

Miroslav Pajic

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ACADEMIC APPOINTMENTS

Assistant Professor Department of Electrical and Computer Engineering Department of Computer Science Duke University, <i>Durham, NC</i>	July 2015 – present
Adjunct Assistant Professor Department of Electrical and Computer Engineering Duke University, <i>Durham, NC</i>	Aug. 2014 – June 2015
Postdoctoral Researcher PRECISE (The Penn Research in Embedded Computing and Integrated System) Center Department of Electrical and Systems Engineering University of Pennsylvania, <i>Philadelphia, PA</i>	Oct. 2012 – June 2015

EDUCATION

Ph.D. in Electrical Engineering University of Pennsylvania, Philadelphia, PA Dissertation: “Closing the Loop: Architectures and Algorithms for Real-Time Control over Wireless Networks” <i>Joseph and Rosaline Wolf Best Dissertation Award</i>	2012
M.S. in Electrical Engineering University of Pennsylvania, <i>Philadelphia, PA</i>	2010
M.S. in Electrical Engineering School of Electrical Engineering, University of Belgrade, <i>Serbia</i> <i>Thesis: “Multirate digital signal processing for timing synchronization in digital modems design”</i>	2007
Diploma Engineer in Electrical Engineering School of Electrical Engineering, University of Belgrade, <i>Serbia</i> Department of Electronics, Telecommunication and Automatic Control <i>Best Student Award</i>	1998 - 2003

RESEARCH INTERESTS

Cyber-Physical Systems; Model-Based Design; Embedded and Distributed/Networked Control; Real-time and Embedded Systems; High-confidence Medical Device Systems; Real-time Signal Processing

HONORS & AWARDS (CHRONOLOGICAL ORDER)

NSF Faculty Early Career Development (CAREER) Award Awarded by the National Science Foundation (NSF)	2017
ONR Young Investigator Award Awarded by the Office of Naval Research (ONR)	2017
Best Paper Award 17 th ACM SIGBED International Conference on Embedded Software (EMSOFT) for the paper " <i>Security-Aware Scheduling of Embedded Control Tasks</i> "	2017
National Academy of Engineering's US Frontiers of Engineering Symposium Invitation	2017
Best Paper Award 5 th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS'14) for the paper " <i>Robustness of Attack-resilient State Estimators</i> "	2014
Best Paper Award Finalist 5 th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS'14) for the paper " <i>Opportunistic Scheduling of Control Tasks over Shared Wireless Channels</i> "	2014
Joseph and Rosaline Wolf Best Dissertation Award Award for the Best Dissertation in Electrical and Systems Engineering Awarded by the School of Engineering and Applied Science, University of Pennsylvania	2013
Best Student Paper Award 18 th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS'12) for the paper " <i>From Verification to Implementation: A Model Translation Tool and a Pacemaker Case Study</i> "	2012
Best Presentation Award 11 th ACM/IEEE Conference on Information Processing in Sensor Networks (IPSN'12) for the presentation " <i>Closing the Loop: A Simple Distributed Method for Control over Wireless Networks</i> "	2012
Best Paper Candidate 18 th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'12) for the paper " <i>Modeling and Verification of a Dual Chamber Implantable Pacemaker</i> "	2012
University of Pennsylvania President Gutmann Leadership Award	2012
ACM SIGBED/SIGSOFT Frank Anger Memorial Award Presented by the ACM Special Interest Group on Embedded Systems (SIGBED) to promote cross-disciplinary research between embedded systems and software engineering	2011
Winner of the Honeywell Users Group Wireless Student Competition Awarded by Honeywell Process Solutions for innovative use of wireless control in industrial plants	2011
Scholarship awarded by Serbian Ministry for Science and Technology	2004
Best Student Award at the School of Electrical Engineering Awarded by the University of Belgrade, <i>Serbia</i>	2003

Professor Aleksandar Damjanovic Foundation Award	2003
Awarded to the best student in the Department of Electronic, Telecommunication and Automatic Control School of Electrical Engineering, <i>Belgrade, Serbia</i>	
ETF BAFA Best Student Award, Class 2003	2003
Awarded by the School of Electrical Engineering in Belgrade Alumni and Friends Association (BAFA)	
Scholarship awarded by Serbian Royal Family	2003
Award presented to only two students of Electrical and Computer Engineering in Serbia	

PUBLICATIONS (JOURNALS)

