunathan‡, H. Ravanbakhsh‡ and **G. Fainekos**, Analyzing Insulin Infusion Pump Usage Strategies in Diabetic Patients, In the Proc. of *50th Annual Allerton Conference on Communication, Control, and Computing*, Monticello, IL, Oct. 2012

(I7) **H. Abbas** and **G. Fainekos**, Convergence Proofs for Simulated Annealing Falsification of Safety Properties, In the Proc. of *50th Annual Allerton Conference on Communication, Control, and Computing*, Monticello, IL, Oct. 2012

(I8) A. Banerjee‡, S. K. S. Gupta, **G. Fainekos**, and G. Varsamopoulos, Towards Modeling and Analysis of Cyber-Physical Medical Systems. In Proc. of the *4th International Symposium on Applied Sciences in Biomedical and Communication Technologies*, Barcelona, Spain, 2011

Other Publications & Competition Reports

This category includes extended abstracts and competition reports with rudimentary peer-review:

(OP1) Gidon Ernst, Paolo Arcaini, Alexandre Donze, **Georgios Fainekos**, Logan Mathesen‡, Giulia Pedrielli, **Shakiba Yaghoubi**, Yoriyuki Yamagata, and Zhenya Zhang‡, ARCH-COMP 2019 Category Report: Falsification, *6th International Workshop on Applied Verification of Continuous and Hybrid Systems*, EPiC Series in Computing, V61, pp. 129-140, 2019

(OP2) Alireza Inanlouganji‡, **Shakiba Yaghoubi**, **Georgios Fainekos**, and Giulia Pedrielli. Falsification of cyber-physical systems through multi-fidelity stochastic optimization, *5th International Workshop on Symbolic-Numeric methods for Reasoning about CPS and IoT (SNR)*, 2019

(OP3) **Cumhur Erkan Tuncali** and **Georgios Fainekos**. Rapidly-exploring Random Trees for Testing Automated Driving Systems, *4th Workshop on Monitoring and Testing of Cyber-Physical Systems (MT-CPS)*, 2019

(OP4) Adel Dokhanchi, **Shakiba Yaghoubi**, Bardh Hoxha, **Georgios Fainekos**, Gidon Ernst, Zhenya Zhang‡, Paolo Arcaini, Ichiro Hasuo, Sean Sedwards. ARCH-COMP 2018 Category Report: Results on the Falsification Benchmarks, *5th International Workshop on Applied Verification of Continuous and Hybrid Systems*, EPiC Series in Computing, V54, pp. 104-109, 2018

(OP5) **Adel Dokhanchi**, **Shakiba Yaghoubi**, **Bardh Hoxha**, **Georgios Fainekos**, ARCH-COMP17 Category Report: Preliminary Results on the Falsification Benchmarks. *ARCH@CPSWeek* 2017: 170-174

(OP6) **Bardh Hoxha** and **Georgios Fainekos**, Pareto Front Exploration for Parametric Temporal Logic Specifications of Cyber-Physical Systems. *1st Workshop on Monitoring and Testing of Cyber-Physical Systems (MT-CPS)*, Vienna, Austria, April 2016

(OP7) **Adel Dokhanchi**, **Bardh Hoxha** and **Georgios Fainekos**, MITL Specification Debugging for Monitoring of Cyber-Physical Systems. *1st Workshop on Monitoring and Testing of Cyber-Physical Systems (MT-CPS)*, Vienna, Austria, April 2016

Selected Technical Reports & Extended Versions of Peer Reviewed Publications

This category includes selected technical reports and extended versions of refereed papers:

(TR1) **Mohammad Hekmatnejad**, Andrew M. Simms and **Georgios Fainekos**, CQL Verifier: Toward Model Checking Clinical Decision Support Systems Using SMT, *arXiv:1901.04545*, 2019

(TR2) **Cumhur Erkan Tuncali** and **Georgios Fainekos**. Rapidly-exploring Random Trees-based Test Generation for Autonomous Vehicles, *arXiv:1903.10629*, 2019

(TR3) **Shakiba Yaghoubi** and **Georgios Fainekos**. Local Descent For Temporal Logic Falsification of Cyber-Physical Systems (Extended Technical Report), *Technical report arXiv:1802.04866*, 2018

(TR4) **Adel Dokhanchi**, **Bardh Hoxha** and **Georgios Fainekos**, Formal Requirement Elicitation and Debugging for Testing and Verification of Cyber-Physical Systems (Extended Version). *Technical report arXiv:1607.02549*, 2018

(TR5) **B. Hoxha**, **A. Dokhanchi** and **G. Fainekos**, Mining Parametric Temporal Logic Properties in Model Based Design for Cyber-Physical Systems (Extended Version). *Technical report arXiv:1512.07956v3*, 2016

(TR6) **Bardh Hoxha**, Nikolaos Mavridis, and **Georgios Fainekos**, VISPEC: A graphical tool for elicitation of MTL requirements (Extended Version). *Technical report arXiv:1508.00618*, 2015

(TR7) **Houssam Abbas** and **Georgios Fainekos**, Towards composition of conformant systems, *Technical Report arXiv:1511.05273*, 2015

(TR8) **Kangjin Kim**, **Georgios Fainekos** and Sriram Sankaranarayanan, On the Minimal Revision Problem of Specification Automata. *Technical Report arXiv:1404.2289*, 2014

(TR9) **Kangjin Kim** and **Georgios Fainekos**, Revision of Specification Automata under Quantitative Preferences, *Technical Report arXiv:1402.3611*, 2014

(TR10) **H. Abbas**, **B. Hoxha**, **G. Fainekos**, J. V. Deshmukh†, J. Kapinski†, and K. Ueda†, Conformance Testing as Falsification for Cyber-Physical Systems. *Technical Report arXiv:1401.5200*, 2014

(TR11) **Houssam Abbas** and **Georgios Fainekos**, Linear Hybrid System Falsification With Descent. *Technical Report arXiv:1105.1733*, 2011

(TR12) **G. E. Fainekos** and G. J. Pappas, Robustness of Temporal Logic Specifications for Finite State Sequences in Metric Spaces. *Technical Report MS-CIS-06-05*, Department of CIS, University of Pennsylvania, May 2006

(TR13) **Georgios E. Fainekos**, An Introduction to Multi–Valued Model Checking. *Technical Report MS-CIS-05-16*, Department of CIS, University of Pennsylvania, September 2005

(TR14) S. Bayraktar, **G. E. Fainekos** and G. J. Pappas, Hybrid Modeling and Experimental Cooperative Control of Multiple Unmanned Aerial Vehicles. *Technical Report MS-CIS-04-32*, Department of CIS, University of Pennsylvania, December 2004

Granted Patents

(P1) U.S. Patent Application No 15/721,243, filed on 9/29/2017. (**Fainekos**, "Automated Test Generation For Structural Coverage For Temporal Logic Falsification Of Cyber-Physical Systems")

Expired Patents

(P1) U.S. Patent Application No 12/708,651, Publication No US 2010/0299651 A1 (published Nov. 25, 2010) (**Fainekos** et al., "Robust Testing for Discrete-Time and Continuous-Time System Models")

Patent Applications

(PA1) U.S. Patent Application No 16/122,770 filed on 2018-09-05 Tuncali et al, "Model predictive adaptive cruise control for reducing rear-end collision risk with follower vehicles"

(PA2) U.S. Patent Application No 15/034,979, filed May 2016. (**Fainekos** et al., "Temporal Logic Guided Testing for Cyber-Physical Systems")

Provisional Patent Applications

(PP1) U.S. Provisional Patent Application No 62/401,989, filed on 9/30/2016. (**Fainekos**, "Automated Test Generation For Structural Coverage For Temporal Logic Falsification Of Cyber-Physical Systems")

(PP2) U.S. Provisional Patent Application No 61/900,866, filed on 11/6/2013. (**Fainekos** et al., "Guided Temporal Logic Testing of Cyber-Physical Systems")

(PP3) U.S. Provisional Patent Application No 61/890,368, filed on 10/14/2013. (**Srinivas** et al., "A graphical language and graphical user interface for linear temporal logic (LTL) motion and mission planning")

(PP4) U.S. Provisional Patent Application No 61/835,352, filed on 6/14/2013. (**Yang** et al., "Querying Parametric Temporal Logic Properties on Embedded Systems")

RELEASED SOFTWARE

More information and links to software repositories can be found on my web-site:
`http://www.public.asu.edu/~gfaineko/research.html#software`

Software Toolboxes

1. **Persephone** is a MATLAB toolbox that implements monitoring algorithms for streams of data generated by perception systems against Timed Quality Temporal Logic (TQTL) specifications. It is built on the S-TaLiRo code base.

