

Sean Phillips | Curriculum Vitae

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Short Biography

Sean Phillips recently joined the Air Force Research Lab – the Space Vehicles Directorate as a research engineer in Albuquerque New Mexico. He received his Ph.D in the Department of Computer Engineering at the University of California – Santa Cruz in 2018. He received his B.S. in Mechanical Engineering from the University of Arizona in 2011 and his M.S. in Mechanical Engineering from the same university specializing in Dynamics and Controls in 2013. In 2009, he joined the Hybrid Dynamics and Controls Lab where he received a NASA Space Grant in 2010. In 2010, he received an Undergraduate Research Grant from the University of Arizona Honors College. He received a Space Scholars Internship at the Air Force Research Laboratory in Albuquerque N.M during the summers of 2011, 2012 and 2017. In 2014, he joined the Hybrid Systems Laboratory at the University of California, Santa Cruz. In 2017, he received the Jack Baskin and Peggy Downes-Baskin Fellowship for his research on autonomous networked systems from the Baskin School of Engineering at the University of California Santa Cruz.

Research Interests

Modeling, stability, robust control, observer design, and simulation of hybrid systems with applications to communication networks, multi-agent systems, aerospace/space, and biology.

Education

University of California, Santa Cruz <i>Ph.D. in Computer Engineering w/ Emphasis in Robotics and Control</i> Thesis Title: Coordination and Control of Networked Systems with Intermittent Communication	Santa Cruz CA 2014–2018
University of Arizona <i>M.S. in Mechanical Engineering</i> Thesis Title: Modeling and Analysis of Robust Stability for Spiking Neuron Models	Tucson AZ 2011–2013
University of Arizona <i>B.S. in Mechanical Engineering</i> Senior Capstone Project: ASME Human Powered Vehicle Competition	Tucson AZ 2006–2011

Professional Experience

Research Mechanical Engineer (DR-II) <i>Air Force Research Laboratory – Space Vehicles Directorate</i> Autonomous Systems and Controls Engineer for the Space Command and Control Program with the Guidance, Control and Software Technologies Section, personally responsible for applying principles of control and dynamics of mechanical systems for multi-agent autonomous systems.	2018 – present <i>Albuquerque, NM</i>
Graduate Student Researcher <i>Hybrid Systems Lab, University of Santa Cruz</i> Developed robust controller and observer designs for coordination of distributed multi-agent systems over networks with intermittent and sporadic information transmission.	2014–2018 <i>Santa Cruz, CA</i>
Graduate Teaching Assistant <i>Computer Engineering Department, University of Santa Cruz</i>	2016–2015 <i>Santa Cruz, CA</i>

Led discussion sections and labs, graded exams, and held weekly office hours.

Graduate Research Assistant

2011–2014

Hybrid Dynamics and Controls Lab, University of Arizona

Tucson, AZ

Modeled, analyzed and simulated the stability and robustness of the dynamics of interconnected neurons.

Graduate Teaching Assistant

2012–2011

Aerospace and Mechanical Engineering Department, University of Arizona

Tucson, AZ

Led weekly instrumentation labs, graded exams, and held weekly office hours.

Space Scholar Graduate Intern

Summers in 2011,'12,'17

Air Force Research Lab, Kirtland Air Force Base

Albuquerque, NM

- (6/17 - 9/17) Develop distributed a transmission based estimation algorithm for space situational awareness applications. Using hybrid systems theory to model and analyze the stability and robustness of such systems. Simulated with Matlab to verify results.
- (6/12 - 8/12) Developed control strategies for a wireless communication of a ground station and satellite in the presence of adversarial attack using game theoretical and optimal control strategies in conjunction with hybrid systems tools.
- (6/11 - 8/11) Using hybrid systems tools, designed and analyzed a decentralized frequency hopping rendezvous protocol for multiple cognitive radios to search, link and synchronize their communication to avoid adversarial attacks. Simulated protocols in Matlab and implemented them into a cognitive radio network.