- J1. V. Lesi, I. Jovanov, and M. Pajic, "Security-Aware Scheduling of Embedded Control Tasks", *ACM Transactions on Embedded Computing Systems*, part of the ESWEEK-TECS special issue, presented in the ACM SIGBED International Conference on Embedded Software (EMSOFT), vol. 16, no. 5s, pp. 188:1-188:21, October 2017.
- J2. M. Elfar, Z. Zhong, Z. Li, K. Chakrabarty, and M. Pajic, "Synthesis of Error-Recovery Protocols for Micro-Electrode-Dot-Array Digital Microfluidic Biochips", *ACM Transactions on Embedded Computing Systems*, part of the ESWEEK-TECS special issue, presented in the International Conference on Compilers, Architecture, and Synthesis for Embedded Systems (CASES), vol. 16, no. 5s, pp. 127:1-127:22, Oct 2017.
- J3. F. Miao, Q. Zhu, M. Pajic, and G. J. Pappas, "A Moving-Horizon Hybrid Stochastic Game for Secure Control of Cyber-Physical Systems", *Automatica*, to appear.
- J4. Z. Li, K. Yi-Tse Lai, P.H. Yu, K. Chakrabarty, M. Pajic, T.Y. Ho and C.Y. Lee, "Efficient and Adaptive Error Recovery in a Micro-Electrode-Dot-Array Digital Microfluidic Biochip", *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, to appear.
- J5. J. Park, R. Ivanov, J. Weimer, M. Pajic, I. Lee, and S. H. Son, "Security of Cyber-Physical Systems in the Presence of Transient Sensor Faults", *ACM Transactions on Cyber-Physical Systems*, vol. 1, no. 3, pp. 15:1-15:23, May 2017.
- J6. M. Pajic, I. Lee, and G. J. Pappas, "Attack-Resilient State Estimation for Noisy Dynamical Systems", *IEEE Transactions on Control of Network Systems*, vol. 4, no. 1, pp. 82 -92, March 2017.
- J7. M. Pajic, J. Weimer, N. Bezzo, O. Sokolsky, G. J. Pappas, I. Lee, "Design and Implementation of Attack-Resilient Cyber-Physical Systems", *IEEE Control Systems Magazine*, vol. 37, no. 2, pp. 66-81, April 2017.
- J8. F. Miao, Q. Zhu, M. Pajic, and G. J. Pappas, "Coding Schemes for Securing Cyber-Physical Systems Against Stealthy Data Injection Attacks", *IEEE Transactions on Control of Network Systems*, vol. 4, no. 1, pp. 106 - 117, March 2017.
- J9. R. Ivanov, M. Pajic, and I. Lee, "Attack-Resilient Sensor Fusion for Safety-Critical Cyber-Physical Systems", *ACM Transactions on Embedded Computing Systems*, vol. 15, no. 1, pp. 21:1 - 21:24, February 2016.
- J10. Z. Jakovljevic, R. Puzovic, and M. Pajic, "Recognition of Planar Segments in Point Cloud based on Wavelet Transform", *IEEE Transactions on Industrial Informatics*, vol. 11, no. 2, pp. 342 - 352, April 2015.
- J11. Z. Jakovljevic, P. B. Petrovic, D. Milkovic, and M. Pajic, "Diagnosis of irregularities in the robotized part mating process based on contextual recognition of contact states transitions", *Assembly Automation*, vol. 35, no. 2, pp. 190 - 199, April 2015.
- J12. K. Gatsis, M. Pajic, A. Ribeiro, and G. J. Pappas, "Opportunistic Control over Shared Wireless Channels", *IEEE Transactions on Automatic Control*, vol. 60, no. 12, pp. 3140 - 3155, March 2015.

- J13. M. Pajic, Z. Jiang, I. Lee, O. Sokolsky, and R. Mangharam, "Safety-critical Medical Device Development using the UPP2SF Model Translation Tool", *ACM Transactions on Embedded Computing Systems*, vol. 13, no. 4s, pp. 127.1-127.26, March 2014.
- J14. M. Pajic, R. Mangharam, O. Sokolsky, D. Arney, J. Goldman, and I. Lee, "Model-Driven Safety Analysis of Closed-Loop Medical Systems", *IEEE Transactions on Industrial Informatics*, vol. 10, no. 1, pp. 3-16, February 2014.
- J15. Z. Jakovljevic, P. Petrovic, D. Milkovic, and M. Pajic, "Fuzzy inference mechanism for recognition of contact states in intelligent robotic assembly", *Journal of Intelligent Manufacturing*, vol. 25, no. 3, pp. 571-587, June 2014.
- J16. Z. Jiang, M. Pajic, R. Alur, and R. Mangharam, "Closed-loop Verification of Medical Devices with Model Abstraction and Refinement", *International Journal on Software Tools for Technology Transfer*, vol. 16, no. 2, pp 191-213, April 2014.
- J17. R. Mangharam and M. Pajic, "Distributed Control for Cyber-Physical Systems", *Journal of the Indian Institute of Science*, vol. 93, no. 3, pp. 353-387, July - September 2013. **Invited paper.**
- J18. M. Pajic, R. Mangharam, G. J. Pappas, and S. Sundaram, "Topological Conditions for In-Network Stabilization of Dynamical Systems", *IEEE Journal on Selected Areas in Communications*, vol. 31, no. 4, pp. 794-807, April 2013.
- J19. M. Pajic, A. Chernoguzov, and R. Mangharam, "Robust Architectures for Embedded Wireless Network Control and Actuation", *ACM Transactions on Embedded Computing Systems*, vol. 11, no. 4, pp. 82:1-82:24, December 2012.
- J20. M. Hadziahmetovic, M. Pajic, S. Grieco, Y. Song, D. Song, Y. Li, A. Cwanger, J. Iacovelli, S. Chu, J. Connelly, M. Spino, and J. Dunaief, "The oral iron chelator deferiprone protects against retinal degeneration induced through diverse mechanisms", *Translational Vision Science & Technology*, vol. 1, no. 3, 2012.
- J21. Z. Jiang, M. Pajic, and R. Mangharam, "Cyber-Physical Modeling of Implantable Cardiac Medical Devices", *Proceedings of the IEEE*, vol. 100, no. 1, pp. 122-137, January 2012.
- J22. M. Pajic, S. Sundaram, G. J. Pappas, and R. Mangharam, "The Wireless Control Network: A New Approach for Control over Networks", *IEEE Transactions on Automatic Control*, vol. 56, no. 10, pp. 2305-2318, October 2011.
- J23. M. Pajic and R. Mangharam, "Spatio-Temporal Techniques for Anti-Jamming in Embedded Wireless Networks", *EURASIP Journal on Wireless Communication and Networking*, vol. 2010, ID 819318, doi: 10.1155/2010/819318, 2010.
- J24. C. Dick, F. Harris, M. Pajic, and D. Vuletic, "Implementing a Real-Time Beamformer on an FPGA Platform", *XCell Journal*, Second Quarter 2007, pp. 36-40, May 2007.

PUBLICATIONS (JOURNALS, SUBMITTED)

1. R. Ivanov, N. Atanasov, M. Pajic, J. Weimer, G.J. Pappas, and I. Lee, "Continuous Estimation Using Context-Dependent Discrete Measurements", *IEEE Transactions on Automatic Control*, submitted.
2. I. Jovanov and M. Pajic, "Relaxing Integrity Requirements for Cyber-Physical Systems", *IEEE Transactions on Automatic Control*, submitted.