   `https://bitbucket.org/cps_vida/persephone/src/master/`

2. **Sim-ATAV** (Simulation-based Adversarial Test generation framework for Autonomous Vehicles): Sim-ATAV is a simulation-based adversarial testing framework that supports methods used to evaluate Cyber-Physical Systems, such as search-based test case generation and automated falsification guided from formal requirements. It is an add-on to the Matlab toolbox S-TaLiRo and it uses open source Webots robotics simulator for simulating vehicles.

   `https://sites.google.com/a/asu.edu/s-taliro/s-taliro/sim-atav`

3. **CQLVerifier** is a translator and model checker for Clinical Quality Language (CQL) expressions that are represented in Clinical Decision Support Knowledge Artifact Specifications as Expression Logical Models (ELM). Our tool parses and translates Logical Expressions in ELM into Satisifbility Modulo Theory (SMT) code. We use Z3 SMT solver in order to check the satisfiability of the SMT code.

   `https://cpslab.assembla.com/spaces/cqlverifier/wiki`

4. **TALIRO (TemporAl LogIc RObustness)** tools is a suit of software tools for the analysis of continuous and hybrid dynamical systems using linear time temporal logics and their time constraint variants. Currently, the following tools are distributed on the web-page:

   `https://sites.google.com/a/asu.edu/s-taliro/`

   - S-TaLiRo (Systems TALIRO) is a software toolbox for Matlab for the temporal logic falsification of Hybrid Automata and Matlab/Simulink models.
   - TaLiRo is a software toolbox for Matlab for the temporal logic robustness analysis of discrete time signals that take values in metric spaces. It is distributed with S-Taliro and it can be utilized for both off-line and on-line testing and monitoring.

In 2012 and 2014, S-TaLiRo was nominated by the industry as a technological breakthrough for research contacted within the ASU National Science Foundation Industry-University Collaborative Research Center (NSF/IUCRC) Center for Embedded Systems (CES). The nominations can be found in the reports:

`http://faculty.washington.edu/scottcs/NSF/2012/NSF_Compendium_2012-WEB.pdf`

`http://faculty.washington.edu/scottcs/NSF/2014/NSF_Compendium_2014.pdf`

5. **Temporal Logic Minimal Specification Revision and Planning (MSRP) Toolbox** is a toolbox that provides tools for Linear Temporal Logic (LTL) planning and specification revision. It supports weighted finite system abstractions and specifications with user preferences.

   `https://www.assembla.com/spaces/temporal-logic-specification-revision-and-planning-toolbox/wiki`

6. **DisCoF** is a software toolbox for cooperative pathfinding in distributed robotic systems with limited sensing and communication range. DisCof targets applications where large numbers of robots must navigate in clattered environments. In such scenarios, the robots will need to locally coordinate and collaborate in order to be able to resolve deadlocks.

   `https://www.assembla.com/spaces/discof/wiki`

7. **Model-Based Development for Multi-iRobot Toolbox (MBDMIRT)** is a Matlab/Simulink toolbox for the simulation of multiple iRobots where the control logic is defined using Stateflow charts. MBDMIRT can also be used for controlling groups of physical iRobots.

   `https://www.assembla.com/code/mbdmirt/subversion/nodes`

8. **LTLvis** is a graphical specification environment to create high level motion plans to control robots by converting a visual representation of the motion/task plan into an Linear Temporal Logic specification. The visual interface is built on the Android tablet platform and provides functionality to create task plans through a set of well defined gestures and on screen controls.

   `https://www.assembla.com/spaces/ltlvis/wiki`

9. **Simulink/Stateflow Interface for NAO** allows the Model Based Development of NAO software. The main benefit of the interface is that it allows both remote control of the NAO robot as well as code generation in a transparent way.

   `https://www.assembla.com/spaces/simulink-stateflow-interface-for-nao/wiki`

10. **LTL2BA_CPSLab** is a modification of the popular LTL2BA tool so it can be used in specification revision applications. LTL2BA translates Linear Temporal Logic (LTL) specifications into finite automata with Buchi acceptance conditions. LTL2BA_CPSLab also provides information regarding which atomic propositions map to which symbols on the finite automaton.

    `https://www.assembla.com/code/ltl2ba_cpslab/git/nodes`

PRESENTATIONS

Note: Presentations given at the conferences listed above are not mentioned in this section. Some selected presentations can be found at: `http://www.public.asu.edu/~gfaineko/papers.html`.

Invited Colloquia and Talks

1. *Temporal Logic Robustness: Applications to Synthesis and Analysis of Autonomous Systems*, University of California Santa Cruz, Santa Cruz, November 2018

2. *Temporal Logic Planning for Mobile Robots: What happens when missions cannot be satisfied?*, National Institute of Informatics (NII), Tokyo, Japan, June 2018

3. *Temporal Logic Planning for Mobile Robots: What happens when missions cannot be satisfied?*, University of Maryland, College Park, Feb. 2018

4. *Beyond Requirements Falsification: Semi-formal methods and tools for the analysis of Cyber-Physical Systems*, National Institute of Informatics (NII), Tokyo, Japan, June 2017
5. *Beyond Requirements Falsification: Semi-formal methods and tools for the analysis of Cyber-Physical Systems*, University of Southern California, Los Angeles, Feb. 2017
6. *Beyond Requirements Falsification: Semi-formal methods and tools for the analysis of Cyber-Physical Systems*, University of Colorado, Boulder, Oct. 2016
7. *Specification guided testing and verification for Cyber-Physical Systems*, University of California, San Diego, Mar. 2015
8. *Specification guided testing and verification for Cyber-Physical Systems*, University of New Mexico, Albuquerque, Mar. 2015
9. *Formal property verification in a conformance testing framework*, TU Delft, Delft, Netherlands, November 2014
10. *Temporal Logic Testing and Verification for Cyber-Physical Systems*, University of Tokyo, Tokyo, Japan, June 2014
11. *Temporal Logic Testing and Verification for Cyber-Physical Systems*, University of Arizona, Tuscon, AZ, April 2014
12. *Graphical Interfaces and Automated User Feedback for Temporal Logic Motion Planning*, KTH Stockholm, Sweden, Mar. 2014
13. *Temporal Logic Testing and Verification for Cyber-Physical Systems*, Boston University, Boston, MA, June 2013
14. *Temporal Logic Testing and Verification for Cyber-Physical Systems*, KTH, Stockholm, Sweden, Nov. 2012
15. *Temporal Logic Testing and Verification for Cyber-Physical Systems*, Lund University, Lund, Sweden, Nov. 2012
16. *Robust testing and Testing robustness for Cyber-Physical Systems*, Department of Electrical Engineering, University of California at Los Angeles, CA, June 2011
17. *Robust testing and Testing robustness for Cyber-Physical Systems*, Department of Computer Science and Engineering, Washington University, USA, September 2010
18. *Testing and Verification of Cyber-Physical Systems*, Department of Computer Science, Columbia University, USA, May 2008
19. *Testing and Verification of Cyber-Physical Systems*, Department of Computer Science and Engineering, Arizona State University, USA, April 2008
20. *Cyber-Physical Systems: Theory and Applications*, Department of Electrical and Computer Engineering, Stevens Institute of Technology, USA, February 2008
21. *Robustness of Temporal Logic Specifications (and an application to verification using simulation)*, Verimag, Grenoble, France, September 2006

Invited Workshop Presentations, Invited Panels and Invited Working Groups

1. *Gray-box Adversarial Testing for Control Systems with Machine Learning Components* CMU Workshop on CPS Verification & Validation Industrial Challenges & Foundations: Safe Learning and Optimization Pittsburgh, USA, Dec 2019
2. Panelist *Autonomous Navigation*, Mathworks Research Faculty Summit, Boston, USA, June 2019