NASA Space Grant Internship

2010–2011

Lunar and Planetary Laboratory, University of Arizona

Tucson, AZ

Hybrid Dynamics and Controls Lab, University of Arizona

2009–2011

Undergraduate Research Assistant

Tucson, AZ

Honors

2016-2017 Jack Baskin and Peggy Downes-Baskin Fellowship

Santa Cruz, CA

UCSC Jack Baskin School of Engineering

2017

Computer Engineering Summer 2016 Fellowship

Santa Cruz, CA

UCSC Computer Engineering Dept.

2016

Best Presentation in Session Award

Portland, OR

IEEE American Control Conference

2014

Best Presentation in Session Award

Washington, DC

IEEE American Control Conference

2013

Aerospace and Mechanical Eng. Department Graduate School Fellowship

Tucson, AZ

University of Arizona

2012-2011

3rd Place in Design

Indianapolis, IN

ASME Human Powered Vehicle East Competition

2011

NASA Space Grant

Tucson, AZ

Lunar and Planetary Sciences Dept., University of Arizona

2011-2010

Honors College Undergraduate Research Grant

Tucson, AZ

University of Arizona

2010

Teaching Experience

2016: Lecturer: Workshop on Hybrid Control Systems

Conf. on Decision and Control, Las Vegas NV

2016: Substitute Lecturer: Introduction to Feedback Control (CMPE 8)

U.C., Santa Cruz, CA

2016: TA – Intro. to Probability and Statistics (CMPE 107)

U.C., Santa Cruz, CA

- Duties included: Grading all exams, creating exam and homework solutions, administer two weekly 70 minute discussion sessions, and hold one weekly office hour.

- Topics included: Introduction to fundamental tools of stochastic analysis. Combinatorics, conditional probability, expectation, variance covariance of multiple continuous and discrete random variables, and random process analysis.
- 2015:** TA – Robot Automation: Intro. to Feedback Control (CMPE 8) *U.C., Santa Cruz, CA*
- Duties included: Grading all exams and brief lab reports, administered two three-hour lab sessions a week, and hold three office hours a week.
- Topics included: Intro to modeling, stability analysis and robustness analysis for dynamical systems with emphasis on feedback control and robotics.
- 2011 – 2012:** TA – Instrumentation Lab (AME 200, undergraduate) *University of Arizona*
- Duties included: Grading all exams and formal lab reports, hold 2 hours of open office hours a week, administered two three-hour lab sessions a week and administered mid- and final exams.
- Topics included: Basic principles of laboratory practice and instrumentation; statistical measurement theory including probability distributions, finite statistics, uncertainty analysis regression analysis dynamics of measurement systems; transducers and signal conditioning circuits. Experiments using basic laboratory instrumentation on the speed of sound, temperature measurements, and the dynamic response of first and second order systems.
- 2011:** TA – Engineering Analysis (AME 201) *University of Arizona*
- Duties included: Grading all exams and homework assignments, hold 5 hours of open office hours a week, and administering midterms and final exams.
- Topics included: Linear algebra, vector analysis, complex variables, Fourier series, matrices, ordinary differential equations, initial and boundary value problems with applications to current engineering problems.

Theses

Doctorate of Philosophy in Computer Engineering.....

Title: *Coordination and Control of Networked Systems with Intermittent Communication*

Advisor: Dr. Ricardo G. Sanfelice

Abstract: Communication networks characterize many modern real-world processes, ranging from the internet and social media networks, to communication networks and power distribution networks, to interconnected neuron and biological models. For such networks, the communication coupling between agents may not be continuous, more specifically, the information transmitted between agents are naturally sporadically impulsive or intermittent. In this thesis, robust coordination algorithms are studied for the case when the agents have linear and hybrid dynamics when information coupling between the agents in the network are intermittent. Namely, coordination in terms of synchronization and desynchronization for a variety of systems are considered. The robust exponential stability of the set characterizing synchronization in continuous linear time-invariant systems when information from neighbors is received impulsively at isolated time instances. For each case, we model the interconnected agents as a hybrid system and use tools for robust set stability of hybrid systems to analyze the dynamic behavior. Applications to the study of dynamical behavior of spiking neurons modeled as a form of interconnected impulse-coupled oscillators and to frequency rendezvous for communication systems are given.

