

# Heather M. Conboy

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## Research Interests:

Software engineering - requirements engineering, program analysis, and real-time monitoring/guidance

## Education:

**Ph.D. in Computer Science**, UMass Amherst, May 2017

Thesis: “Automatic Derivation of Requirements for Components Used in Human-Intensive Systems”

Co-Advisors: Lori A. Clarke and George S. Avrunin

**M.S. in Computer Science**, UMass Amherst, Sept. 2007

**B.S. with Honors**, Major in Computer Science, Minor in Chemistry, UMass Amherst, May 1997

GPA 3.937/4.0, William F. Field Alumni Scholar 1996, Phi Beta Kappa 1995

## Research Experience:

After completing my B.S. degree, I worked full-time as a software engineer, and later also became a part-time Masters student. I took one or two courses a semester until completing my MS degree in 2007, when I became a full-time PhD student.

**Postdoctoral Researcher**, June 2017 - present

School of Information and Computer Sciences, UMass Amherst

Under direction of George S. Avrunin, Lori A. Clarke, and Leon J. Osterweil

- Investigating techniques to improve the quality of human-intensive processes (e.g., medical processes) involving coordination among human performers, software applications, and hardware devices. Working with domain experts, formally modeling the processes in the Little-JIL process programming language and then validating the models using manual reviews and automated techniques for model checking and fault tree analysis.
- Collaborating on a framework for Smart Checklists, which provide dynamic, context-aware guidance to human performers by showing past, current, and possible next process activities. Was one of two primary developers of this framework that dynamically updates the Smart Checklists by comparing validated process models against monitored real-world process events. Obtained initial positive feedback from focus groups and now performing a human simulation study.

**Research Assistant**, Sept. 2007 – May 2017

School of Information and Computer Sciences, UMass Amherst

Under direction of George S. Avrunin and Lori A. Clarke

- Developed a process-based requirement derivation approach that extended interface synthesis methods that employ model checking techniques to produce derived requirements that prevent violations of the system requirements. Applied to case studies in the healthcare and election administration domains. Showed that the derived requirements could provide insights about the components, processes, or both and that the requirement derivation had reasonable performance.

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### Software Engineer, July 1997 – Aug. 2007

Laboratory for Advanced Software Engineering Research, University of Massachusetts Amherst  
Under direction of George S. Avrunin, Lori A. Clarke, and Leon J. Osterweil

- Became the primary developer and maintainer of the FLAVERS model checker, which determines whether a system adheres to user-defined safety properties. Supervised student projects.
- Contributed to the evaluation of FLAVERS for Little-JIL, Java, and Ada (<http://laser.cs.umass.edu/verification-examples> for Ada).

### Refereed Papers

- “Piloting an Interactive Ethics and Responsible Computing Learning Environment in Undergraduate CS Courses”, Francisco Castro, Sahitya Raipura, *Heather Conboy*, Peter Haas, Leon Osterweil, Ivan Arroyo, In Proceedings of the 54th ACM Technical Symposium on Computer Science Education (SIGCSE 2023), 2023, pp. 659-665.
- “A Coding Framework for Usability Evaluation of Digital Health Technologies”, Mahdi Ebnali, Lauren Kennedy-Metz, *Heather Conboy*, Lori Clarke, Leon Osterweil, George Avrunin, Christian Miccile, Maria Arshanskiy, Annette Phillips, Marco Zenati, Roger Dias, In Proceedings of the 2022 International Conference on Human-Computer Interaction (HCI International 2022), 2022, pp. 185-196.
- “Dissecting cardiac surgery: A video-based recall protocol to elucidate team cognitive processes in the operating room”. Roger D. Dias, Marco A. Zenati, *Heather M. Conboy*, Lori A. Clarke, Leon J. Osterweil, George A. Avrunin, Steven J. Yule. *Annals of Surgery*, Volume 274, Issue 2, 2021.
- “Analysis of Dynamic Changes in Cognitive Workload during Cardiac Surgery Perfusionists’ Interactions with the Cardiopulmonary Bypass Pump”. Lauren R. Kennedy-Metz, Roger D. Dias, Rithy Srey, Geoffrey C. Rance, *Heather M. Conboy*, Miguel E. Haime, Jacquelyn A. Quin, Steven J. Yule, Marco A. Zenati. *Human Factors*, Volume 63, Issue 5, 2021, pp. 757-771.
- "Digital Cognitive Aids to Support Adaptation of Surgical Processes to COVID-19 Protective Policies", *Heather M. Conboy*, Lauren R. Kennedy-Metz, George S. Avrunin, Lori A. Clarke, Leon J. Osterweil, Roger D. Dias, Marco A. Zenati, In Proceedings of the 2020 IEEE Conference on Cognitive and Computational Aspects of Situation Management (CogSIMA'20), Victoria, BC, Canada, 2020, pp. 205-210. (Presenter, virtual)
- “Process-Model-Driven Guidance to Reduce Surgical Procedure Errors: An Expert Opinion”, Leon J. Osterweil, *Heather M. Conboy*, Lori A. Clarke, and George S. Avrunin, *Seminars in Thoracic Cardiovascular Surgery*, Volume 31, Issue 3, Autumn 2019, pp. 453-457.
- “Process Driven Guidance for Complex Surgical Procedures”, George S. Avrunin, Stefan C. Christov, *Heather M. Conboy*, Lori A. Clarke, Leon J. Osterweil, and Marco A. Zenati, *American Medical Informatics Association Annual Symposium Proceedings (AMIA'18)*, 2018, pp. 175-184. (Presenter)
- “Intelligent Interruption Management System to Enhance Safety and Performance in Complex Surgical and Robotic Procedures”, Roger D. Dias, *Heather M. Conboy*, Jennifer M. Gabany, Lori A. Clarke, Leon J. Osterweil, David Arney, Julian M. Goldman, Giuseppe Riccardi, George S. Avrunin, Steven J. Yule, and Marco A. Zenati, “OR 2.0 Context-Aware Operating Theaters, Computer Assisted Robotic Endoscopy, Clinical Image-Based Procedures, and Skin Image Analysis”, 2018, pp. 62 - 68.