3. *Specifications for robotics & RSS Model: Formalization with Temporal Logics for testing, verification and control*, Dagstuhl Seminar on "Specification Formalisms for Modern Cyber-Physical Systems", Dagstuhl, Germany, Feb. 2019
4. Expert Panel *Explainable Artificial Intelligence*, Mathworks Research Faculty Summit, Boston, USA, June 2018
5. *Teaching theoretical foundations of Cyber-Physical Systems*, Cyber-Physical Security Education Workshop, Paris, France, July 2017
6. *On-line and off-line Temporal Logic Planning under Incomplete or Conflicting Information*, RSS Workshop on Integrated Task and Motion Planning, Boston, MA, July 2017
7. *Reverse Testing in CPS Model Based Robust Testing*, National Institute for Informatics (NII) Shonan Meeting: Reverse Execution in Testing, Shonan, Japan, July 2017
8. Overview Talk: Formal Methods in Hybrid System Synthesis and Verification, Workshop on Verification and Synthesis of Hybrid Systems, University of Texas at Austin, June 2017
9. Data-driven synthesis and/or search-driven synthesis, Dagstuhl Seminar on "Formal Synthesis of Cyber-Physical Systems", Dagstuhl, Germany, May 2017
10. *Formal Specification Debugging for Monitoring and Testing of Cyber-Physical Systems*, Dagstuhl Seminar on "Symbolic-Numeric Methods for Reliable and Trustworthy Problem Solving in Cyber-Physical Domains", Dagstuhl, Germany, Dec. 2016
11. *Automatic Test Generation for Autonomous Vehicular Systems*, Dagstuhl Seminar on "Robustness in Cyber-Physical Systems", Dagstuhl, Germany, Sep. 2016
12. *Formal requirement elicitation and debugging for testing and verification of cyber-physical systems*, Verification and Validation of Cyber-Physical Systems, Reykjavik, Iceland, Jun. 2016
13. *Formal property verification in a conformance testing framework*, The First Workshop on Design and Analysis of Robust Systems, CPSWeek, Vienna, Austria, Apr. 2016
14. Presentation on *Collaborative Vehicular Systems* and panel discussion on *Transportation CPS*, NSF CPS PI Meeting, Arlington, Virginia, Nov. 2015
15. *Requirements driven falsification with coverage metrics*, Embedded Software, ESWeek, Amsterdam, The Netherlands, Oct. 2015
16. *On-Line Monitoring for Temporal Logic Robustness*, Safe and Secure Systems and Software Symposium (S5), Dayton, Ohio, June 2015
17. Directors' roundtable on *Medical Devices*, Mathworks Research Faculty Summit, Boston, USA, June 2015
18. Chair of Working Group on *Discrete Event Systems*, Mathworks Research Faculty Summit, Boston, USA, June 2015
19. *Formal property verification in a conformance testing framework*, Toyota CPS Summit 2014, Los Angeles, CA, Dec. 2014
20. *Specification guided testing and verification for Cyber-Physical Systems*, Dagstuhl Seminar on "Automated Planning and Model Checking", Dagstuhl, Germany, Nov. 2014
21. *Descending MTL Robustness*, Dagstuhl Seminar on "Verification of Cyber-Physical Systems", Dagstuhl, Germany, Mar. 2014
22. Working Group on "Test, Evaluation, Verification and Validation for Autonomy", Wright Brothers Institute, Dayton, OH, Jan. 2014

23. Working Group on "Testing and Verification", NSF Workshop on Transportation Cyber-Physical Systems, D.C., USA, Jan. 2014
24. Temporal Logic Testing, Verification and Motion Planning for Robotic Systems (talk, software tool demonstration and poster), 4th Workshop on Formal Methods for Robotics and Automation, Berlin, Germany, June 2013
25. Chair of Working Group on *The importance of tools in establishing an engineered systems science*, Mathworks Research Faculty Summit, Boston, USA, June 2013
26. Presentation and panelist in session *Potential Roles of Computing Clouds in CPS Control*, NSF Workshop on Cloud Computing for Cyber-Physical Systems, Washington DC, USA, Mar. 2013
27. *Automatically Modifying Conflicting Specifications*, Safe and Secure Systems and Software Symposium (S5), Fairborn, Ohio, June 2012
28. *Temporal Logic Testing for Hybrid Systems*, National Institute for Informatics (NII) Shonan Meeting: Hybrid Systems - Theory and Practice, Seriously, Shonan, Japan, April 2012
29. *Verification of Control Applications using S-TaLiRo*, Workshop on Control systems and software Verification and Validation, Georgia Tech, Oct. 2011

Invited Talks and Outreach to Industry

1. *Temporal Logic as a High Level Specification Language: Applications to Cyber-Physical System Analysis, Planning, and Control*, United Technologies Research Center, Hartford, CT, May 2017
2. *Specification guided testing and verification for Cyber-Physical Systems*, United Technologies Research Center, Hartford, CT, Nov. 2014
3. *Specification guided testing and verification for Cyber-Physical Systems*, Model Based Systems Engineering and Model Based safety Analysis Seminar, Boeing, Nov. 2014
4. *Testing and Verification of Cyber-Physical Systems*, NEC Laboratories, USA, March 2008

Invited Sessions at Conferences (Presentation only)

1. *Temporal Logic Testing for Cyber-Physical Systems*, INFORMS Annual Meeting, Phoenix, AZ, Oct. 2012

Summer Schools and Tutorials

1. *Robustness of Specifications and its applications to Falsification, Parameter Mining, and Runtime Monitoring with S-TaLiRo*, Runtime Verification, Oct. 2019
2. *Specification guided testing and verification for Cyber-Physical Systems*, 7th Halmstad Summer School on Testing, June 2017
3. *Automotive control design bug-finding with the S-TaLiRo tool*, Tutorial session on "Simulation-Guided Approaches for Verification of Automotive Powertrain Control Systems", American Control Conference, Chicago, USA, July 2015
4. *Temporal Logics over Lattices and Applications*, Tutorial session on "Partial order techniques for the analysis and synthesis of hybrid and embedded systems", IEEE Conference on Decision and Control, New Orleans, USA, December 2007

ASU Seminars, Workshops and Guest Lectures

1. *Autonomy for Cyber-Physical Systems: In search for safety through requirements*, Sensor, Signal & Information Processing (SenSIP) Industry Consortium, ASU, Mar. 2019
2. *Adversarial Test Generation for Automated Vehicles*, ASU Southwest Robotics Symposium (SWRS), 2019
3. *Planning and Testing for Autonomous Vehicles*, ASU Southwest Robotics Symposium (SWRS), 2018
4. *Your car run's on code: Can you trust it?*, ASU Math Club, ASU, Sept. 2014
5. *Your car run's on code: Can you trust it?*, SCIDSE Faculty Seminar Series, ASU, Sept. 2014
6. *Model based design for Cyber-Physical Systems*, Professional Seminar, Nanoscience and Nanotechnology, ASU, Apr. 2013
7. *Ensuring that agile robots can maximally accomplish their tasks*, Piper Health Solutions Workshop on Rehabilitation Robotics, ASU, Feb. 2013
8. *Ensuring that agile robots can maximally accomplish their tasks*, Computational Mathematics Seminar, ASU, Jan. 2013
9. *Temporal Logic Testing and Verification for Cyber-Physical Systems*, Dynamics and Controls Colloquium, ASU, Dec. 2012

Defenses

1. *Robustness of Temporal Logic Specifications*, PhD thesis defense, University of Pennsylvania, USA, June 2008. Committee: Rajeev Alur (Chair), Edmund M. Clarke (External), Insup Lee, and Oleg Sokolsky
2. *Multi–Valued Model Checking*, In-depth examination, University of Pennsylvania, USA, June 2005 Committee: Rajeev Alur (Chair), Insup Lee and George J. Pappas
3. *Ant Colony Optimization: Applications to discrete and continuous problems*, Thesis defense, National Technical University of Athens, Greece, September 2001 Committee: K. Giannakoglou (Chair), K. Mathioudakis, K. Papailiou