PUBLICATIONS (CONFERENCES)

- C1. I. Jovanov and M. Pajic, "Sporadic Data Integrity for Secure State Estimation", *IEEE Conference on Decision and Control (CDC)*, to appear.
- C2. V. Lesi, I. Jovanov, and M. Pajic, "Network Scheduling for Secure Cyber-Physical Systems", *IEEE Real-Time Systems Symposium (RTSS)*, 2017, to appear.
- C3. V. Lesi, I. Jovanov, and M. Pajic, "Security-Aware Scheduling of Embedded Control Tasks", *ACM SIGBED International Conference on Embedded Software (EMSOFT)*, Seoul, Korea, October 2017 (**Best Paper Award**).
- C4. M. Elfar, Z. Zhong, Z. Li, K. Chakrabarty, and M. Pajic, "Synthesis of Error-Recovery Protocols for Micro-Electrode-Dot-Array Digital Microfluidic Biochips", *International Conference on Compilers, Architectures and Synthesis for Embedded Systems (CASES)*, Seoul, Korea, October 2017.
- C5. Z. Jakovljevic, S. Mitrovic and M. Pajic, "Cyber Physical Production Systems-An IEC 61499 Perspective", *Proceedings of 5th International Conference on Advanced Manufacturing Engineering and Technologies (NEWTECH)*, pp. 27-39, June 2017.
- C6. Z. Jakovljevic, V. Majstorovic, S. Stojadinovic, S. Zivkovic, N. Gligorijevic and M. Pajic, "Cyber-Physical Manufacturing Systems (CPMS)", *Proceedings of 5th International Conference on Advanced Manufacturing Engineering and Technologies (NEWTECH)*, pp. 199-214, June 2017.
- C7. J. Park, M. Pajic, O. Sokolsky, and I. Lee, "Automatic Verification of Finite Precision Implementations of Linear Controllers", *International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, pp. 153-169, April 2017.
- C8. R. Fricks, H. Tseng, M. Pajic, and K. Trivedi, "Transient Performance and Availability Modeling in High Volume Eye Care Clinics", *63rd Annual IEEE Reliability and Maintainability Symposium (RAMS)*, pp. 1-6, January 2017.
- C9. Z. Li, K. Yi-Tse Lai Lai, P. H. Yu, K. Chakrabarty, M. Pajic, T. Y. Ho, and C.Y. Lee, "Error Recovery in a Micro-Electrode-Dot-Array Digital Microfluidic Biochip", *International Conference on Computer Aided Design (ICCAD)*, pp. 105:1-105:8, Austin, TX, November 2016.
- C10. P. Bogdan, M. Pajic, P. Pande, and V. Raghunathan, "Making the Internet-of-Things a Reality: From Smart Models, Sensing and Actuation to Energy-Efficient Architectures", *Proceedings of the 11th International Conference on Hardware/Software Co-design and System Synthesis (CODES+ISSS)*, pp. 25:1-25:10, Pittsburgh, PA, October 2016.
- C11. M. Ibrahim, C. Boswell, K. Chakrabarty, K. Scott, and M. Pajic, "A Real-Time Digital-Microfluidic Platform for Epigenetics", *International Conference on Compilers, Architectures and Synthesis for Embedded Systems (CASES)*, pp. 10:1-10:10, Pittsburgh, Pennsylvania, October 2016.
- C12. V. Lesi, Z. Jakovljevic and M. Pajic, "Towards Plug-n-Play Numerical Control for Reconfigurable Manufacturing Systems", *21st IEEE International Conference on Emerging Technologies and Factory Automation (ETFA)*, pp. 1-8, Berlin, Germany, September 2016.
- C13. J. Park, M. Pajic, I. Lee, and O. Sokolsky, "Scalable Verification of Linear Controller Software", *22nd International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, pp. 662-679, Eindhoven, Netherlands, April 2016.
- C14. R. Ivanov, N. Atanasov, J. Weimer, M. Pajic, A. Simpao, M. Rehman, G.J. Pappas, and I. Lee, "Estimation of Blood Oxygen Content Using Context-Aware Filtering", *Proceedings of the 7th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPs)*, pp. 1-10, Vienna, Austria, April 2016.