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- “Development of an Interactive Dashboard to Analyze Cognitive Workload of Surgical Teams During Complex Procedural Care”, Roger Daglius Dias, *Heather Conboy*, Jennifer Gabany, Lori Clarke, Leon Osterweil, George S. Avrunin, David Arney, Julian Goldman, Giuseppe Riccardi, Steven Yule, and Marco A. Zenati, In Proceedings of the 2018 IEEE Conference on Cognitive and Computational Aspects of Situation Management (CogSIMA’18), 2018, pp. 77 - 82.
- “Toward Improving Surgical Outcomes by Incorporating Cognitive Load Measurement into Process-Driven Guidance”, George S. Avrunin, Lori A. Clarke, *Heather M. Conboy*, Leon J. Osterweil, Roger D. Dias, Steven J. Yule, Julian M. Goldman, and Marco A. Zenati, In Proceedings of the 2018 IEEE/ACM International Workshop on Software Engineering in Healthcare Systems (SEHS’18), 2018, pp. 2 - 9. (Presenter)
- “Cognitive Support During High-Consequence Episodes of Care in Cardiovascular Surgery”, *Heather M. Conboy*, George S. Avrunin, Lori A. Clarke, Leon J. Osterweil, Stefan C. Christov, Julian M. Goldman, Steven J. Yule, and Marco A. Zenati, In Proceedings of the 2017 IEEE Conference on Cognitive and Computational Aspects of Situation Management (CogSIMA’17), 2017, pp. 1 - 3. (Presenter)
- “A Comprehensive Framework for Using Iterative Analysis to Improve Human-Intensive Process Security: An Election Example”, Leon J. Osterweil, Matt Bishop, *Heather M. Conboy*, Huong Phan, Borislava I. Simidchieva, George S. Avrunin, Lori A. Clarke, and Sean Peissart, In ACM Transactions on Privacy and Security (TOPS), 2017, pp. 5:1 - 5:31.
- “Smart Checklists to Improve Healthcare Outcomes”, Stefan C. Christov, *Heather M. Conboy*, Nancy Famigletti, George S. Avrunin, Lori A. Clarke, and Leon J. Osterweil, In Proceedings of the International Conference on Software Engineering (ICSE) 2016 Workshop on Software Engineering in Healthcare Systems (SEHS’16), 2016, pp. 54 - 57. (Presenter)
- “Process Modelling of Aortic Cannulation in Cardiac Surgery: Toward a Smart Checklist to Mitigate the Risk of Stroke”, *Heather M. Conboy*, Jason K. Maron, Stefan C. Christov, George S. Avrunin, Lori A. Clarke, Leon J. Osterweil, and Marco A. Zenati, In Proceedings of the 5<sup>th</sup> Workshop on Modeling and Monitoring of Computer Assisted Interventions (M2CAI’14), 2014. (Available here: <http://laser.cs.umass.edu/techreports/14-015.pdf>).
- “Insider Threat Identification by Process Analysis”, Matt Bishop, *Heather M. Conboy*, Huong Phan, Borislava I. Simidchieva, George S. Avrunin, Lori A. Clarke, Leon J. Osterweil, and Sean Peisert, In Proceedings of the 1<sup>st</sup> Workshop on Research for Insider Threat (WRIT’14), 2014, pp. 251 - 264.
- “Modal Abstraction View of Requirements for Medical Devices Used in Healthcare Processes”, *Heather M. Conboy*, George S. Avrunin, and Lori A. Clarke, In Proceedings of the ICSE 2013 Workshop on Software Engineering in Health Care (SEHC’13), 2013, pp. 24 - 27. (Presenter)
- “Process-Based Derivation of Requirements for Medical Devices”, *Heather M. Conboy*, George S. Avrunin, and Lori A. Clarke, In Proceedings of the 1<sup>st</sup> ACM International Health Informatics Symposium (IHI ’10), 2010, pp. 656 - 665. (Presenter)