Selected Posters

1. **Houssam Abbas**, **Bardh Hoxha**, **Georgios Fainekos** and Koichi Ueda†, Robustness-Guided Temporal Logic Testing for Stochastic Hybrid Systems, *International Conference on Hybrid Systems: Computation and Control*, Berlin, Germany, April 2014
2. **H. Abbas**, **B. Hoxha**, **G. Fainekos**, J. V. Deshmukh†, J. Kapinski†, and K. Ueda†, Conformance Testing as Falsification for Cyber-Physical Systems. *ACM/IEEE 5th International Conference on Cyber-Physical Systems*, Berlin, Germany, April 2014
3. H. Kress-Gazit, **G. E. Fainekos** and G. J. Pappas, Temporal Logic Motion Planning for Mobile Robots, *Hybrid Systems : Computation and Control*, Santa Barbara, California, March 2006
4. **G. E. Fainekos**, H. Kress-Gazit and G. J. Pappas, Temporal Logic Motion Planning for Mobile Robots, *Graduate Research Symposium*, University of Pennsylvania, March 2005 **(Best poster award)**

TEACHING EXPERIENCE

- **Instructor**, Arizona State University, USA
  - **CSE 355 (Spring 2020): Introduction to Theoretical Computer Science**
    Evaluation: Course: ?/5, Instructor: ?/5, Responses: ?/128, ?%

– **CSE 494 (Fall 2019): Introduction to Mobile Robotics**
Evaluation: Course: 4.66/5, Instructor: 4.74/5, Responses: 19/80, 23.75%
Number of students: 80; Some student comments: ** Flexible but heavily guided [course]. * The relevance to the real world and industries. Instructor used great examples throughout the lectures. * The projects are pretty difficult so when you start seeing real progress from your work its really gratifying. * Finally finding a use for all the math that I never had a use for before. * [...] I thought the homework assignments were the perfect level of challenge. * [...] I liked how responsive the professor was on Piazza. * Dr. Fainekos is one of the best computer science professors I've had at ASU. He was always willing to help me understand course concepts (even outside of office hours) and takes the time to make sure I really get it, creatively finding new ways to explain. **

– **CSE 591 (Spring 2019): Cyber-Physical Systems: Modeling, Verification and Synthesis**
Evaluation: Course: 4.61/5, Instructor: 4.8/5, Responses: 5/12, 41.67%
Number of students: 12; Some student comments: ** Loved this course. Learned so much. I really wish the course was divided into two part if possible. * One of the best courses ever I have taken at ASU.*

– **CSE 494 (Fall 2018): Introduction to Mobile Robotics**
Evaluation: Course: 4.4/5, Instructor: 4.7/5, Responses: 9/63, 14.29%
Number of students: 63; Some student comments: ** Dr. Fainekos is a fun teacher! * The ideas in the course felt pretty advanced and it felt like the students got a taste of what a graduate level course would feel like to take. * Dr. Fainekos is a very good teacher with a lot of passion for the subject. * Professor is really good, he knows his lessons very well and he enjoys teaching the course. * He also likes engaging students to go to Robotics events and learning more about by providing information. * Dr. Fainekos is an incredible professor and his enthusiasm for robotics was clear and really inspiring throughout the class. * His more hands-on approach brought these difficult concepts to life and he made an effort to ensure that everyone understood what was being discussed. I cannot recommend Dr. Fainekos enough and I hope to one day take another class of his. * Would highly recommend this course to robotics enthusiasts*

– **CSE 355 (Spring 2018): Introduction to Theoretical Computer Science**
Evaluation: Course: 4.63/5, Instructor: 4.77/5, Responses: 24/125, 19.2%
Number of students: 125; Some student comments: ** It really stimulated thinking and I could finally see some good outside world applications for this course, much more than I would see with other course topics. * The instruction is phenomenal, from both the professor and the teaching assistant. * The material of the course, which can at times seem like it will be boring and dry, is made to be exciting because the instructor makes a point to emphasize its relevance to and significance in our field of study * Quite a rarity to find, Professor Fainekos had a genuine passion not only in his subject but in teaching his students. * There were no wrong questions in his class and I noticed, not only in myself, but the entire class was noticeably more interactive with each other and the professor than in any other class I've ever seen. * His teaching methods kept the class instructed during lectures while maintaining a friendly atmosphere. * The way this courses uses piazza is fantastic. * This class was set up in a way to get students to really learn the material and develop an interest * A truly wonderful course with a quality almost unheard of. Definitely one of the best-structured CS courses I've taken at ASU. * Overall, an outstanding professor that truly promoted a positive environment to learn. Engaging the class as a whole, he is easily one of the best professors in the department. * While I still don't like proofs, I must say, the class was a lot more interesting than I first thought it would be. * He was always helpful in answering questions and did his best to make sure you did not feel stupid in his class even though you really were stupid in his class.*

– **CSE 355 (Fall 2017): Introduction to Theoretical Computer Science**
Evaluation: Course: 4.7/5, Instructor: 4.79/5, Responses: 22/122, 18.03%
Number of students: 122; Some student comments: ** I've never felt so enthusiastic about giving positive feedback for a course. When I saw we could nominate our professors for outstanding teacher I immediately wrote a lengthy response as to why Dr.Fainekos should be outstanding teacher. * There was so much material provided and requirements were so clear that I would honestly be excited to take the exams. * Lectures have recordings from previous classes. And piazza is extremely helpful. **

*Dr. Fainekos takes his time with harder subjects, and always makes sure to gauge where everyone is at by posting questions on piazza (which are later discussed). * There is a plethora of supplementary materials you can use outside of lecture to get help, such as JFLAP, online lecture videos, and multiple practice exams and quizzes. * Very challenging material, group homework stimulated thinking * Professor was enthusiastic and the use of Piazza made the class feel approachable.*

- **ASU 101 (Spring 2017)**
  Evaluation: Course: 4.2/5, Instructor: 4.38/5, Responses: 9/21, 42.86%
- **CSE 591 (Spring 2016): Cyber-Physical Systems: Modeling, Verification and Synthesis**
  Evaluation: Course: 4.93/5, Instructor: 4.7/5, Responses: 6/7, 85.71%
- **CSE 494 (Fall 2015): Introduction to Mobile Robotics**
  Evaluation: Course: 4.26, Instructor: 4.39, Responses: 11/24, 45.83%
  Number of students: 24; Some student comments: ** Very interesting subject, interesting lectures. * Professor made a strong effort to continuously modify and tailor the materials to the students throughout the semester. * I enjoyed the homework assignments and I really enjoyed creating my own project INSTEAD of taking an exam!*
- **CSE 355 (Spring 2015): Introduction to Theoretical Computer Science**
  Evaluation: Course: 4.54, Instructor: 4.69, Responses: 40/115, 34.78%
  Number of students: 125; Some student comments: ** The class was very organized. The materials were explained very well. Lots of examples for assignments and sample exams were provided. * How well organized it was. The material can be both dull and obscure at times but Professor Fainekos presented it in an extremely learnable way. * Instructor's enthusiasm when presenting topics in lecture * The topics interest me, and they were presented in a way that promoted solid understanding, rather than memorization. * Optional project was real eye opener; plus I will get extra credit for that. * Thanks for making a good course where I actually learned and wasn't miserable * Very good, one of my favorite classes. Do not change course structure at all*
- **CSE 574 (Fall 2014): Planning and Learning Methods in AI**
  Evaluation: Course: 4.37/5, Instructor: 4.36/5, Responses: 10/15, 67%
  Number of students: 15; Some student comments: ** Fascinating topics, particularly the robotics stuff. * The content is interesting. Gives a good start to understand how to present and do projects. * Professor used very good ideas and material to develop student's interest in the course.*
- **CSE 355 (Spring 2014): Introduction to Theoretical Computer Science**
  Evaluation: Course: 4.48/5, Instructor: 4.56/5, Responses: 39/97, 40%
  Number of students: 97; Some student comments: ** The course structure is gold standard. * [Dr. Fainekos] provides TONS of resources and uses technology effectively in lecture. He is enthusiastic and manages to interest students in what would otherwise be fairly boring content. * The effort the professor put into relating the theoretical material to application was very nice. This is especially important in a theory class because its easy to get lost in the level of abstractness. * Dr Fainekos is an excellent teacher, probably the most prepared instructor I have studied under at ASU. * Even though I'm not particularly interested in the topic it was one of the best run/organized classes I have taken at ASU. * Hard material. Great instructor.*
- **CSE 355 (Fall 2013): Introduction to Theoretical Computer Science**
  Evaluation: Course: 4.54/5, Instructor: 4.57/5, Responses: 47/78, 60%
  Number of students: 78; Some student comments: ** Amazing enthusiasm and energy. Puts in more than 100% in preparing the students. * [I liked most] Instructor's passion for teaching and the quality of study material provided. * Prof Fainekos is a easy going professor and always engages in good interaction with students. He relates his teachings to any application possible and most importantly makes the classes enjoyable and easy to learn !*
- **CSE 591 (Spring 2013): Introduction to Algorithmic Robotics**
  Evaluation: Course: 3.95/5, Instructor: 4.36/5, Responses: 5/14, 36%
  Number of students: 14; Some student comments: ** The content is very direct and easy to see applications * It was a fun subject * Great class!*