Master of Science in Mechanical Engineering.....

Title: *Modeling and Analysis of Robust Stability for Spiking Neuron Models*

Advisor: Dr. Ricardo G. Sanfelice

Abstract: A generalized hybrid systems framework for modeling and analysis of robust stability in spiking neurons is proposed. This framework is developed for a population of N-interconnected neurons to study the behavior of several excitatory and inhibitory neuron phase response models and to study the N-interconnected inhibiting integrate-and-fire neuron model. Using Lyapunov stability tools for hybrid systems, the stability properties for each case of the neuron models considered are established. Due to the regularity properties of the data of the hybrid models, the asserted stability properties are robust to small perturbations. For the integrate and fire model, analysis of several different perturbation types is given. Furthermore, an external stimuli is introduced to

achieve a global asymptotic stability property for the 2-neuron simplified Hodgkin and Huxley neuron model. Numerical simulations are included to illustrate the results.

Publications

Journal Articles.....

- [4]: S. Phillips, and R. G. Sanfelice. Robust Distributed Synchronization of Networked Linear Systems with Intermittent Information, *Automatica*, (under review).
- [3]: Y. Li, S. Phillips, and R. G. Sanfelice. Robust Distributed Estimation for Linear Systems under Intermittent Information, *IEEE Transactions on Automatic Control*, 63(4):973–988, 2018.
- [2]: Y. Li, S. Phillips, and R. G. Sanfelice. Basic Properties and Characterization of Incremental Stability Prioritizing Flow Time for a Class of Hybrid Systems, *Systems and Control Letters*, 90:7–15, 2016.
- [1]: S. Phillips, and R. G. Sanfelice. Robust asymptotic stability of desynchronization in impulse-coupled oscillators., *IEEE Transactions on Control of Networked Systems*, 3(2):127–136, 2016.

Peer-Reviewed Conference Proceedings.....

- [12]: S. Phillips, R. S. Erwin, and R. G. Sanfelice. Robust Exponential Stability of an Intermittent Transmission State Estimation Protocol. In *Proceedings of the American Control Conference*. (accepted) June 2018
- [11]: A. Duz, S. Phillips, A. Fagiolini, R. G. Sanfelice and F. Pasqualetti. Stealthy Attacks in Cloud-Connected Linear-Impulsive Systems. In *Proceedings of the American Control Conference*. (accepted) June 2018
- [10]: S. Phillips, A. Duz, F. Pasqualetti and R. G. Sanfelice. Hybrid Attack Monitor Design to Detect Recurrent Attacks in a Class of Cyber-Physical Systems In *Proceedings of the 2017 IEEE 56th Annual Conference on Decision and Control*. pages 1368-1373. Dec 2017
- [9]: S. Phillips, and R. G. Sanfelice. On Asymptotic Synchronization of Interconnected Hybrid Systems with Applications. In *Proceedings of the American Control Conference*. pages 2291-2296, May 2017
- [8]: S. Phillips, Y. Li, and R. G. Sanfelice. A hybrid consensus protocol for pointwise exponential stability with intermittent information. In *Proceedings of the 10th IFAC Symposium on Nonlinear Control Systems*. pages 146–151, August 2016
- [7]: Y. Li, S. Phillips, and R. G. Sanfelice. On Distributed Observers for Linear Time-invariant Systems Under Intermittent Information Constraints. In *Proceedings of the 10th IFAC Symposium on Nonlinear Control Systems*. pages 654–659, August 2016
- [6]: S. Phillips, and R. G. Sanfelice. Robust Synchronization of Interconnected Linear Systems over Intermittent Communication Networks, In *Proceedings of the American Control Conference*, pages 5575–5580, June 2016.
- [5]: S. Phillips, and R. G. Sanfelice. Robust Synchronization of Two Linear Systems over Intermittent Communication Networks, In *Proceedings of the Conference on Decision and Control*, pages 5569–5574, December 2015.
- [4]: Y. Li, S. Phillips, and R. G. Sanfelice. Results on Incremental Stability for Hybrid Systems, In *Proceedings of the Conference on Decision and Control*, pages 3089–3094, December 2014.
- [3]: S. Phillips, and R. G. Sanfelice. A framework for modeling and analysis of robust stability for spiking neurons, In *Proceedings of the American Control Conference*, pages 1414–1419, June 2014.
- [2]: S. Phillips, and R. G. Sanfelice. Results on the asymptotic stability properties of desynchronization in impulse-coupled oscillators, In *Proceedings of the American Control Conference*, pages 3278–3283, June 2013.
- [1]: S. Phillips, R. G. Sanfelice, R. S. Erwin. On the synchronization of two impulsive oscillators under communication constraints, In *Proceedings of the American Control Conference*, pages 2443–2448, July 2012.