- C15. R. Mangharam, H. Abbas, M. Behl, K. Jang, M. Pajic and Z. Jiang, "Three challenges in cyber-physical systems", *8th International Conference on Communication Systems and Networks (COMSNETS)*, pp. 1-8, Bangalore, India, 2016.
- C16. M. Pajic, P. Tabuada, I. Lee, and G. J. Pappas, "Attack-Resilient State Estimation in the Presence of Noise", *Proceedings of the 54th IEEE Conference on Decision and Control (CDC)*, pp. 527-532, Osaka, Japan, December 2015.
- C17. M. Pajic, J. Park, I. Lee, G. J. Pappas, and O. Sokolsky, "Automatic Verification of Linear Controller Software", *Proceedings of the 12th ACM SIGBED International Conference on Embedded Software (EMSOFT)*, pp. 217-226, Amsterdam, Netherlands, October 2015.
- C18. M. Al Faruque, F. Regazzoni, and M. Pajic, "Design Methodologies for Securing Cyber-Physical Systems", *Proceedings of the 10th International Conference on Hardware/Software Codesign and System Synthesis (CODES+ISSS)*, pp. 30-36, Amsterdam, Netherlands, October 2015.
- C19. R. Ivanov, N. Atanasov, M. Pajic, G. J. Pappas, and I. Lee, "Robust Estimation Using Context-Aware Filtering", *53rd Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, 2015.
- C20. R. Ivanov, N. Atanasov, M. Pajic, I. Lee, and G. J. Pappas, "Robust Localization Using Context-Aware Filtering", *Workshop on Multi View Geometry in Robotics (MVGRO), in conjunction with RSS*, Rome, Italy, July 2015.
- C21. J. Park, R. Ivanov, J. Weimer, M. Pajic, and I. Lee, "Sensor Attack Detection in the Presence of Transient Faults", *Proceedings of the 6th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, pp. 1-10, Seattle, WA, April 2015.
- C22. K. Gatsis, M. Pajic, A. Ribeiro, and G. J. Pappas, "Opportunistic sensor scheduling in wireless control systems", *Proceedings of the 53rd IEEE Conference on Decision and Control (CDC)*, pp. 3777 - 3782, Los Angeles, CA, December 2014.
- C23. F. Miao, Q. Zhu, M. Pajic, and G. J. Pappas, "Coding Sensor Outputs for Injection Attacks Detection", *Proceedings of the 53rd IEEE Conference on Decision and Control (CDC)*, pp. 5776 - 5781, Los Angeles, CA, December 2014.
- C24. O. Sokolsky, M. Pajic, N. Bezzo, and I. Lee, "Architecture-Centric Software Development for Cyber-Physical Systems", *Workshop on Cyber-Physical System Architectures and Design Methodologies (CPSArch)*, ESWeek, New Delhi, India, 2014.
- C25. N. Bezzo, J. Weimer, M. Pajic, O. Sokolsky, G. J. Pappas, and I. Lee, "Attack Resilient State Estimation for Autonomous Robotic Systems", *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 3692 - 3698, Chicago, IL, September 2014.
- C26. J. Weimer, N. Bezzo, M. Pajic, O. Sokolsky, and I. Lee, "Attack-Resilient Minimum-Variance Estimation", *American Control Conference (ACC)*, pp. 1114-1119, June 2014.
- C27. M. Pajic, J. Weimer, N. Bezzo, P. Tabuada, O. Sokolsky, I. Lee, and G. J. Pappas, "Robustness of Attack-resilient State Estimators", *Proceedings of the 5th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, pp. 163-174, Berlin, Germany, April 2014 (**Best Paper Award**).
- C28. K. Gatsis, M. Pajic, A. Ribeiro, and G. J. Pappas, "Opportunistic Scheduling of Control Tasks over Shared Wireless Channels", *Proceedings of the 5th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, pp. 48-59, Berlin, Germany, April 2014 (**Best Paper Award Finalist**).
- C29. R. Ivanov, M. Pajic, and I. Lee, "Resilient Multidimensional Sensor Fusion using Measurement History", *Proceedings of the 3rd ACM International Conference on High Confidence Networked Systems (HiCoNS)*, pp. 1-10, Berlin, Germany, April 2014.

- C30. R. Ivanov, M. Pajic, and I. Lee, "Attack-Resilient Sensor Fusion", *Design, Automation and Test in Europe (DATE)*, Dresden, Germany, March 2014.
- C31. M. Pajic, S. Sundaram, and G. J. Pappas, "Stabilizability over Deterministic Relay Networks", *Proceedings of the 52nd IEEE Conference on Decision and Control (CDC)*, pp. 4018-4023, Florence, Italy, December 2013.
- C32. K. Gatsis, M. Pajic, A. Ribeiro, and G. J. Pappas, "Power-aware communication for wireless sensor-actuator systems", *Proceedings of the 52nd IEEE Conference on Decision and Control (CDC)*, pp. 4006-4011, Florence, Italy, December 2013.
- C33. F. Miao, M. Pajic, and G. J. Pappas, "Stochastic Game Approach for Replay Attack Detection", *Proceedings of the 52nd IEEE Conference on Decision and Control (CDC)*, pp. 1854-1859, Florence, Italy, December 2013.
- C34. F. Miao, M. Pajic, R. Mangharam, and G. J. Pappas, "Networked Realization of Discrete-Time Controllers", *American Control Conferences (ACC)*, pp. 3002-3007, Washington DC, June 2013.
- C35. M. Pajic, N. Bezzo, J. Weimer, O. Sokolsky, R. Alur, R. Mangharam, N. Michael, G. J. Pappas, P. Tabuada, S. Weirich, and I. Lee, "Towards Synthesis of Platform-aware Attack-Resilient Control Systems", *Proceedings of the 2nd ACM International Conference on High Confidence Networked Systems (HiCoNS)*, Philadelphia, PA, April 2013.
- C36. J. Weimer, N. Bezzo, M. Pajic, G. J. Pappas, O. Sokolsky, and I. Lee, "Resilient Parameter-Invariant Control with Application to Vehicle Cruise Control", *Control of Cyber-Physical Systems (Workshop held at Johns Hopkins University), Lecture Notes in Control and Information Sc.*, vol. 449, pp. 197-216, 2013.
- C37. M. Pajic, S. Sundaram, J. Le Ny, G. J. Pappas, and R. Mangharam, "Closing the Loop: A Simple Distributed Method for Control over Wireless Networks", *Proceedings of the 11th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN)*, pp. 25-36, Beijing, China, April 2012 (**Best Presentation Award**).
- C38. M. Pajic, Z. Jiang, I. Lee, O. Sokolsky, and R. Mangharam, "From Verification to Implementation: A Model Translation Tool and a Pacemaker Case Study", *Proceedings of the 18th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS)*, pp. 173-184, Beijing, China, April 2012 (**Best Student Paper Award**).
- C39. Z. Jiang, M. Pajic, S. Moarref, R. Alur, and R. Mangharam, "Modeling and Verification of a Dual Chamber Implantable Pacemaker", *Lecture Notes in Computer Science, 2012, Volume 7214, Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, pp. 188-203, Tallinn, Estonia, March 2012 (**Best Paper Candidate**).
- C40. M. Pajic, S. Sundaram, G. J. Pappas, and R. Mangharam, "Topological Conditions for Wireless Control Networks", *Proceedings of the 50th IEEE Conference on Decision and Control (CDC)*, pp. 2353-2360, Orlando, FL, December 2011.
- C41. M. Pajic, S. Sundaram, G. J. Pappas, and R. Mangharam, "Network Synthesis for Dynamical System Stabilization", *45th Annual Asilomar Conference on Signals, Systems, and Computers (Asilomar)*, Pacific Grove, CA, November 2011. **Invited paper**.
- C42. Z. Jakovljevic, M. Pajic, D. Aleksendric, and D. Milkovic, "Wireless Sensors Network Application in Machining Operations Control", *Proceedings of the 34th International Conference on Production Engineering (ICPE)*, pp. 365-368, Nis, Serbia, September 2011.
- C43. M. Pajic, S. Sundaram, G. J. Pappas, and R. Mangharam, "A Simple Distributed Method for Control over Wireless Networks", *CPS Week Workshop on Real-Time Wireless for Industrial Applications (RealWIN)*, Chicago, IL, April 2011.