### Invited Talks and Poster Presentations

- “A Model-based Approach to Iteratively Improve Human Intensive Processes”, *Heather M. Conboy*, The Parker Lab, Virginia Tech, March 2022. (Invited talk, virtual)
- “The Use of Process Modeling and Smart Checklists in Healthcare”, *Heather M. Conboy*, Research Seminars, STRATUS Center for Medical Simulation, August 2020. (Invited talk, virtual)

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- “Process-Model-Driven Guidance to Reduce Surgical Procedural Errors”, *Heather M. Conboy*, George S. Avrunin, Stefan C. Christov, Lori A. Clarke, Leon J. Osterweil, and Marco A. Zenati, American Association for Thoracic Surgery (AATS) Surgical Patient Safety Course, Boston, MA, June 2018. (Abstract and poster presentation)
- “MAC (Memory and Aging Center) Process Modeling Project”, *Heather M. Conboy* and Kate Rankin, MAC, University of California San Francisco, March 2014. (Invited talk)
- “Learning Medical Device Requirements from Medical Processes”, *Heather M. Conboy*, George S. Avrunin, and Lori A. Clarke, CRA-W Grad Cohort, San Francisco, CA, March 2009. (Poster presentation)
- “Building Finite State Verifier (FSV) Models from the Bandera Intermediate Representation (BIR)”, *Heather M. Conboy*, George S. Avrunin, Lori A. Clarke, and Stephen F. Siegel, SANTOS Laboratory, Kansas State University Manhattan, KS, February 2002. (Invited talk)

## Teaching and Mentoring Experience

**Instructor**, Introduction to Software Engineering (320 and 429), Spring 2023  
Manning College of Computer and Information Sciences, UMass Amherst

- Supported multiple teams and their managers collaboratively working on semester long software development projects. For the first part of the semester, gave lectures and homework assignments. For the remainder of the semester, had the teams hold weekly team meetings and give weekly team presentations. Met weekly with the team managers. Held a mid-point and final project fair.

**Instructor**, Theory and Practice of Software Engineering (520), Spring 2020, Fall 2020, Spring 2021, Fall 2021, Spring 2022, Fall 2022, Spring 2023  
Manning College of Computer and Information Sciences, UMass Amherst

- Taught in person and remotely. Assigned individual homeworks, in-class group exercises, and a semester long final group project. Developed a course website, Moodle page, and lecture slides. Supervised teaching assistants and graders.

### Graduate Research Mentor

Honors Program Capstone Project, UMass Amherst, Fall 2009/Spring 2010, Spring/Fall 2015, Spring/Fall 2018, Spring 2020/Fall 2020, Fall 2020/Spring 2021

Research Experiences for Undergraduates Program, Summer 2001, 2002, 2008, 2011, 2013, 2015, 2016, 2017

In collaboration with Lori A. Clarke or Leon J. Osterweil

- For each project, held weekly research meetings with the mentee and supervised their software tool development, tool demonstrations, and presentations.

**Teaching Assistant**, Advanced Software Engineering: Analysis (521/621), Fall 2007, 2008, 2009  
School of Computer and Information Sciences, UMass Amherst  
Under the direction of Lori A. Clarke

- During each semester, presented one or two lectures, gave tool demonstrations, held office hours, organized project materials, and graded.

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## Activities

- AMIA Reviewer, Spring 2019, Spring 2020, Spring 2021, Spring 2022, Spring 2023
- ICSE 2019 Demonstrations Track Program Committee Member, Fall 2018
- ICSE 2018 Posters Track Program Committee Member, Spring 2018
- Graduate Student Senator, University of Massachusetts Amherst, Feb. 2011 - Aug. 2011
- CS Women's Group Co-Chair, University of Massachusetts Amherst, June 2009 - Aug 2010

## References

### **George S. Avrunin**

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University of Massachusetts Amherst  
[avrunin@math.umass.edu](mailto:avrunin@math.umass.edu)

### **Lori A. Clarke**

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### **Leon J. Osterweil**

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