– **CSE 355 (Fall 2012): Introduction to Theoretical Computer Science**
Evaluation: Course: 3.97/5, Instructor: 4.09/5, Responses: 37/63, 59%
Number of students: 63; Some student comments: ** [I liked most] The amount of group and individual Homeworks covering the exercises in the textbook were really good and would be highly recommended by me to all other professors to follow. * Although this was a prerequisite for me since I changed streams, this was one of the BEST class I've attended here at ASU. * Best teacher for 355 by far. Teaches everything well, prepares everything well, has students come prepared and makes sure they are prepared, he works with the students and all the material is posted before hand.*

– **CSE 522 (Spring 2012): Real-time Embedded Systems**
In-person section evaluation: Course: 4.33/5, Instructor: 4.51/5, Responses: 21/31, 68%
Number of students: 31; Some student comments: ** Overall the best course with the best professor. * The professor was able to help the students almost always which I liked the most. * Great course.*

– **CSE 522 (Spring 2012): Real-time Embedded Systems** (On-line)
On-line section evaluation: Course: 4.07/5, Instructor: 4.53/5, Responses: 8/10, 80%
Number of students: 10; Some student comments: ** I liked the fact that the class covered a variety of concepts concerning real-time embedded systems. From the basics to more advanced concepts. * Subject areas were interesting and having real life applications made the learning experience more concrete and interesting. * Professor Fainekos was very responsive and answered emails promptly. He was very helpful and gave good feedback and clarification on concepts when asked.*

– **CSE 355 (Fall 2011): Introduction to Theoretical Computer Science**
Evaluation: Course: 3.98/5, Instructor: 3.79/5, Responses: 28/63, 44%
Number of students: 63; Some student comments: ** Most thought provoking class I have had yet. * He is very encouraging and very helpful. He is very clear about the exams and what is expected out of the students. Can't find a helpful professor like this !!! * Exams and quizzes are well designed. The instructor gave us sample each time before exam or quiz.*

– **CSE 522 (Spring 2011): Real-time Embedded Systems**
In-classroom section evaluation: Course: 4.37/5, Instructor: 4.41/5, Responses: 24/33, 73%
Number of students: 33; Some student comments: ** Very broad topic allowed grasping the big picture while still tying together several diverse fields of study. * Professor Fainekos is a very good professor. He always comes to class very prepared. * Good course in general. The instructor was helpful and showed a lot attention to students' progress.*

– **CSE 522 (Spring 2011): Real-time Embedded Systems** (On-line)
On-line section evaluation: Course: 3.66/5, Instructor: 3.73/5, Responses: 15/24, 63%
Number of students: 24; Some student comments: ** Dr Fainekos brought a lot of insight into the material from his experiences, and really did a good job putting together great slides to cover the material. * The instructor is very friendly, wants his students to learn, and communicates the material very well. The material is fun and challenging. * Instructor was fair and seemed to genuinely care whether his students learned the material.*

– **CSE 355 (Fall 2010): Introduction to Theoretical Computer Science**
Evaluation: Course: 4.43/5, Instructor: 4.48/5, Responses: 29/49, 59%
Number of students: 49; Some student comments: ** Teacher was very enthusiastic about the course and us learning. * The professor was able to make difficult concepts easy to learn. The professor was great! * Not a huge fan of the material, the professor does a good job of making it interesting though.*

– **CSE 591 (Spring 2010): Theoretical aspects of Cyber-Physical Systems**
Evaluation: Course: 4.09/5, Instructor: 4.10/5, Responses: 14/16, 88%
Number of students: 16; Some student comments: ** The course is a challenge. * This course attempts to build on necessary PhD skills.*

  - **CSE 355 (Fall 2009): Introduction to Theoretical Computer Science**
    Evaluation: Course: 4.34/5, Instructor: 4.48/5, Responses: 14/26, 54%
    Number of students: 26; Some student comments: ** This class made me enjoy and appreciate theory. * Overall a great class and instructor. * Keep it up man!*

- **Teaching Assistant**, University of Pennsylvania, USA
  - CSE 110 (Spring 2004): *Introduction to Programming (in C)*, Responsibilities: recitations (3 hour lectures per week), office hours, homeworks and exams, grading
  - CSE 390/MEAM 420 (Fall 2003): *Robotics*, Responsibilities: office hours, homeworks and exams, preparation of labs (using Lego Mindstorms), grading

STUDENTS

Current Students

- **PhD**

1. Mohammad Hekmatnejad (Full time student since Fall 2017, CIDSE, ASU)
   Research: *Requirement languages for robotics and perception systems.*
2. Keyvan Majd (Full time student since Fall 2019, CIDSE, ASU)
   Research: *Safe Human-Robot Control & Interaction.*
3. Shakiba Yaghoubi (Full time student since Spring 2016, CIDSE, ASU)
   Research: *Optimal control techniques for verification of Cyber-Physical Systems.*

Alumni

Further information on the CPSLab's alumni can be found on my web site:
`http://www.public.asu.edu/~gfaineko/misc.html#alumni`

- **PhD**

1. Kangjin Kim (Fall 2019, CIDSE, ASU)
   Thesis: *Mission and Motion Planning for Multi-robot Systems in Constrained Environments.*
   First placement: Assistant Professor at Chodang University (Korea)
2. C. Erkan Tuncali (Spring 2019, CIDSE, ASU)
   Thesis: *Search-based Test Generation for Automated Driving Systems: From Perception to Control Logic.*
   First placement: Amazon
3. Adel Dokhanchi (Fall 2017, CIDSE, ASU)
   Thesis: *From Formal Requirement Analysis to Testing and Monitoring of Cyber-Physical Systems.*
   First placement: Western Digital
4. Bardh Hoxha (Summer 2017, CIDSE, ASU)
   Thesis: *Formal Requirements-Driven Analysis of Cyber Physical Systems.*
   First placement: Assistant Professor at Southern Illinois University
5. Houssam Abbas (Spring 2015, ECEE, ASU, Co-advised with Tolga Duman).
   Thesis: *Test-Based Falsification and Conformance Testing for Cyber-Physical Systems.*
   First placement: Postodoc at the University of Pennsylvania
   First tenure track position: Assistant Professor at Oregon State University

