Collin A. Politsch

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Research Interests

Machine Learning/Statistics: Massive spatial datasets, spatial modeling, distributed spatial models, time series analysis, signal processing, forecasting, data mining, nonparametric statistics, uncertainty quantification, high-dimensional statistics, statistical machine learning

Astrophysics: Astrostatistics and astroinformatics, cosmostatistics, nonparametric and data-driven astrophysics, Lyman-α forest, intergalactic medium, statistical cosmography, large-scale structure of the Universe, planetary transits

Academic Positions

Flatiron Institute, Center for Computational Astrophysics — New York, NY
Guest Researcher — August 2021 – present

Carnegie Mellon University, Machine Learning Department — Pittsburgh, PA
Postdoctoral Fellow, Supervisor: Ryan J. Tibshirani — July 2020 – July 2021

Education

Carnegie Mellon University — Pittsburgh, PA
Joint Ph.D. in Statistics and Machine Learning — 2020

Dissertation: *Statistical Astrophysics: From Extrasolar Planets to the Large-scale Structure of the Universe*

Award: Umesh K. Gavaskar Memorial Award for Best Ph.D. Dissertation (2020-'21)

Advisors: Larry Wasserman, Jessi Cisewski-Kehe, Rupert A.C. Croft

Carnegie Mellon University — Pittsburgh, PA
M.Sc. in Machine Learning — 2017

Thesis: *Exploring the Intergalactic Medium*

Advisors: Larry Wasserman, Jessi Cisewski-Kehe, Rupert A.C. Croft

University of Kansas — Lawrence, KS
B.Sc. in Mathematics (With Honors) — 2014

Honors Thesis: *On Discrete-Time Linear Quadratic Control*

Advisor: Tyrone E. Duncan

Peer-Reviewed Publications

1. **Three-dimensional cosmography of the high redshift Universe using intergalactic absorption**
   C. A. Politsch, J. Cisewski-Kehe, R. A. C. Croft, L. Wasserman
   In preparation. Pre-submission inquiry approved by *Nature*.

2. **Trend Filtering – I. A Modern Statistical Tool for Astronomical Spectroscopy and Time-Domain Astronomy**
   C. A. Politsch, J. Cisewski-Kehe, R. A. C. Croft, L. Wasserman
   Monthly Notices of the Royal Astronomical Society, Volume 492, Issue 3, March 2020, Pages 4005-4018.
   Publisher. arXiv. trendfiltering R package.

* **Finalist for best paper in the 2020 ASA Astrostatistics Student Paper Competition**, sponsored by the Astrostatistics Interest Group.

3. **Trend Filtering – II. Denoising Astronomical Signals with Varying Degrees of Smoothness**
   C. A. Politsch, J. Cisewski-Kehe, R. A. C. Croft, L. Wasserman
   Monthly Notices of the Royal Astronomical Society, Volume 492, Issue 3, March 2020, Pages 4019-4032.
   Publisher. arXiv. trendfiltering R package.

   * **Finalist for best paper in the 2020 ASA Astrostatistics Student Paper Competition**, sponsored by the Astrostatistics Interest Group.

4. **An Open Repository of Real-Time COVID-19 Indicators**
   A. Reinhart, L. Brooks, M. Jahja, A. Rumack, J. Tang, et al.
   Proceedings of the National Academy of Sciences, Volume 118, Issue 51, December 2021.
   Publisher. medRxiv. Supplement. Data Access.

5. **Evaluation of individual and ensemble probabilistic forecasts of COVID-19 mortality in the US**
   E. Y. Cramer, E. L. Ray, V. K. Lopez, et al.
   Submitted to *Proceedings of the National Academy of Sciences*.
   medRxiv. COVID-19 Forecast Hub.

6. **Augmenting Adjusted Plus-Minus in Soccer with FIFA Ratings**
   F. Matano, L. F. Richardson, T. Pospisil, C. A. Politsch, J. Qin
   Submitted to *Journal of Quantitative Analysis in Sports*.
   arXiv. Up-to-date player ratings.

