Dr. Theodore (Ted) P. Pavlic

CONTACT
INFORMATION

Postdoctoral Researcher
Department of Computer Science and Engineering
The Ohio State University
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RESEARCH
INTERESTS

Complex adaptive systems with applications in control systems engineering and behavioral science: distributed algorithms, agent-based modeling, hybrid dynamic systems, amorphous computing, autonomous systems, control, communications, verification, cooperation, optimization, game theory, resource allocation, parallel computation, robotics, behavioral ecology, engineering education, bio-mimicry and bio-inspiration

ACADEMIC
APPOINTMENTS

Postdoctoral Researcher   September 2010 to present
Department of Computer Science and Engineering, The Ohio State University
- National Science Foundation Cyber-Physical Systems (ENG, ECCS)
  – "Autonomous Driving in Mixed-Traffic Urban Environments" (grant #0931669)
  – Supervisor (co-PI): Professor Paolo A. G. Sivilotti
  – PI: Professor Ümit Özgüner

EDUCATION

The Ohio State University, Columbus, OH

Ph.D., Electrical and Computer Engineering, August 2010
- Thesis Topic: *Design and Analysis of Optimal Task-Processing Agents*
- Candidacy: *Research Problems in Distributed Control for Energy Systems*
- Adviser: Professor Kevin M. Passino
- Area of Study: Control Engineering

M.S., Electrical and Computer Engineering, August 2007
- Thesis Topic: *Optimal Foraging Theory Revisited*
- Adviser: Professor Kevin M. Passino
- Area of Study: Control Engineering

B.S., Electrical and Computer Engineering, June 2004
- *Magna cum Laude*, With Honors in Engineering
- Electrical specialization (emphasis on electromagnetics and digital computers)
- Minor in Computer and Information Systems (programming and algorithms)

REFEREED
JOURNAL
PUBLICATIONS

[1] Pavlic, T.P., and K.M. Passino. Generalizing foraging theory for analysis and design. *The International Journal of Robotics Research [Special Issue on Stochasticity in Robotics and Bio-Systems Part 1]*. 30(5):505–523. 2011. doi:10.1177/0278364910396551

[2] Pavlic, T.P., and K.M. Passino. The sunk-cost effect as an optimal rate-maximizing behavior. *Acta Biotheoretica*, 59(1):53–66. 2011. doi:10.1007/s10441-010-9107-8

[3] Pavlic, T.P., and K.M. Passino. When rate maximization is impulsive. *Behavioral Ecology and Sociobiology*, 64(8):1255–1265. August 2010. doi:10.1007/s00265-010-0940-1

[4] Pavlic, T.P., and K.M. Passino. Foraging theory for autonomous vehicle speed choice. *Engineering Applications of Artificial Intelligence*, 22(3):482–489, April 2009. doi:10.1016/j.engappai.2008.10.017

Submitted
Journal
Publications

[5] Pavlic, T.P., and K.M. Passino. Cooperative task processing. *IEEE Transactions on Systems, Man, and Cybernetics*. 2012. Submitted.

Conference
Publications

[6] Pavlic, T.P., P.A.G. Sivilotti, A.D. Weide, and B.W. Weide. Verification of Smooth and Close Collision-Free Cruise Control. In: *Proceedings of the 2011 Symposium on Control and Modeling Cyber-Physical Systems*, October 20–21, 2011. Poster abstract.

[7] Özgüner, Ü., A. Krishnamurthy, F. Özgüner, K. Redmill, P. Sivilotti, B. Weide, and T. Pavlic. CPS: Autonomous driving in urban environments. In: *Proceedings of the 2011 NSF CPS PI Meeting*, August 1–2, 2011. Poster abstract.

[8] Pavlic, T.P. Stigmergic memory for real-time primal-space distributed optimization under constraints. In: *Proceedings of the 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC 2011)*, December 12–15, 2011. Submitted.

[9] Pavlic, T.P., and K.M. Passino. Cooperative task-processing networks. In: *Proceedings of the Second International Workshop on Networks of Cooperating Objects (CONET 2011)*, April 11, 2011.

[10] Pavlic, T.P., and K.M. Passino. Cooperative task processing. In: *Proceedings of the ICAM 2009 Symposium: Emergence in Physical, Biological, and Social Systems IV*, November 13, 2009. Poster abstract.