- C44. Z. Jiang, M. Pajic, and R. Mangharam, "Model-based Closed-loop Testing of Implantable Pacemakers", *Proceedings of the 2nd ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, pp. 131-140, Chicago, IL, April 2011.
- C45. M. Pajic, S. Sundaram, J. Le Ny, G. J. Pappas, and R. Mangharam, "The Wireless Control Network: Synthesis and Robustness", *Proceedings of the 49th IEEE Conference on Decision and Control (CDC)*, pp. 7576-7581, Atlanta, GA, December 2010.
- C46. S. Sundaram, M. Pajic, C. N. Hadjicostis, R. Mangharam, and G. J. Pappas, "The Wireless Control Network: Monitoring for Malicious Behavior", *Proc. of the 49th IEEE Conference on Decision and Control (CDC)*, pp. 5979 - 5984, Atlanta, GA, December 2010. **Invited paper.**
- C47. Z. Jiang, M. Pajic, A. Connolly, S. Dixit, and R. Mangharam, "Real-time Heart Model for Implantable Cardiac Device Validation and Verification", *Proc. of the 2010 22nd IEEE/Euromicro Conference on Real-Time Systems (ECRTS)*, pp. 239-248, Brussels, Belgium, July 2010.
- C48. M. Pajic and R. Mangharam, "Embedded Virtual Machines for Robust Wireless Control and Actuation", *Proceedings of the 2010 16th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS)*, pp. 79-88, Stockholm, Sweden, April 2010.
- C49. D. Arney, M. Pajic, J. M. Goldman, I. Lee, R. Mangharam, and O. Sokolsky, "Toward patient safety in closed-loop medical device systems", *Proceedings of the 1st ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, pp. 139-148, Stockholm, Sweden, April 2010.
- C50. R. Mangharam and M. Pajic, "Embedded Virtual Machines for Robust Wireless Control Systems", *ICDCSW '09: Proc. of the 29th IEEE Int. Conf. on Distributed Computing Systems Workshops – 2nd Int. Workshop on Cyber-Physical Systems (WCPS)*, pp. 38-43, Montreal, Canada, June 2009.
- C51. M. Pajic and R. Mangharam, "Anti-Jamming for Wireless Sensor Networks", *Proceedings of the 8th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN)*, pp. 301-312, San Francisco, CA, April 2009.
- C52. M. Pajic and R. Mangharam, "WisperNet: Anti-Jamming for Wireless Sensor Networks", *Proceedings of the 2nd Workshop on Embedded Systems Security, A Workshop of the IEEE/ACM EMSOFT'2008 and the Embedded Systems Week (WESS)*, pp. 38 – 43, Atlanta, GA, September 2008.
- C53. M. Jorgovanovic, M. Pajic, G. Kvascev, and J. Popovic, "FPGA Design of Arbitrary Down-sampler", *Proceedings of 26th IEEE International Conference on Microelectronics (MIEL)*, pp. 391-394, Nis, Serbia, September 2008.
- C54. C. Dick, f. harris, M. Pajic, and D. Vuletic, "Real-Time QRD-Based Beamforming on an FPGA Platform", *Proceedings of Fortieth Asilomar Conference on Conference on Signals, Systems and Computers (Asilomar)*, pp. 1200 – 1204, Monterey, CA, 2006.
- C55. M. Pajic and S. Tadic, "QR Matrix Decomposition Algorithm Based on Virtex-4 FPGA Architecture", *50th Conference for Electronics, Telecommunications, Computers, Automatic Control and Nuclear Engineering (Etran)*, Belgrade, Serbia, June 2006.
- C56. M. Pajic, S. Denic, and S. Tadic, "Timing Synchronization in Burst PAM Modem", *13th Telecommunications Forum (Telfor)*, Belgrade, Serbia, October 2005.
- C57. S. Tadic, S. Denic, M. Pajic, and D. M. Dramicanin, "SDR implementation of CPFSK modem for land mobile radio", *12th Telecommunications Forum (Telfor)*, Belgrade, Serbia, Oct 2004.

PUBLICATIONS (CONFERENCES, SUBMITTED)

1. I. Jovanov, M. Naumann, K. Kumaravelu, W. Grill, and M. Pajic, "Platform for Model-Based Design and Testing for Deep Brain Stimulation", *ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, submitted.
2. H. Zhu, M. Elfar, M. Pajic, and M. L. Cummings, "Human Augmentation of UAV Cyber-Attack Detection", *American Institute of Aeronautics and Astronautics (AIAA)*, submitted.
3. J. Park, M. Pajic, S. Park, O. Sokolsky, I. Lee, "LCV: A Verification Tool for Linear Controller Software", submitted.

PUBLICATIONS (BOOK CHAPTERS)

- B1. R. Ivanov, M. Pajic, and I. Lee, "Attack-Resilient Sensor Fusion for Cyber-Physical Systems", *Multisensor Data Fusion: From Algorithm and Architecture Design to Applications*, pp. 409-424, Aug 2015.

PUBLICATIONS (BOOK CHAPTERS, SUBMITTED)

1. M. Pajic, A. Girard, S. Sundaram, and G. J. Pappas, "Cyber-Physical Systems: A View from Computer Science", *Lecture Notes in Control and Information sciences*, submitted.