Presentations

Oral Presentations.....

- [12]: Robust Exponential Stability of an Intermittent Transmission State Estimation Protocol, *American Control Conference*. Milwaukee, WI, June 2018
- [11]: Hybrid Attack Monitor Design to Detect Recurrent Attacks in a Class of Cyber-Physical Systems, *Conference on Decision and Control* Melbourne, Victoria, AUS, Dec 2017
- [10]: Synchronization in Networked Hybrid Systems with Applications to Intermittent Communication, *Los Alamos National Laboratory* Los Alamos, New Mexico, USA, Nov 2017
- [9]: On Asymptotic Synchronization of Interconnected Hybrid Systems with Applications *American Control Conference* Seattle, Washington, USA, May 2017
- [8]: Lightening talk: Interconnection of Networks of Hybrid System with Applications to Attack Detection *UCOP LFRP Cybersecurity RFP Workshop* UCSC-Silicon Valley, California, USA, May 2017
- [7]: A hybrid consensus protocol for pointwise exponential stability with intermittent information *10th IFAC Symposium on Nonlinear Control Systems* Monterey, California, USA, August 2016
- [6]: Robust Synchronization of Interconnected Linear Systems over Intermittent Communication Networks *American Control Conference* Boston, Massachusetts, USA, July 2016
- [5]: Robust Synchronization of Two Linear Systems over Intermittent Communication Networks *Conference on Decision and Control* Osaka, Japan, Dec 2015
- [4]: A framework for modeling and analysis of robust stability for spiking neurons *American Control Conference* Portland, Oregon, USA, June 2014
- [3]: Results on the asymptotic stability properties of desynchronization in impulse-coupled oscillators *American Control Conference* Washington DC., USA, June 2013
- [2]: On the synchronization of two impulsive oscillators under communication constraints *American Control Conference* Montreal, Canada, July 2012
- [1]: Biological Trajectory Recording of Bee Paths and Analysis for Implementation to Micro Air Vehicles *2011 Arizona Space Grant Symposium* Tempe, Arizona, USA, April 2011

Poster Presentations.....