- **MS**

1. Sai Krishna Bashetty (Fall 2019, CIDSE, ASU; Co-advised with Heni Ben Amor)
   Thesis title: *DeepCrashTest: Translating Dashcam Videos to Virtual Tests for Automated Driving Systems* First job placement: Radius AI.
   Public software release: Add-on to Sim-ATAV
2. Joseph Campbell (Summer 2016, CIDSE, ASU).
   Thesis title: *Traffic Light Status Detection Using Movement Patterns of Vehicles.*
   First job placement: PhD at ASU.
3. Rahul Thekkalore Srinivasa (Summer 2016, CIDSE, ASU).
   Thesis title: *Instrumentation and Coverage Analysis of Cyber Physical System Models.*
   First job placement: Seagate Technology, USA.
   Public software release: Add-on to S-Taliro tools
4. Xiaotong Zhang (Summer 2016, CIDSE, ASU).
   Thesis title: *Design and Synthesis of a Hierarchical Hybrid Controller for Quadrotor Navigation.*
   First job placement: Amazon, USA.
5. Wei Wei (Summer 2016, CIDSE, ASU).
   Thesis title: *Extended LTLvis Motion Planning Interface.*
   First job placement: Page Per Page, USA.
   Public software release: Extended LTLvis
6. Shashank Srinivas (Spring 2013, CIDSE, ASU).
   Thesis title: *A Graphical Language for LTL Motion and Mission Planning.*
   First job placement: Intel, USA.
   Public software release: LTLvis: A Graphical Language for LTL Motion and Mission Planning.
7. Hengyi Yang (Spring 2013, CIDSE, ASU).
   Thesis title: *Dynamic Programming algorithm for Computing Temporal Logic Robustness.*
   First job placement: Amazon, USA.
   Public software release: Contributed to the S-Taliro tools.
8. Ramtin Kermani (Fall 2013, CIDSE, ASU).
   Thesis title: *Model-based Design, Simulation and Automatic Code Generation For Embedded Systems and Robotic Applications.*
   First job placement: OSIsoft, USA.
   Public software release: NAOMBD: NAO Model-Based Development for Simulink / Stateflow.
9. Parth Pandya (Spring 2013, CIDSE, ASU).
   Thesis title: *A Modular ROS package for Linear Temporal Logic based Motion Planning.*
   First job placement: Qualcomm, USA
10. Shih-Kai Su (Fall 2012, CIDSE, ASU).
    Thesis title: *Model-Based Development for Multi-iRobot Simulation and Control.*
    First job placement: Cypress Technology Co., Taiwan
    Public software release: MBDMIRT: Model-Based Development for Multi-iRobot Toolbox.
11. Yashwanth Singh Rahul Annapureddy (Fall 2011, CIDSE, ASU).
    Thesis title: S-*TaLiRo: A tool for Temporal Logic Falsification for Hybrid Systems.*
    First job placement: Mathworks, USA.
    Public software release: Contributed to the S-Taliro tools.

- **BS (REU & FURI supported)**

  REU: Research Experience for Undergraduates (NSF supported)
  FURI: Fulton Undergraduate Research Initiative (ASU supported)

  1. Nathan Kelly (NSF REU 2017, CIDSE, ASU)
     Project: Deep Neural Networks for abnormal vehicle behaviors
  2. Aaron James (NSF REU 2016, CIDSE, ASU)
     Project: QR-code tracking system for robot localization

3. Julian De Ocampo (NSF REU 2015-16, CIDSE, ASU)
   Project: Multi-robot simulator for warehouse environments
4. William Duong (NSF REU 2014-15, CIDSE, ASU)
   Project: *Development of a multi-robot platform for automated warehouse applications.*
   Highlights:
   - Co-author of CASE 2015 conference paper
5. Sami Mian (NSF REU 2013-15, CIDSE, ASU)
   Projects: *Development of a multi-robot platform for automated warehouse applications; Development of a humanoid robot driving a small electric vehicle.*
   Highlights:
   - Honorable award in the Cornell Cup competition 2014
   - Research internship for Fall 2014 in Singapore-MIT Alliance for Research and Technology in the Autonomous Vehicles Group
6. Rick Ahlf (NSF REU & FURI 2013-14, SEMTE, ASU)
   Project: *Model Development and Testing for Automotive Systems.*
   First job placement: Smartplane Inc.
7. Hoang Bach (NSF REU 2013-14, CIDSE, ASU)
   Project: *Graphical User Interface for Cyber-Physical System Requirements.*
   Highlights:
   - Co-author of DIFTS 2014 workshop paper
   - Internship after CPS Lab: Intel
8. Jorge Arce Mendoza (NSF REU 2012-13, Senior, ASU)
   Project: *Parallelization of Embedded Control Applications on Multi-core Architectures.*
   First job placement: General Dynamics C4 Systems.
9. Scott Jones (NSF REU 2012-13, ECEE, ASU)
   Project: *Temporal Logic Testing for Stochastic Cyber-Physical Systems.*
   Internship after CPS Lab: Raytheon.

Other student advising:

- **Competition Teams**

1. F1 Tenth Autonomous Racing Competition 2016
   3rd Place!
   Team name: ASU Desert Runners
2. Cornell Cup USA 2014
   Honorable mention award
   Team name: NAO Navigators
   Project entry: *Electric vehicle driven by an autonomous NAO humanoid robot.*
3. RoboCup Standard Platform League (SPL)
   Setup the team, acquired the robots, recruited students, and mentoring the team to participate to its first competition in 2015.

- **Capstone teams supported**

1. 2019-20, CIDSE, ASU: Project title: *VR add-on to the LGSVL simulator for autonomous vehicles.*
2. 2018-19, CIDSE, ASU: Project title: *VR add-on to the Webots simulator.*
3. 2015-16, CIDSE, ASU: Project title: *RoboCup Standard Platform League (SPL).*
4. 2014-15, CIDSE, ASU: Project title: *RoboCup Standard Platform League (SPL).*
5. 2014, CIDSE, ASU: Project title: *Touch screen interface for a game controlling a virtual UAV.*

6. 2013-14, CIDSE, ASU: Project title: *Electric Vehicle Driven by a Humanoid NAO Robot.*
7. 2012-13, CIDSE, ASU: Project title: *Touch screen interface for controlling a UAV.*
8. 2011-12, CIDSE, ASU: Project title: *Touch screen interface for Human-Robot Interaction.*
9. 2010-11, CIDSE, ASU: Project title: *Multi-Robot Experimental Platform.*

- **On-line MCS Applied Projects**

1. Jonathan Duncan (Spring 2014, CIDSE, ASU), Applied project title: *Sound Tracker: Human in the Loop Sound Tracking Robot*
2. Steve Miskovetz (Fall 2013, CIDSE, ASU), Applied project title: *A home automation and monitoring system built on a framework for expandability*
3. Andrew Tomlinson (Spring 2013, CIDSE, ASU), Applied project title: *Autonomous Home Watering System*
4. Shawn Cook (Fall 2012, CIDSE, ASU), Applied project title: *Dreadful Bacon: Online drum machine application that employs intuitive user interface gestures and graphical tree structures to create musical drum beats*
5. Benjamin Jones (Fall 2011, CIDSE, ASU), Applied project title: *Automated Control of Multistage Evaporative Chilling for Residential Cooling Systems*

Thesis Committees

- **External PhD Thesis reviewer / committe member:**

1. Yash Vardhan Pant: Safe Planning and Control of Autonomous Systems: Robust Predictive Algorithms (2016, Electrical Engineering, University of Pennsylvania, Advisor: Rahul Mangharam)
2. Meng Guo: Hybrid Control of Multi-robot Systems under Complex Temporal Tasks (2016, Electrical Engineering, KTH, Sweden, Advisor: Dimos V. Dimarogonas)
3. Sadegh E.S. Soudjani : Formal Abstractions for Automated Verification and Synthesis of Stochastic Systems (2014, Delft Center for Systems & Control, TU Delft, Netherlands, Advisors: Alessandro Abate and Hans Hellendoorn)

- **ASU PhD Thesis committee member:**

1. Dylan Lusi (in progress, CIDSE, ASU, Advisor: Charles Colbourn)
2. Joe Campbell (in progress, CIDSE, ASU, Advisor: Hani Ben Amor)
3. Shiba Biswal (in progress, SEMTE, ASU, Advisor: Spring Berman)
4. Mohammad Khajenejad (in progress, SEMTE, ASU, Advisor: Sze Zheng Yong)
5. Kevin S. Luck: Sample-Efficient Reinforcement Learning of Robot Control Policies in the Real World (2019, CIDSE, ASU, Advisor: Hani Ben Amor)
6. Abdurrahman Alshareef: Activity Specification for Time-based Discrete Event Simulation Models (2019, CIDSE, ASU, Advisor: Hessam S. Sarjoughian)
7. Benjamin Gaudette: An Intelligent Framework for Energy-aware Mobile Computing Subject to Stochastic System Dynamics (2017, CIDSE, ASU, Advisors: Sarma Vrudhula and Carole-Jean Wu)
8. Soroosh Gholami: Hybrid Multi-resolution Simulation & Model Checking: Network on-Chip Systems (2017, CIDSE, ASU, Advisor: Hessam Sarjoughian)
9. Yooseong Kim: WCET-Aware Scratchpad Memory Management for Hard Real-Time Systems (2017, CIDSE, ASU, Advisor: Aviral Shrivastava)
10. Aravindhan Krishnan: Methods for Calibration, Registration, and Change Detection in Robot Mapping Applications (2016, SESE, ASU, Advisor: Srikanth Saripalli)
11. Reza Kamyar: Parallel Optimization of Polynomials for Large-Scale Problems in Stability and Control (2016, SEMTE, ASU, Advisor: Matthew Peet)

