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 — **Dayton, OH**
Masters of Science in Computer Science (In Progress) — *Spring, 2018*

Wright State University — **Dayton, OH**
Bachelor of Science in Computer Science, Minor in Statistics — *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

My work has been focused theory-first approaches to practical density-based clustering. Specifically, 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 [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 page[1].

[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 lead to the development of a closed-form solution which greatly reduces the parametrized complexity *Mapper* framework, but enables more tractable analysis of the *Mapper* construction in the context of Persistent Homology. 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 lead to multiple publications [3, 4]. I also worked on:

- Parallelizing existing atmospheric absorption routines with OpenCL through MATLABs MEX interface
- A model for predicting web navigation patterns using Hierarchical Markov Models
- A prototypical UI to 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:

- Codifying a novel nonlinear optimization algorithm in ANSI-C
- Implementing an unsplittable flow approximation algorithm in C++ and Python
- 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)