

Matthew Piekenbrock

Curriculum Vitae

☎ (937) 269 8582 • ✉ matt.piekenbrock@gmail.com • 🏠 wright.edu/~piekenbrock.5

Education

GPA: 3.8 Overall, 4.0 In-Major

Wright State University

Masters of Science in Computer Science (In Progress)

Dayton, OH

Spring, 2018

Wright State University

Bachelor of Science in Computer Science, Minor in Statistics

Dayton, OH

Fall, 2015

Relevant Courses Taken.....

- Network Science
- Applied Stochastic Processes
- Computational Tools and Techniques for Data Analysis
- Machine Learning
- Applied Statistics I & II
- Theoretical Statistics
- Information Theory
- Algorithm Design and Analysis
- Foundations of Artificial Intelligence

Research Experience

Research Interests: My research interests are in statistical learning theory, unsupervised learning, and building software for the purpose of scientific computing and reproducible research.

Graduate Research Assistant

2015 - 2017

Wright State University

Web and Complex Systems Lab

I'm currently pursuing a M.S. in Computer Science as a Graduate Research Assistant. The topic areas I've focused on include:

- Density-based clustering techniques and theory
- Dynamic or Temporal Network Models
- Trajectory mining and modeling

Much of my work has focused on augmenting the cluster tree, a shape characteristic of an estimated density function, with semi-supervised information for purpose of point of interest (POI) discovery in geospatial contexts [8]. These POIs are then used in a new type of dynamic random graph model, a separate part of the research project I'm indirectly a part of [2]. Additional research on the utility of Generative Adversarial Networks (GANs) and their potential for generating certain types of spatiotemporal data, e.g. trajectory data which is characteristically indistinguishable from a given set of trajectory data, is ongoing. My research is supported by the Center for Surveillance Research, a National Science Foundation I/UCRC.

Student Participant

Summer 2017

Google Summer of Code 2017

R Project for Statistical Computing / Google

I submitted a successful funding proposal under the Google Summer of Code (GSOC) Initiative to the R Project for Statistical Computing to explore, develop, and unify developments related the theory of density-based clustering, namely the recent developments related to the cluster tree. This involved a mixture of code development which culminated in the form of an R package, as well as deep research to further understand the theory and utility of the cluster tree. For more details, see the project page¹.

¹<https://summerofcode.withgoogle.com/archive/2017/projects/5919718795902976/>

Student Research Associate

2017

Air Force Research Laboratory

Oak Ridge Institute for Science and Education

In a collaborative effort to foster new research frontiers in the area of Topology Data Analysis (TDA) between WSU and AFRL, I worked in a research group studying how to combine techniques from the field of topology and machine learning for the purpose of both supervised and unsupervised analysis. I researched theoretical extensions to the *Mapper* framework, an often used modality for performing TDA. My work led to the development of a closed-form solution to compute all distinct simplicial complexes, under certain conditions, usable within the *Mapper* framework. A journal article demonstrating the utility of this solution is currently in development [7].

Undergraduate Research Assistant

2014 - 2016

Air Force Institute of Technology

Oak Ridge Institute for Science and Education

I worked on the development of a novel Iterative Closest Point algorithm amenable to massive parallelization, implemented in C++/CUDA, for the purposes of enabling real-time tracking of aircraft in the context of Autonomous Aerial Refueling. The effort led to multiple publications [3, 4]. I also worked on:

- o Parallelizing existing atmospheric absorption routines with OpenCL through MATLABs MEX interface
- o A model for predicting web navigation patterns using Hierarchical Markov Models
- o A prototypical UI to enhance searching and viewing of 3D models using ThreeJS

Undergraduate Research Assistant

2013 - 2014

Air Force Institute of Technology

Southwestern Ohio Council for Higher Education

As my first part-time position in academia, I worked on a diverse set of projects, often assisting graduate or doctoral students working in the research area with primarily programmatic or educational tasks. This involved:

- o Codifying a novel nonlinear optimization algorithm in ANSI-C
- o Implementing an unsplitable flow approximation algorithm in C++ and Python
- o Creating a conversion tool that allowed for converting back and forth between Oracle's Abstract Data Type specification to its equivalent representation as an XMLType

Publications

Refereed Publications.....

Journals.....

(Under Review) Michael Hahsler, **Matt Piekenbrock**, and Derek Doran. dbscan: Fast density-based clustering with R. *Journal of Statistical Software*.

Conference Papers.....

Jace Robinson and Derek Doran. Seasonality in dynamic stochastic block models. In *Proceedings of the International Conference on Web Intelligence*, pages 976–979. ACM, 2017.

Matt Piekenbrock, Jace Robinson, Lee Burchett, Scott Nykl, Brian Woolley, and Andrew Terzuoli. Automated aerial refueling: Parallelized 3d iterative closest point: Subject area: Guidance and control. In *Aerospace and Electronics Conference (NAECON) and Ohio Innovation Summit (OIS), 2016 IEEE National*, pages 188–192. IEEE, 2016.

Jace Robinson, **Matt Piekenbrock**, Lee Burchett, Scott Nykl, Brian Woolley, and Andrew Terzuoli. Parallelized iterative closest point for autonomous aerial refueling. In *International Symposium on Visual Computing*, pages 593–602. Springer International Publishing, 2016.

Matthew Maurice, **Matt Piekenbrock**, and Derek Doran. Waminet: An open source library for dynamic geospace analysis using wami. In *Multimedia (ISM), 2015 IEEE International Symposium on*, pages 445–448. IEEE, 2015.

Abstracts.....

Derek Doran and **Matt Piekenbrock**. Exploring information-optimal network discretization for dynamic network analysis. *Sunbelt Social Networks Conference of the International Network for Social Network Analysis*, page 262, 2016.

Under Development.....

(*In Development*): **Matt Piekenbrock** and Derek Doran. Cover parameterization and simplicial complex generation for mapper. *SIAM Journal on Applied Algebra and Geometry*, 2018. Draft version available after: http://mattpiekenbrock.com/resources/SIAGA_Mapper.pdf.

Matt Piekenbrock and Derek Doran. Intrinsic point of interest discovery from trajectory data. *arXiv preprint arXiv:1712.05247*, 2017.

Extra Curricular

Regional Model United Nations Annual Conference: Served in Volunteer Staff (2016 - 2017)

Outstanding Position Paper Award: National Model United Nations Annual Conference (2014)

Outstanding Delegation Award: National Model United Nations Annual Conference (2013)