- [14]: Distributed Estimation and Consensus under Intermittent Communication for Space Situational Awareness *Air Force Research Lab Space Scholars Symposium*, Albuquerque, New Mexico, USA, August 2017
- [13]: Robust analysis and control of interconnected spiking neurons through hybrid systems modeling *Workshop on Brain Dynamics and Neurocontrol Engineering*, St. Louis, Missouri, USA, June 2017
- [12]: Estimation and Synchronization of Multi-agent Systems Using Tools for Hybrid Systems *Baskin School of Engineering Open House*, Santa Cruz, California, USA, March 2017
- [11]: Estimation and Synchronization of Multi-agent Systems Using Tools for Hybrid Systems *CITRIS @ UC Santa Cruz Open House*, Santa Cruz, California, USA, April 2016
- [10]: Estimation and Synchronization of Multi-agent Systems Using Tools for Hybrid Systems *12th Annual Graduate Research Symposium*, Santa Cruz, California, USA, April 2016
- [9]: Estimation and Synchronization of Multi-agent Systems Using Tools for Hybrid Systems *UCSC Research Review Day*, Santa Cruz, California, USA, October 2015
- [8]: Estimation and Synchronization of Multi-agent Systems Using Tools for Hybrid Systems *CITRIS Day 2015*, Berkeley, California, USA, October 2015
- [7]: On Desynchronization of Impulsive Oscillators for Coordination of Actions of Multiple Players *NSF Connection One Semi-Annual Meeting*, Scottsdale, Arizona, USA, May 2012
- [6]: Optimal Cognitive Network Reconfiguration in Adversarial Conditions with Delays Using Game Theoretical Methods *Air Force Research Lab Space Scholar Symposium*, Albuquerque, New Mexico, USA, August 2012

- [5]: On the Synchronization of Impulsive Oscillators For Decentralized Rendezvous *NSF Connection One Semi-Annual Meeting*, Scottsdale, Arizona, USA, May 2012
- [4]: Simultaneous Synchronization Rendezvous (SSR) in Decentralized Cognitive Radio Networks *Air Force Research Lab Space Scholar Symposium*, Albuquerque, New Mexico, USA, August 2011
- [3]: American Society of Mechanical Engineers Human Power Vehicle Competition: Speed Class *Engineering Senior Design Day*, Tucson, Arizona, USA, May 2011
- [2]: Large Scale Stirling Engines *University of Arizona Honors College Undergraduate Research Symposium* Tucson, Arizona, USA, December 2010
- [1]: Large Scale Stirling Engines *University of Arizona Alumni Student Showcase* Tucson, Arizona, USA, November 2010

Lectures/Workshops.....

- [4]: Workshop on Feedback Control of Hybrid Systems *2016 IEEE Conference on Decision and Control*, Las Vegas, Nevada, USA, December 2016
- [3]: Lecture on Introduction to Feedback Control for CMPE 8: Robot Automation: Feedback Control, *UCSC* Santa Cruz, CA, Nov. 2016
- [2]: Introduction to Feedback Control for Middle School Girls in Engineering Society, *UCSC*, Santa Cruz, CA, Nov. 2016
- [1]: Introduction to Feedback Control for High School Teachers in MESA, *University of Arizona*, Tucson, AZ, Mar. 2013

Academic Service Work

Computer Engineering Graduate Student Society <i>Steering Committee, Santa Cruz, CA</i>	UC Santa Cruz <i>2015-2017</i>
Aerospace and Mechanical Eng. Dept. Machine Shop Committee <i>Graduate Student Representative, Tucson, AZ</i>	University of Arizona <i>2011-2014</i>
Student Chapter of American Society of Mechanical Engineering <i>Graduate Student Advisor, Tucson, AZ</i>	University of Arizona <i>2011-2013</i>
Aerospace and Mechanical Eng. Dept. Machine Shop Committee <i>Undergraduate Student Representative, Tucson, AZ</i>	University of Arizona <i>2009-2011</i>
Student Chapter of American Society of Mechanical Engineering <i>Founding Treasurer, Tucson, AZ</i>	University of Arizona <i>2009-2011</i>
Student Chapter of American Society of Mechanical Engineering <i>Steering Committee, Tucson, AZ</i>	University of Arizona <i>2009</i>