12. Randall Hellman: Haptic Perception, Decision-making, and Learning for Manipulation with Artificial Hands (2016, SEMTE, ASU, Advisor: Veronica Santos)
13. Arun Das: Modeling, Analysis, and Efficient Resource Allocation in Cyber-Physical Systems and Critical Infrastructure Networks (2016, CIDSE, ASU, Advisor: Arunabha Sen)
14. Ganesh P Kumar: Development and Analysis of Stochastic Boundary Coverage Strategies for Multi-Robot (2016, CIDSE, ASU, Advisor: Spring Berman)
15. Michael Bartholomew: Answer Set Programming Modulo Theories (2016, CIDSE, ASU, Advisor: Joohyung Lee)
16. Michael Jonas: Improving AI Planning by Using Extensible Components (2016, CIDSE, ASU, Advisor: Ashraf Gaffar)
17. Young Wn Song: Dynamic Analysis of Embedded Software (2015, CIDSE, ASU, Advisor: Yann-Hang Lee)
18. Mark Ison: On Enhancing Myoelectric Interfaces by Exploiting Motor Learning and Flexible Muscle Synergies (2015, SEMTE, ASU, Advisor: Panagiotis Artemiadis)
19. Jun Shen: A Study of Backward Compatible Dynamic Software Update (2015, CIDSE, ASU, Advisor: Rida Bazzi)
20. Yucong Lin: Moving Obstacle Avoidance for Unmanned Aerial Vehicles (2015, SESE, ASU, Advisor: Srikanth Saripalli)
21. Yunsong Meng: Answer Set Programming and Other Computing Paradigms (2013, CIDSE, ASU, Advisor: Joohyung Lee)
22. Ayan Banerjee: Model Based Safety Analysis and Verification of Cyber-Physical Systems (2012, CIDSE, ASU, Advisor: Sandeep Gupta)

- **ASU Master Thesis & Applied Project committee member:**

1. Edward Paul Andert III: Crossroads - A Time-Sensitive Autonomous Intersection Management Technique (2017, CIDSE, ASU, Advisor: Aviral Shrivastava)
2. Shankar Nair: SmartGateway Framework (2015, CIDSE, ASU, Advisor: Yann-Hang Lee)
3. Vignesh Narayanan: Human Factors Analysis of Automated Planning Technologies for Human-Robot Teaming (2015, CIDSE, ASU, Advisor: Subbarao Kambhampati)
4. Savitha Sundaramoorthi: Eclipse BIRT Plug-ins for Dynamic Piecewise Constant and Event Time Series (2015, CIDSE, ASU, Advisor: Hessam Sarjoughian)
5. Tushar Rawat: Enabling Multithreaded Applications on Hybrid Shared Memory Many-core Architectures (2014, CIDSE, ASU, Advisor: Aviral Shrivastava)
6. Savitha Sundaramoorthi: Eclipse BIRT Plug-ins for Dynamic Piecewise Constant and Event Time Series (2014, CIDSE, ASU, Advisor: Hessam Sarjoughian)
7. Girish Rao Bulusu: Asymmetric Multiprocessing Real Time Operating System on Multicore Platforms (2014, CIDSE, ASU, Advisor: Yann-Hang Lee)
8. Anurag Kamasamudram: Smooth path planning using splines for unmanned planetary vehicles (Fall 2013, CIDSE, ASU, Advisor: Srikanth Saripalli)
9. Xiaolan Wang: Leveraging Metadata for Extracting Robust Multi-Variate Temporal Features for Time Series (2013, CIDSE, ASU, Advisor: Kasim Candan)
10. Sai Hemachandra Vemprala: Leveraging Metadata for Extracting Robust Multi-Variate Temporal Features for Time Series (2013, SESE, ASU, Advisor: Srikanth Saripalli)
11. Nirav Jadav: Applied project (2013, Nanoscience, ASU, Advisors: Jingyue Liu and John Venables)
12. He Lu: Multiple Thread Replay Debugger with Human Behavior on Android Platform (2012, CIDSE, ASU, Advisor: Yann-Hang Lee)
13. James Melkon Smith: Scalable Knowledge Interchange Broker: Design and Implementation for Semiconductor Supply Chain Systems (2012, CIDSE, ASU, Advisor: Hessam Sarjoughian)

14. Barry Lumpkin: A High Level Language for Human Robot Interaction (2012, CIDSE, ASU, Advisor: Chitta Baral)
15. Fei Hong: Soft Error Resilient Redundant CMP Architecture (2011, CIDSE, ASU, Advisor: Aviral Shrivastava)
16. Sailesh Kandula: Model Based Safety Analysis of Cyber Physical Systems (2010, CIDSE, ASU, Advisor: Sandeep Gupta)

- **ASU Honors Thesis & Creative Project Prospectus committee member:**

1. Julia Nakhleh: Improved Algorithms for Hierarchical Sequential Decision Making (2019, CIDSE, ASU, Advisor: Siddharth Srivastava)
2. Sarah Martin: Deep Learning of Control Policies for Autonomous Driving (2018, CIDSE, ASU, Advisor: Hani Ben Amor)
3. Nathan Flick: Adaptive Medium Access Control (MAC) Protocols (2016, CIDSE, ASU, Advisor: Violet Syrotiuk)

SERVICE AND PROFESSIONAL ACTIVITIES

ASU Internal Service

- 2019-20:
  - Chair of the Computer Systems Engineering (CSE) Undergraduate Program Committee (UPC)
  - ASU University Senate
  - Course coordinator for CSE 355
- 2018-19:
  - Leadership Academy: TeamLA Robotics
  - CIDSE Administration and Planning Committee (APC),
  - Computer Engineering Graduate Program Committee (CEN-GPC)
  - Robotics and Automation Systems Graduate Program Committee (RAS-GPC)
- 2017-18:
  - Leadership Academy: TeamLA Robotics
  - CIDSE Administration and Planning Committee (APC),
  - Computer Engineering Graduate Program Committee (CEN-GPC)
  - Ad-hoc committee on teaching load / class size balancing
  - Chair of the IoT/CPS faculty search committee
- 2016-17:
  - Member of the joint SFIS/FSE senior faculty search committee
  - Computer Engineering Graduate Program Committee (CEN-GPC)
- 2015-16:
  - Computer Systems Engineering (CSE) Undergraduate Program Committee (UPC)
  - Chair of the robotics faculty search committee
  - Computer Engineering program qualifying exams

- 2014-15:
  - Chair of the robotics faculty search committee
- 2013-14:
  - Robotics faculty search committee
  - Computer Systems Engineering (CSE) Undergraduate Program Committee (UPC)
  - Computer Engineering (CEN) Admissions Committee
- 2012-13:
  - Computer Systems Engineering (CSE) Undergraduate Program Committee (UPC)
- 2011-12:
  - Computer Science (CS) Admissions Committee
- 2010-11:
  - Computer Systems Engineering (CSE) Undergraduate Program Committee (UPC)

Local Community Outreach

- Co-organization of the first "La vida robotics" (`http://www.lavidarobots.org/`) meeting at "Local Motors", June 2015: Presentations on robotics and hands-on robotics labs
- Robotics exhibit at ASU Engineering Open House Family Day 2012

External Service

- Professional Society Service
  - 2015-2018: IEEE Control Systems Society (CSS) representative in the IEEE Systems Council
- Associate Editor
  - 2012 to 2016: ACM SIGBED Review (ISSN: 1551-3688) (`http://sigbed.seas.upenn.edu/`)
- Conference Organizer:
  - Program Chair (with Alessandro Abate): Hybrid Systems: Computation & Control (HSCC); Part of CPSWeek 2016.
- Workshop Organizer:
  - Program Chair (with H. Abbas, J. Deshmukh and B.-G. Kim): 2nd Workshop on Monitoring and Testing of Cyber-Physical Systems; Affiliated with the Cyber-Physical Systems (CPS) Week 2017.
  - Program Chair (with E. Goubault and S. Putot): Numerical Software Verification (NSV) III; Affiliated with the Federated Logic Conference (FLOC) 2010.
  - Program Chair (with E. Goubault and S. Sankaranarayanan): Numerical Software Verification (NSV) II: Verification of Cyber-Physical Software Systems; Affiliated with the Cyber-Physical Systems (CPS) Week 2009.