[11] Freuler, R.J., M.J. Hoffmann, T.P. Pavlic, J.M. Beams, J.P. Radigan, P.K. Dutta, J.T. Demel, and E.D. Justen. Experiences with a Comprehensive Freshman Hands-On Course – Designing, Building, and Testing Small Autonomous Robots. In: *Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition*, 2003.

Other
Publications

[12] Pavlic, T.P., P.A.G. Sivilotti, A.D. Weide, and B.W. Weide. Comments on 'Adaptive Cruise Control: Hybrid, Distributed, and Now Formally Verified'. Tech. report OSU-CISRC-7/11-TR22, The Ohio State University, 2011.

[13] Pavlic, T.P., and K.M. Passino. Cooperative Task-processing Networks: Parallel Computation of Non-trivial Volunteering Equilibria. Tech. report OSU-CISRC-3/11-TR05, The Ohio State University, 2011.

[14] Pavlic, T.P. *Design and Analysis of Optimal Task-Processing Agents*. PhD thesis, The Ohio State University, Columbus, OH, 2010.

[15] Pavlic, T.P. *Optimal Foraging Theory Revisited*. Master's thesis, The Ohio State University, Columbus, OH, 2007.

Books in
Preparation

[16] Pavlic, T.P., B.W. Andrews, K.M. Passino, and T.A. Waite. *Foraging Theory for Engineering*.

Papers in
Preparation

[17] Pavlic, T.P., K.M. Passino. Distributed optimization under constraints: Pareto-optimal intelligent lighting.

[18] Pavlic, T.P. The ideal free distribution as degenerate form of nutrient-constrained optimization.

Grants

Senior staff, "Autonomous Driving in Mixed-Traffic Urban Environments", NSF, ECCS-0931669, $1,499,833, September 1, 2009 to August 31, 2012.

Senior staff, "Cooperative LED Arrays for Preference-Adaptive Lighting in Smart Buildings", NSF, EFRI-SEED preliminary proposal, 2009.

STUDENT ADVISING	**Cory Henderson**, **James O'Donnell**, **Ian Neack**, and **Patrick Whewell**. Undergraduate students in Electrical and Computer Engineering. Group design project on retrofittable vehicle-to-vehicle communications system for adaptive-cruise-control in mixed-traffic environments. 2012.

Manas Agrawal. Graduate student in Computer Science and Engineering. Software verification and model checking applied to railroad safety problems. 2012.

Sai Prathyusha Peddi. Graduate student in Computer Science and Engineering. Software verification applied to adaptive cruise control and instrumented intersection signal timing. 2011–2012.

Jaeyong Park. Graduate student in Electrical and Computer Engineering. Provably correct on-line control synthesis for autonomous vehicles with hybrid dynamics. 2011–2012.

TEACHING EXPERIENCE

The Ohio State University, Columbus, OH

Instructor **March 2012 to August 2012**

- Instructor for ECE 683: Undergraduate Design Project
  - Students designed retrofitable vehicle-to-vehicle communications system to aid in the development of verifiably safe adaptive cruise control.
  - Design project folded into larger research project on autonomous vehicles in mixed-traffic urban environments.

Teaching Assistant **September 2007 to August 2009**
(sample graded material and student evaluations available upon request)

- Instructor for ECE 327: Electronic Devices and Circuits Laboratory I
  - Autumn 2007, Winter (2) and Spring 2008 (2), Winter (2) and Summer 2009
  - Responsible for 1-hour lecture and supervision of 3-hour laboratory. Students design and implement infrared modem and 8-ohm speaker driver.
  - Authored hundreds of pages of course material archived at http://www.tedpavlic.com/teaching/osu/ece327.

- Grader for ECE 481 Ethics in Electrical and Computer Engineering
  - Autumn 2007 and Autumn 2008

- Instructor for ECE 209: Circuits and Electronics Laboratory
  - Autumn 2008
  - Responsible for lecture and supervision of basic electronics laboratory.
  - Authored material at http://www.tedpavlic.com/teaching/osu/ece209.

- Instructor for ECE 557: Control, Signals, and Systems Laboratory
  - Summer 2008 (2 sections) and Summer 2009
  - Responsible for lecture and supervision of laboratory. Students used Simulink and dSPACE RTI1104 units for linear system control design.
  - Authored material at http://www.tedpavlic.com/teaching/osu/ece557.