PUBLICATIONS (OTHER)

1. M. Elfar, H. Zhu, A. Raghunathan, Y. Tay, J. Wubbenhorst, M. L. Cummings, M. Pajic, "Platform for Security-Aware Design of Human-on-the-Loop Cyber-Physical Systems", **Demonstration at the 8th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS, CPSWEEK 2017)**, Pittsburgh, PA, April 2017.
2. M. Pajic, N. Bezzo, J. Weimer, O. Sokolsky, N. Michael, G. J. Pappas, P. Tabuada, and I. Lee, "Synthesis of Platform-aware Attack-Resilient Vehicular Systems", **Demonstration at the 4th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS, CPSWEEK 2013)**, Philadelphia, PA, April 2013.
3. S. Sarode, S. Radhakrishnan, V. Sampath, Z. Jiang, M. Pajic, and R. Mangharam, "Model-Based Testing of Implantable Cardiac Devices", **Demonstration at the 3rd ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS, CPSWEEK 2012)**, Beijing, China, April 2012.
4. M. Pajic, S. Sundaram, M. Aneja, S. Vemuri, G. J. Pappas, and R. Mangharam, "Architecture for a Fully Distributed Wireless Control Network", **Demonstration at ACM/IEEE Int. Conf. on Information Processing in Sensor Networks (IPSN, CPSWEEK 2011)**, Chicago, IL, April 2011.
5. Z. Jiang, M. Pajic, and R. Mangharam, "Closed-loop Testing for Implantable Cardiac Pacemakers", **Demonstration at the 10th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN, CPSWEEK 2011)**, Chicago, IL, April 2011.
6. M. Pajic, S. Sundaram, G. J. Pappas, and R. Mangharam, "The Wireless Control Network", **Demonstration at the Annual Multiscale Systems Center (MuSyC) Meeting**, September 2010.
7. M. Pajic, Z. Jiang, A. Connolly, S. Dixit, and R. Mangharam, "A platform for implantable medical device validation", **Demonstration at the 9th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN, CPSWEEK 2010)**, Stockholm, Sweden, April 2010.

8. M. Pajic and R. Mangharam, "Embedded Virtual Machines for Wireless Industrial Automation", **Demonstration at the 8th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN, CPSWEEK 2009)** San Francisco, CA, April 2009.
9. M. Ponjavic and M. Pajic, "Signals and systems - Laboratory Manual" (in Serbian), ISBN 86-7466-252-8, Akademska Misao, Belgrade 2006.

SELECTED TALKS

1. "Towards Automatic Software Verification for Safety-Critical Cyber-Physical Systems", **Safe and Secure Systems and Software Symposium (S5)**, July 2016.
2. "Securing Autonomy in Contested Environments", **Assured Autonomy Workshop at the Florida Institute on National Security, Invited Talk**, April 2016.
3. "Automatic Software Verification for High-Confidence Cyber-Physical Systems", **High-Confidence Software and Systems Conference (HCSS)**, May 2016.
4. "Model-Based Design of Closed-Loop Medical Cyber-Physical Systems", **University of North Carolina**, November 2015.
5. "From Verified Models to Verified Code for Medical Devices", **IEEE Engineering in Medicine and Biology Society Conference (EMBC), NSF/NIH Organized Session on Health Cyber-Physical Systems, Invited Talk**, August 2014.
6. "Design and Implementation of Attack-Resilient Cyber-Physical Systems", **High Confidence Software and Systems Conference (HCSS), Invited Talk**, May 2014.
7. "Closing the Loop with Medical Cyber-Physical Systems", **UCLA Electrical Engineering**, April 2014.
8. "Closing the Loop with Medical Cyber-Physical Systems", **University of Minnesota, Computer Science and Engineering Department Seminar**, April 2014.
9. "Model-Based Design of Closed-Loop Medical Cyber-Physical Systems", **University of Maryland, ISR Special Seminar**, March 2014.
10. "Closing the Loop with Medical Cyber-Physical Systems", **Cornell University, School of Electrical and Computer Engineering**, March 2014.
11. "Closing the Loop with Medical Cyber-Physical Systems", **University of Illinois Urbana-Champaign, Electrical and Computer Engineering Seminar**, March 2014.
12. "Closing the Loop with Medical Cyber-Physical Systems", **Duke University, Electrical and Computer Engineering Seminar**, March 2014.
13. "Closing the Loop with Wireless Cyber-Physical Systems", **Washington University in St. Louis, Department of Computer Science and Engineering Colloquia Series**, February 2014.
14. "Closing the Loop with Medical Cyber-Physical Systems", **University of Virginia, Computer Science Colloquia**, February 2014.
15. "Closing the Loop with Medical Cyber-Physical Systems", **Virginia Tech, Electrical and Computer Engineering Department**, February 2014.
16. "Closing the Loop with Medical Cyber-Physical Systems", **Washington University in St. Louis, Department of Computer Science and Engineering Colloquia Series**, November 2013.
17. "Control Clouds - Cloud Computing for CPS Control", **NSF Workshop on Cloud Computing for Cyber-Physical Systems- Invited talk**, March 2013.

18. "Closing the Loop: A Simple Distributed Method for Control over Wireless Networks", *IPSN*, April 2012 (**Best Presentation Award**).
19. "Wireless Control: Current State of the Art and Future Research", *NAMUR* (International user association of automation technology in process industries) *meeting- Invited talk*, February 2012.
20. "Architecture and Algorithms for the Wireless Controller Cloud", *Honeywell Senior Technologists eSeminar*, October 2010.
21. "The Wireless Control Network: A New Approach for Control over Networks", *Multiscale Systems Center (MuSyC) Mid-Year eWorkshop*, June 2010.

SOFTWARE ARTIFACTS

1. UPP2SF – a tool for automatic translation of UPPAAL timed automata based models into Simulink/Stateflow, 2012.
2. Penn Virtual Heart Model and Closed-loop Implantable Device Models for medical device software validation and verification. Open-source Matlab/Simulink models, 2011.