- Conference Organizing Committee member:
  - Organizing committee: ASU South West Robotics Symposium (SWRS) 2018, 2019, 2020
  - Steering Committee member: Workshop on Monitoring and Testing of Cyber-Physical Systems (MT-CPS), 2018 – to date
  - Publication chair: International Conference on Cyber-Physical Systems (ICCPS) 2015
  - Registration chair: Cyber-Physical Systems (CPS) Week 2013
  - Exhibit chair: Annual Conference of IEEE Industrial Electronics (IECON) 2010
- Program Committee member:
  - Conferences:
    * IFAC Conference on Analysis and Design of Hybrid Systems (ADHS) 2015, 2018
    * International Conference on Computer Aided Verification (CAV) 2017, 2018
    * International Conference on Embedded Software (EMSOFT) 2018, 2019, 2020
    * International Conference on Formal Methods for Industrial Critical Systems (FMICS) 2012, 2020
    * Formal Modeling and Analysis of Timed Systems (FORMATS) 2012, 2013, 2014
    * ACM International Conference on Hybrid Systems: Computation and Control (HSCC) 2013, 2014, 2015, 2017, 2018, 2020
    * International Conference on Cyber-Physical Systems (ICCPS) 2015, 2016, 2018, 2019, 2020
    * Interaction and Concurrency Experiences (ICE) 2009
    * IEEE International Conference on Robotics and Automation (ICRA) 2014, 2015, 2017, 2019
    * IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2019
    * International Conference on Runtime Verification (RV) 2015, 2020
    * Summer Computer Simulation Conference (SCSC) 2014, 2017
    * Spring Simulation Conference (SummerSim) 2020
    * Temporal Representation and Reasoning (TIME) 2013
  - Workshops:
    * Workshop on Applied Verification for Continuous and Hybrid Systems (ARCH) 2014
    * Workshop on Cyber-Physical Systems Education (CPS-Ed) 2013
    * Design Automation for CPS and IoT (DESTION) 2019
    * International Workshop on Design, Modeling and Evaluation of Cyber Physical Systems (CyPhy) 2015, 2017
    * Workshop on Design and Analysis of Robust Systems (DARS) 2017
    * International Workshop on Formal Engineering approaches to Software Components and Architectures (FESCA) 2016, 2017
    * Workshop on Formal Verification of Autonomous Vehicles (FVAV) 2017
    * Workshop on Hybrid Autonomous Systems (HAS) 2014
    * ACM SIGPLAN/SIGBED Conference on Languages, Compilers, Tools and Theory for Embedded Systems (LCTES) 2015
    * Logics for System Analysis (LfSA) 2010
    * Quantitative Formal Methods (QFM) 2009
    * IEEE Real-Time Systems Symposium (RTSS) 2010, 2011 WiP, 2014 CPS
    * International Workshop on Model Checking and Automated Planning (MOCHAP) 2015
    * Workshop on Monitoring and Testing of Cyber-Physical Systems (MT-CPS) 2016, 2018, 2019, 2020
    * International Workshop on Numerical Software Verification (NSV) 2012, 2016, 2017
    * AAAI-16 Workshop on Planning for Hybrid Systems (PlanHS-16) 2016
    * AAAI Spring Symposium on Integrating Representation, Reasoning, Learning, and Execution for Goal Directed Autonomy (SIRLE) 2018
    * Workshop on Synthesis of Continuous Parameters (SynCoP) 2014

- NSF Panels
  - Cyber-Physical Systems (CPS)
  - Computer Systems Research (CSR)
  - Formal Methods in the Field (FMitF)
  - National Robotics Initiative (NRI)
- Reviewer for Journals (alphabetical order):
  - ACM Transactions on Embedded Computing Systems
  - Automatica
  - Discrete Event Dynamic Systems
  - Formal Methods in System Design
  - IEEE Control Systems Magazine
  - IEEE Robotics and Automation Magazine
  - IEEE Systems, Man and Cybernetics
  - IEEE Transactions on Automatic Control
  - IEEE Transactions on Automation Science and Engineering
  - IEEE Transactions on Control Systems Technology
  - IEEE Transactions on Control of Network Systems
  - IEEE Transactions on Cybernetics
  - IEEE Transactions on Robotics
  - IEEE Transactions on Software Engineering
  - International Journal of Robotics Research
  - Robotics and Autonomous Systems
  - Science Robotics
  - Theoretical Computer Science
- (Regular) Reviewer for Major Conferences and Workshops (alphabetical order):
  - American Control Conference (ACC)
  - Analysis and Design of Hybrid Systems (IFAC ADHS)
  - Conference on Automation Science and Engineering (IEEE CASE)
  - Computer Aided Verification (CAV)
  - Conference on Decision and Control (IEEE CDC)
  - Embedded Systems Software (ACM EMSOFT)
  - European Control Conference (ECC)
  - Formal Modeling and Analysis of Timed Systems (FORMATS)
  - Hybrid Systems: Computation and Control (ACM HSCC)
  - Industrial Electronics (IEEE IECON)
  - Intelligent Transportation Systems Conference (IEEE ITSC)
  - Intelligent Vehicles Symposium (IEEE IV)
  - International Conference on Cyber-Physical Systems (ACM ICCPS)
  - International Conference on Intelligent Robots and Systems (IEEE/RSJ IROS)
  - International Conference on Robotics and Automation (IEEE ICRA)
  - Logic in Computer Science (LICS)
  - Mediterranean Control Conference (MED)
  - NASA Formal Methods (NFM)
  - Multi-conference on Systems and Control (MSC)
  - Real-Time Systems Symposium (IEEE RTSS)

Other Service

- Graduate Student Representative for the academic year 2007-08 at the University of Pennsylvania (Attending faculty meetings; Member of the committee for the appointment of the new department Chairperson)

Professional Memberships

- Association for Computing Machinery (ACM): Member 2008-, Student Member 2006-08.
  Special Interest Group: Embedded Systems (SIGBED).
- Institute of Electrical and Electronics Engineers (IEEE): Member 2008 -, Student Member 2004-08.
  Societies: Robotics and Automation Society (RAS); Control Systems Society (CSS).
- American Society Of Mechanical Engineers (ASME) Member 2008-10, Student Member 2006-08.
- Member of the Technical Chamber of Greece 2002-2012 (as Mechanical Engineer)

OTHER EDUCATIONAL BACKGROUND

- **Launching of Ariane V.** Ecole Centrale Paris, Board of European Students of Technology (BEST) Spring course 2002, Paris, France.
  Classes on the propulsion system of Ariane V and visits to ESA, Snecma
- **Usability Engineering.** Chalmers University of Technology, Board of European Students of Technology (BEST) Summer course 2001, Gothenburg, Sweden.
  Classes on usability engineering and visits to SKF

COMPUTER KNOWLEDGE & FOREIGN LANGUAGES

- **Programming:** C, C++, Fortran, Visual Basic, OCaml
- **CAD/FEA:** SolidWorks, CosmosWorks, AutoCAD, Mechanical Desktop, Pro Engineer
- **Model Checking Tools:** SPIN, SMV
- **Modelling and Prototyping:** MATLAB, Simulink, LabView, Mathematica
- **Greek:** Native, **English:** Fluent (Cambridge Certificate of Proficiency in English), **German, Spanish, Japanese:** beginner

EXTRA-CURRICULAR ACTIVITIES

- Open Sea Sailing (former member of the Hellenic Offshore Racing Club, Greece)
- Horse Riding (former member of the Horse Riding Club of Mesogeion, Greece)
- Basketball (During High-School: member of Kronos Basketball Team, Greece)
- Playing the saxophone (former member of Agios Dimitrios Municipality Band, Greece)