- Lab Instructor for ECE 758: Control Systems Implementation Laboratory
  - Spring 2009 (2 sections)
  - Responsible for lecture and supervision of laboratory. Graduate and senior undergraduate students used Simulink, with dSPACE RTI1104 units for analysis of and advanced control implementation for linear and non-linear systems.
  - Authored material at http://www.tedpavlic.com/teaching/osu/ece758.

National Science Foundation GK-12 Fellow **September 2006 to October 2007**

Developed, implemented, and evaluated daily inquiry-based fourth-grade science lessons for a local inner-city public school class.

Instructor   **March 2002 to June 2004**

- Member of Fundamentals of Engineering for Honors instructional team.
- Special graduate teaching appointment as undergraduate.
- Lectured weekly engineering laboratory for ENG H191, H192, and H193.
- Trained in-class undergraduate teaching assistants in laboratory procedure.
- Graded weekly lab reports and provided laboratory exams.

Teaching Assistant   **September 2000 to March 2002**

- Assisted Fundamentals of Engineering for Honors instructional team.
- Provided support to first-year engineering students (ENG H191, H192, and H193).
- Graded daily assignments on programming and drafting.
- Developed on-line journal system for Physics Education Research Group (PERG).

Undergraduate Researcher   **September 2000 to March 2002**

- Participated in the Europa Undergraduate Research Forum, a part of the Reusable Software Research Group.
- Studied component-based software engineering undergraduate pedagogy.
- Researched changes to RESOLVE/C++ implementation for ANSI compliance.

Grader   **September 2001 to December 2001**

- Graded daily electromagnetics assignments (ECE 311).

PROFESSIONAL SERVICE

Referee Service
- *49th Annual Conference on Decision and Control*
- *Bioinspiration & Biomimetics*
- *Behavioral Ecology*
- *IEEE Transactions on Signal Processing*
- *The International Journal of Robotics Research*
- *Swarm and Evolutionary Computation*
- *IEEE Transactions on Control Systems Technology*
- *International Journal of Control*

Conference Service
- Organizer/Associate Editor for invited session: "Correctness by Verification and Design", 14th IEEE Conference on Intelligent Transportation Systems (ITSC 2011), Washington, DC, October 5–7, 2011.

PROFESSIONAL EXPERIENCE

The Ohio State University, Columbus, OH

Postdoctoral Researcher   **September 2010 to present**

- Funding: National Science Foundation Cyber-Physical Systems (ENG, ECCS)
  - "Autonomous Driving in Mixed-Traffic Urban Environments" (grant #0931669)
  - Supervisor (co-PI): Professor Paolo A. G. Sivilotti
  - PI: Professor Ümit Özgüner
- Developed new approaches to software verification in the context of hybrid-state and hybrid-time dynamical systems.
- Supervised student design project for novel vehicle-to-vehicle communications systems to assist in adaptive cruise control.

National Instruments, Austin, TX

Hardware R&D Intern for Multifunction DAQ   **June 2003 to September 2003**

- Designed final verification test fixture for use with STC2 MIO products.
- Designed and executed study of the effect of varying burn-in time on long-term drift of common industry voltage references.

Hardware R&D Intern for Multifunction DAQ   **June 2002 to September 2002**

- Designed and performed validation tests for 16-bit 800 kHz NI-6120 SMIO DAQ.
- Designed high-quality source to use with NI-5411 arbitrary function generator.

IBM Network Storage, Research Triangle Park, NC

Core Systems Software Developer for FlexNAS   **June 2001 to September 2001**

- Designed and implemented highly available multihop communications subsystem.
- Participated in software development of various vital box services.

CallTech Communications, Columbus, OH

Information Technology Systems Engineer   **June 1997 to May 2001**

- Responsible for the acquisition, setup, and administration of all hardware and software systems supporting NetWalk Internet service and web presence provider.
- Designed and implemented state-of-the-art open-source highly available load-balancing system supporting thousands of virtual servers.
- Developed call-center software for clients such as CompuServe, AOL, and Priceline.

MegaLinx Communications, Dublin, OH

Web Developer and Support Representative   **June 1995 to May 1997**

- Produced web content for commercial clients.
- Assisted in administration of UltraSPARC, x86, 680x0, and PowerPC systems.
- Developed multi-platform open-source file-sharing solution.
- Provided technical support for Internet and web presence customers.