RESEARCH GROUP

Postdocs

1. Aditya Zutshi

PhD Students

1. Mahmoud Elfar (ECE Duke)
2. Ilija Jovanov (ECE Duke)
3. Vuk Lesi (ECE Duke)
4. Muhammad Abdullah Naeem (ECE Duke)
5. Siddhartha Nalluri (CS Duke)

Undergraduate Students

1. Matthew Cleaveland (ECE Duke)
2. Brianna Loomis (ECE/BME Duke)
3. Michael Naumann (ECE Duke)
4. Adithya Raghunathan (ECE Duke)
5. Yi Yan Tay (ECE Duke)
6. Jeffrey Wubbenhorst (ECE Duke)

Alumni

1. Edward Kim (ECE Duke undergraduate); next position: PhD student at UC Berkeley

Visiting Students

1. Nishant Patel (Summer 2017), undergraduate student from IIT Gandhinagar, India

TEACHING EXPERIENCE

Department of Electrical and Computer Engineering Duke University, *Durham, NC*

Fully responsible for curriculum development and teaching graduate and undergraduate courses

- *ECE 590 – Formal Methods for Cyber-Physical Systems Design* Spring 2017
- *ECE 459 – Introduction to Embedded Systems* Fall 2016, 2017
- *ECE 590 – Cyber-Physical Systems Design* Fall 2015

Instructor

Department of Computer & Information Science, University of Pennsylvania, *Philadelphia, PA*

Fully responsible for curriculum development and teaching a mandatory graduate course

- *CIS 542 – Embedded Systems Programming* Spring 2013

Lecturer, School of Electrical Engineering, University of Belgrade, *Serbia* 2004-2007

Planned and delivered lectures and course notes; designed exams and homework sets; coordinated laboratory teaching assistants

- *Digital Signal Processing* Fall 2004, Fall 2005, Spring 2007
- *Systems for Real-Time Signal Processing* Spring 2004, Spring 2005
- *Digital VLSI Systems Design* Spring 2007
- *Signals and Systems* Spring 2007
- *Digital Systems Design* Fall 2007
- *Basics of Electronics* Fall 2004, Fall 2005, Fall 2007

PROFESSIONAL EXPERIENCE

Research Assistant Sept. 2008 – Sept. 2012

ESE Department, University of Pennsylvania, *Philadelphia, PA*

Research on distributed fault-tolerant wireless controller grids and medical cyber-physical systems

Research Scholar Feb. 2008 – Aug. 2008

ESE Department, University of Pennsylvania, *Philadelphia, PA*

Developed spatio-temporal techniques for anti-jamming in embedded wireless networks

Research Scholar Mar. 2006 – June 2006

Department of Electronic Engineering, E.T.S.I Telecomunicacion, Universidad Politécnica, *Madrid, Spain*

Developed a special purpose OFDM system in FPGA, as part of AMEBA2 project (under TEMPUS JEP 17028-02)

Research Associate Jan. 2004 – Jan. 2008

School of Electrical Engineering, University of Belgrade, *Serbia*

Researched and developed real-time signal processing *proof-of-concept* solutions and architectures on FPGAs and DSPs (in collaboration with Xilinx Advanced Systems Technology Group – DSP Division, Cubic Corporation, IPMobileNet, Signumconcepts and Bitgear Wireless)

Lecturer

Mar. 2004 – Jan. 2008

Department of Electronics Engineering, School of Electrical Engineering, University of Belgrade, *Serbia*

Taught courses in (real-time) digital signal processing, VLSI system design and digital systems design

PROFESSIONAL SERVICE

Journal & Conference Editor

1. Guest-editor, *Special Issue on Medical Cyber-Physical Systems, ACM Transactions on Cyber-Physical Systems*, 2016-2017.
2. Associate Editor, *Mediterranean Conference on Control and Automation (MED)*, 2017.

Conference Organization

1. Publicity Chair, *23rd IEEE International Conference on Embedded and Real-Time Computing Systems and Applications*, Hsinchu, Taiwan, August 2017.
2. Co-Chair, *2nd International Workshop on the Swarm at the Edge of the Cloud*, Co-located with CPS Week, Seattle, WA, April 2015.
3. Track Chair, "Technologies for Safety Assurance of Embedded Circuits and Systems", *15th International Conference on Embedded Systems*, Kolkata, India, January 2016.
4. Chair, RTSS WiP Session - *IEEE Real-Time Systems Symposium (RTSS), Work in Progress Session*, San Antonio, TX, December 2015.
5. Chair, RTSS@Work Session - *IEEE Real-Time Systems Symposium (RTSS), Demo Session*, Rome, Italy, December 2014.

Program Committees

1. ACM/IEEE International Conference on Cyber-Physical Systems (**ICCPS 2015, 2016, 2017**)
2. ACM Conference on Embedded Software (**EMSOFT 2015, 2016, 2017**)
3. IEEE Real-Time Systems Symposium (**RTSS 2013, 2014, 2015, 2016, 2017**) - Cyber-Physical Systems and Wireless Sensor Networks tracks
4. IEEE Real-Time and Embedded Technology and Applications Symposium (**RTAS 2015, 2017**)
5. IEEE International Conference on Embedded and Real-Time Computing Systems & Applications (**RTCSA'16**)
6. International Conference on Computer Aided Design (**ICCAD 2016**)
7. ACM International Conference on High Confidence Networked Systems (**HiCoNS 2014**)
8. IEEE International Conference on Autonomic Computing (**ICAC 2016**)
9. ACM Symposium on Applied Computing (**SAC 2014**) - Track on Mobile Platforms
10. The Analytic Virtual Integration Cyber-Physical Systems (**AVICPS 2014**) Workshop
11. Euromicro Conference on Digital System Design (**DSD 2013, 2014**) - Special Session on CPS
12. ACM/IEEE Conference on Information Processing in Sensor Networks (**IPSN 2013**) – PhD Forum

Journal Reviewer

1. ACM Transactions on Cyber-Physical Systems
2. IEEE Transactions on Automatic Control
3. IEEE Embedded Systems Letters
4. IEEE Transactions on Industrial Informatics