Grant Writing Experience

- Distributed Estimation and Consensus for Applications in Space Situational Awareness**
National Research Council - Research Apprenticeship Program, May 2017
Sole Author, *Status: NRC Recommended-Lab Decision Pending*
- Coordination Algorithms in Multi-agent Systems (MAS) with Intermittent Information**
2016-17 Jack Baskin & Peggy Downes Baskin Fellowship, June 2016
Sole Author, *Status: Accepted*
- Reconfigurable Algorithms for High Performance and Robust Autonomy in Complex Networks**
Air Force Office of Scientific Research, 2015
Graduate Contributor, *Status: Accepted*
- Robust Feedback Control of Reconfigurable MAS in Uncertain Adversarial Environments**
Air Force Office of Scientific Research, YIP, 2012

Undergraduate and Graduate Contributor, *Status: FA9550-12-1-0366*

Large Scale Fluid Piston Stirling Engines

University of Arizona, Honors College, 2010

Sole Author, *Status: Accepted*

Professional Activities

- **Chair and Co-chair** of sessions “Autonomous Aerospace Systems - I”, “Networked Control”, “Autonomous Aerospace Systems - II” at the IFAC Networked & Autonomous Air & Space Systems (NAASS) in Santa Fe, NM, USA;
- **Co-chair** of session “Hybrid and Switched Systems” at the 2012 American Control Conference in Montreal, QC, CA;
- **Reviewer** of technical papers submitted to the journals: IEEE Transactions on Automatic Control; IEEE Transactions on Signal Processing; IEEE Transactions on Control Systems Technology; and Automatica.
- **Reviewer** of technical papers submitted to the conferences: IEEE Conference on Decision and Control; IEEE American Control Conference; IEEE Conference on Control Technologies; AIAA Scitech.

Outreach and Volunteer Activities

Panelist: Graduate Student Researcher Panel <i>CMPE 200: Research and Teaching in Computer Science and Engineering</i>	UC Santa Cruz <i>Oct 2017</i>
Volunteer: Trail Building at Teaching Rock <i>Pinnacles Climber Appreciation Day, Pinnacles National Park, CA</i>	Pinnacles National Park <i>Oct 2017</i>
Volunteer: Adopt-a-crag Glen Canyon <i>Bay Area Climbers Coalition, San Francisco, CA</i>	Glen Canyon State Park <i>Apr 2017</i>
Judge: Field Competition <i>VEX Robotics State Championship</i>	Santa Clara, CA <i>Feb 2017</i>
Lecturer: Hybrid System Lab: Intro. to Feedback Control <i>Girls in Engineering</i>	UC Santa Cruz <i>July 2016</i>
Volunteer: Adopt-a-crag Goat Rock <i>Bay Area Climbers Coalition, Saratoga, CA</i>	Castle Rock State Park <i>Apr 2016</i>
Volunteer: MESA Achievement Day at UC, Santa Cruz <i>Mathematics, Engineering, Science Achievement</i>	UC Santa Cruz <i>Mar 2016</i>
Volunteer: Adopt-a-crag Summit Rock <i>Bay Area Climbers Coalition, Saratoga, CA</i>	Castle Rock State Park <i>Oct 2015</i>
Volunteer: Adopt-a-crag Indian Rock <i>Bay Area Climbers Coalition, Saratoga, CA</i>	Castle Rock State Park <i>Apr 2015</i>
Lecturer: Control Engineering for High School Teachers <i>Mathematics, Engineering, Science Achievement</i>	University of Arizona <i>Aug 2011</i>
Mentor: High School Students for Summer Internship <i>Hybrid Dynamics and Controls Lab</i>	University of Arizona <i>June 2010</i>
Lecturer: Intro. to Vicon Camera System and Feedback Control <i>Hybrid Dynamics and Controls Lab</i>	University of Arizona <i>Oct 2009</i>

News Articles

[1]: Jack Baskin and Peggy Downes-Baskin Fellowship Announcement, Santa Cruz, CA, Feb. 2017