PROFESSIONAL
MEMBERSHIPS

Institute for Electrical and Electronics Engineers (IEEE), Member, 2002–present
- IEEE Control Systems Society (2004–present)
- IEEE Computer Society (2009–present)
- IEEE Intelligent Transportation Systems Society (2011–present)
- IEEE Systems, Man, and Cybernetics Society (2011–present)
- IEEE Robotics and Automation Society (2011–present)

Animal Behavior Society, Member, 2011–present

Society for Mathematical Biology, Member, 2012–present

SERVICE

Recent contributor to several open-source software projects, including:
- Vim-LaTeX suite
- Vimperator and Pentadactyl Firefox extensions
- Git distributed version control system
- Mercurial distributed version control system
- Personal projects archived at `http://hg.tedpavlic.com/`

Frequent contributor to Wikipedia
- Significant contributions to articles on control theory, electronics, and signals and systems.

Contributor to Quora
- Contributions to articles on thermodynamics, chaos theory, electronics, and evolutionary biology.

OSU FIRST Robotics Team, The Ohio State University, 2000–2004
- Introduced middle school and high school students to science and technology by participating with them in national robotics competitions.
- Led 2002 team to regional silver medal *Engineering Inspiration Award*.
- *Lead Team Mentor*, 2002–2004
- *Component Design Team Lead Mentor*, 2001–2002

Director of Computers, Engineers' Council, The Ohio State University, 2002

Linux Virtual Server Project, 1999–2000
- Early member of the team that formed the open-source project that is now an important load balancing solution for the Linux software platform.

Greater Columbus Free-Net, 1995–1997
- Provided technical support services.

CompuTeen Bulletin Board System, 1993–1995
- Administrated dial-up bulletin board system.
- Founded and administrated TeenLiNK, an international electronic mail network that spread through the United States, Canada, and Australia and delivered mail over a series of electronic dial-up drop offs.

APPLICATION AREAS

Autonomous and Unmanned Vehicles, Flexible Manufacturing Systems, Distributed Power Generation, Intelligent Lighting, Power Demand Response, Microgrids, Smart Grids

HARDWARE AND SOFTWARE SKILLS

Analog and Digital Electronics:
- Bipolar and FET implementations of continuous and switched amplifiers, modulators, converters, and filters
- Computer-Aided Design Tools: Cadence OrCAD, NI Multisim, SPICE, pst-circ

Embedded and Real-time Systems:
- Software and hardware development with several MCU and DSP platforms (e.g., Motorola MCU's, Texas Instruments DSP's, Atmel ATmega MCU's, Microchip PIC MCU's, and others)

Instrumentation, Control, Data Acquisition, Test, and Measurement:
- dSPACE hardware (e.g., RTI1104) and Control Desk software, Simulink, LabVIEW and other National Instruments control and data acquisition hardware and software (e.g., MIO, SMIO, DSA, DMM, and others), Hewlett-Packard and Agilent bench-top equipment

Computer Programming:
- C, C++, Java, JavaScript, NetLogo, Pascal, Perl, PHP, Lisp, UNIX shell scripting (including POSIX.2), GNU make, AppleScript, SQL, MySQL, MATLAB, Maple, Mathematica, and others

Version Control and Software Configuration Management:
- DVCS (Mercurial/MQ, Git/StGit), VCS (RCS, CVS, SVN, SCCS), and others

MATLAB skill set:
- Linear algebra, Fourier transforms, Monte Carlo analysis, nonlinear numerical methods, polynomials, statistics, N-dimensional filters, visualization
- Toolboxes: communications, control system, filter design, genetic algorithm and direct search, signal processing, system identification

Software Verification:
- KeY, PRISM, KeYmaera

Information/Internet Technology:
- Networking (UDP, TCP, ARP, DNS, Dynamic routing), Services (Apache, SQL, MediaWiki, POP, IMAP, SMTP, application-specific daemon design)

Productivity Applications:
- TEX (LATEX, BIBTEX, PSTricks), Vim, most common productivity packages (for Windows, OS X, and Linux platforms)

Operating Systems:
- Microsoft Windows family, Apple OS X, IBM OS/2, Linux, BSD, IRIX, AIX, Solaris, and other UNIX variants

EXPERTISE

Mathematics:
- Applied Mathematics, Real and Complex Analysis, Measure Theory, Differential Geometry, Game Theory, Graph Theory, Combinatorics

Control Theory and Engineering:
- Linear and Nonlinear Systems Theory, Feedback, Variable Structure Systems and Sliding Modes, Distributed and Intelligent Control, Dynamic Optimization, Biomimicry, Bioinspiration, Hybrid and CyberPhysical Systems