5. IEEE Transactions on Industrial Electronics
6. IEEE Transactions on Computers
7. Automatica
8. IEEE Journal on Selected Areas of Communication
9. IEEE/ASME Transactions on Mechatronics
10. IEEE Transactions on Cybernetics
11. IEEE Transactions on Smart Grids
12. Real-Time Systems Journal
13. Embedded Software Design - Journal of System Architecture
14. Systems & Control Letters
15. Biomedical Signal Processing and Control
16. Information and Computation
17. Measurement

Conference Reviewer

ACM Conference on Embedded Software (**EMSOFT 2010, 2011, 2012, 2014**); IEEE Real-Time and Embedded Technology and Applications Symposium (**RTAS 2009**); IEEE Real-Time Systems Symposium (**RTSS 2011, 2012, 2013**); ACM/IEEE International Conference on Cyber-Physical Systems (**ICCPS 2010, 2012, 2013, 2014**); ACM/IEEE Conference on Information Processing in Sensor Networks (**IPSN 2012**); IEEE Conference on Decision and Control (**CDC 2011, 2012, 2013, 2014, 2015, 2016**); IFAC Workshop on Estimation and Control of Networked Systems (**NecSys 2016**); American Control Conference (**ACC 2013, 2014**); Canadian Conference on Electrical and Computer Engineering (**CCECE 2012**); IEEE/ACM International Conference on Computer-Aided Design (**ICCAD 2011**); Design, Automation, and Test in Europe conference (**DATE 2013**); International Conference on Formal Modeling and Analysis of Timed Systems (**FORMATS 2009,2012**); ACM SIGPLAN/SIGBED Conference on Languages, Compilers, and Tools for Embedded Systems (**LCETS 2009**); IEEE/IFIP Conference on Embedded and Ubiquitous Computing (**EUC 2009**); Military Communications Conference (**MILCOM 2010**); IEEE Multi-conference on Systems and Control (**MSC 2011**); Workshop On High Confidence Medical Devices, Software, and Systems & Medical Device Plug-and-Play Interoperability (**HCMDSS-MDPnP 2011**)

Panelist

1. Federal Trade Commission (FTC) and the National Highway Traffic Safety Administration (NHTSA) workshop on Connected Cars, Panelist on "Security of Connected Cars", *Washington, DC*, June 2017.
2. NSF SaTC PI meeting, Panelist on "Security Challenges for Cyber-Physical Systems", *Washington, DC*, January 2017. Panelist
3. NSF Sponsored Workshop on Cloud Computing for Cyber-Physical Systems, *Washington, DC*, March 2013. Panelist

Government Activities

1. NSF proposal panels: CPS 2014, CISE 2015, SaTC 2017
2. NSF Workshop on Research Frontiers in Medical Cyber-Physical Systems, *Washington, DC*, February 2014 Breakout Group Co-Chair for "Modeling, Simulation, and Verification to Predict Performance and Reliability"
3. Reviewer for Technology Foundation STW, Netherlands' research council for the engineering and applied sciences, 2015

Professional Activities

1. Consultant: DTS Cybersecurity Standard for Connected Diabetes Devices, *Diabetes Technology Society*, 2015

UNIVERSITY SERVICE

Committees

1. Pratt Space Committee, Duke University, Durham, NC, September 2016 - present

Outreach

1. Durham Academy GEMS club (Girls in Engineering, Math and Science) visit to Duke Robotics, Nov. 2016

Ph.D. Thesis Committees

1. Radoslav Ivanov, University of Pennsylvania, July 2017
2. Zipeng Li, Duke University, April 2017

Ph.D. Qualifier Committees

1. Haibei Zhu, PhD Qualifying Exam (Chair), November 2017
2. Atefeh Mehrabi, PhD Qualifying Exam (Chair), October 2017
3. Jianqiao Li, PhD Qualifying Exam, May 2017
4. Fan Wang, PhD Qualifying Exam (Chair), April 2017
5. Adam Konneker, PhD Qualifying Exam (Chair), November 2016
6. Zhongxi Li, PhD Qualifying Exam, November 2016
7. Abhishek Koneru, PhD PhD Qualifying Exam, October 2015
8. Alfredo Velasco, PhD Qualifying Exam, October 2015
9. Shi Jin, PhD Preliminary Exam, May 2017
10. Georgios Mappouras, PhD Preliminary Exam, May 2017
11. Mohamed Ibrahim, PhD Preliminary Exam, March 2017
12. Adam Konneker, PhD Preliminary Exam, August 2017

FUNDING

Total amount (since 07/2015): \$2,045,027.00

Current

1. *CAREER: Foundations for Secure Control of Cyber-Physical Systems*
National Science Foundation (NSF)
PI: Miroslav Pajic
\$441,951; 03/15/2017 – 02/28/2022
2. *Young Investigator Program: Design of High-Assurance Cyber-Physical Systems*
Office of Naval Research (ONR)
PI: Miroslav Pajic
\$510,000; 06/01/2017 – 05/31/2020

3. *Development of Control-Aware Cyber Techniques for Attack-Resilient Industrial Control & Combat Systems*
Office of Naval Research (ONR)
Duke PI: Miroslav Pajic
\$744,876; 10/01/2016 – 09/30/2019
4. *Synergy: Collaborative Research: Security and Privacy-Aware Cyber-Physical Systems*
National Science Foundation (NSF) and Intel Partnership, CPS-Security Program
Duke PI: Miroslav Pajic
\$300,000; 07/01/2015 – 06/30/2018

Past

1. *Design of High-Assurance Autonomous Vehicles*
DARPA High-Assurance Cyber Military Systems (HAMCS) Program subcontract
PI: Miroslav Pajic
\$35,000; 07/01/2015 – 06/30/2016
2. *Development of Safe and Reliable Embedded Systems for Internet-of-Things Applications*
Lord Foundation of North Carolina
PI: Miroslav Pajic
\$13,200; 07/01/2016 – 06/30/2017

CITIZENSHIP AND IMMIGRATION STATUS

US permanent resident; Serbian citizen