Communications and Signal Processing:
- Probability, Random Variables, Stochastic Processes, Information Theory, Estimation, Networks

Computer Science and Engineering:
- Model Checking (automated, distributed, hybrid, probabilistic), Hybrid Automata, Software Verification, Component-Based Reusable Software

Natural Sciences (Biology, Neuroscience, Psychology, Anthropology):
- Behavioral Ecology, Foraging Theory, Altruism, Impulsiveness, Evolution

AWARDS

National Science Foundation
- GK-12 Fellowship, 2006–2007
- Graduate Research Fellowship Honorable Mention, 2005

The Ohio State University
- Dean's Distinguished University Fellowship, 2004–2010
- Electrical and Computer Engineering Bradshaw Scholarship, 2002–2004
- Electrical and Computer Engineering Shafstall Scholarship, 2001–2003
- University Scholarship, 1999–2003

SECURITY CLEARANCE

Department of Defense Top Secret SCI with polygraph (expired: 2002)

REFERENCES AVAILABLE TO CONTACT

Dr. Kevin M. Passino (e-mail: passino.1@osu.edu; phone: +1-614-312-2472)
- Professor, Electrical and Computer Engineering, The Ohio State University
- ◇ 205 Dreese Laboratories, 2015 Neil Ave., Columbus, OH 43210
- ⋆ *Dr. Passino was my graduate adviser.*

Dr. Bruce W. Weide (e-mail: weide.1@osu.edu; phone: +1-614-292-1517)
- Professor and Associate Chair, Computer Science and Engineering
  The Ohio State University
- ◇ 395 Dreese Laboratories, 2015 Neil Ave., Columbus, OH 43210
- ⋆ *Dr. Weide is a co-PI on the NSF grant that funds my current postdoctoral position.*

Dr. Ian M. Hamilton (e-mail: hamilton.598@osu.edu; phone: +1-614-292-9147)
- Assistant Professor, Evolution, Ecology, and Organismal Biology and Mathematics
  The Ohio State University
- ◇ 300 Aronoff Laboratory, 318 W. 12th Avenue, Columbus, OH 43210
- ⋆ *Dr. Hamilton has been a valuable interdisciplinary resource to me.*

Dr. Andrea Serrani (e-mail: serrani.1@osu.edu; phone: +1-614-292-4976)
- Associate Professor, Electrical and Computer Engineering
  The Ohio State University
- ◇ 205 Dreese Laboratories, 2015 Neil Ave., Columbus, OH 43210
- ⋆ *Dr. Serrani was a member of my doctoral committee.*

Dr. Paolo A. G. Sivilotti (e-mail: sivilotti.1@osu.edu; phone: +1-614-292-5835)
- Associate Professor, Computer Science and Engineering, The Ohio State University
- ◇ 395 Dreese Laboratories, 2015 Neil Ave., Columbus, OH 43210
- ⋆ *Dr. Sivilotti is a co-PI on the NSF grant that funds my current postdoctoral position.*

Dr. Richard J. Freuler (e-mail: freuler.1@osu.edu; phone: +1-614-688-0499)
- Professor of Practice, Mechanical and Aerospace Engineering
  The Ohio State University
- ◇ 244 Hitchcock Hall, 2070 Neil Ave., Columbus, OH 43210
- ⋆ *Dr. Freuler coordinates the Fundamentals of Engineering for Honors program in which I served as an instructor early in my academic career.*

Dr. George H. Staab (e-mail: staab.1@osu.edu; phone: +1-614-292-7920)
- Associate Professor, Mechanical and Aerospace Engineering
  The Ohio State University
- ◇ W192 Scott Laboratory, 201 W. 19th Ave., Columbus, OH 43210
- ⋆ *Dr. Staab is the faculty adviser for the OSU FIRST robotics and engineering outreach group of which I was a four-year member and team leader.*

Dr. Clayton Daigle (e-mail: Clayton.Daigle@silabs.com; phone: +1-512-532-5935)
- Mixed-Signal Engineer, Silicon Laboratories, Austin, TX
- ⋆ *Dr. Daigle was my direct supervisor when I worked for National Instruments as an analog hardware R&D engineer.*

MORE
INFORMATION

More information and auxiliary documents can be found at
http://www.tedpavlic.com/facjobsearch/.