Other Publications

1. **Mapping the Large-scale Universe through Intergalactic Silhouettes**
   C. A. Politsch and R. A. C. Croft
   CHANCE, Volume 32, Issue 3, Sep. 2019, Pages 14-19.
   Publisher.

Awards and Honors

- 2020-'21 Umesh K. Gavaskar Memorial Award for Best Ph.D. Dissertation in Statistics and Data Science at Carnegie Mellon University.
- Finalist for best paper in the 2020 ASA Astrostatistics Student Paper Competition, sponsored by the Astrostatistics Interest Group.
- 2nd Place: The Data Open 2018 at CMU, presented by Citadel and Correlation One.
  - 300+ applications, ∼125 selected to compete for $25,000 in prizes
- 2nd Place: 2017 NBA Basketball Analytics Hackathon, New York, NY, hosted by the NBA.
  - 900+ applications, ∼200 selected to compete for ∼$20,000 equivalent in tickets, etc.
- 2nd Place: The Data Open 2017 at CMU, presented by Citadel and Correlation One.
  - 550+ applications, ∼125 selected to compete for $25,000 in prizes

- 3rd Place: 2017 CMU BrainHub NeuroHackathon, sponsored by Google.
  - 51 CMU graduate students selected to compete for free tuition and travel stipends

Selected Talks

Invited

- *Three-dimensional cosmography of the high redshift Universe using intergalactic absorption*
  - *Into the Impossible With Brian Keating*, Aug. 2021. YouTube.
  - University of Chicago, Machine Learning in Complex Phenomena seminar series, Chicago, IL. Feb. 2021.
  - University of Maryland, Department of Mathematics, College Park, MD. Nov. 2020.
  - Duke University, Department of Statistical Science, Durham, NC. Nov. 2020.
  - The "Physics of the Future" NSF AI Planning Institute at Carnegie Mellon & the Statistical Methods for the Physical Sciences (STAMPS) Research Group at Carnegie Mellon. Oct. 2020.
  - The Flatiron Institute, Center for Computational Astrophysics & NYU. Oct. 2020.
  - Los Alamos National Laboratory, Los Alamos, NM. Oct. 2020.
- *Trend Filtering: A Modern Statistical Tool for Time-Domain Astronomy and Astronomical Spectroscopy*
  - Joint Statistical Meetings. Best Astrostatistics Student Paper Award Session. Aug. 2020.
  - The "Data-Driven Discovery in Physics" NSF AI Planning Institute at Carnegie Mellon. Oct. 2019.
- *From Mapping the Universe to Forecasting the Pandemic*
  - OnSolve Nexus 2021: Managing Uncertainty for Organizational Resiliency (Paid speaker). April 2021.
- *A Multi-Resolution 3D Map of the Intergalactic Medium via the Lyman-α Forest*
  - Uber Technologies, Inc., San Francisco, CA. Aug. 2018.
  - Statistical and Applied Mathematical Sciences Institute (SAMSI), Cosmology Working Group Seminar Series, Durham, NC. Nov. 2016.

Contributed Conference Proceedings & Seminars

- *Three-dimensional cosmography of the high redshift Universe using intergalactic absorption*
  - Joint Statistical Meetings. Session: *Statistical Challenges in Cosmology*. Aug. 2021.
- *A Multi-Resolution 3D Map of the Intergalactic Medium via the Lyman-α Forest*
  - Statistical and Applied Mathematical Sciences Institute (SAMSI), Astronomy Transition Workshop, Durham, NC. May 2017.
- *Multi-resolution Regression, Divide and Conquer Risk Estimation, and the Large-scale Universe*
  - Department of Statistics & Data Science, Carnegie Mellon University, Pittsburgh, PA. May 2017.
  - Statistical and Applied Mathematical Sciences Institute (SAMSI), Durham, NC. April 2017.
- *Exploring the Intergalactic Medium*
  - Department of Statistics & Data Science, Carnegie Mellon University, Pittsburgh, PA. April 2017.

Software

R package trendfiltering: *The state-of-the-art method for denoising 1D signals*
Available at https://capolitsch.github.io/trendfiltering

R package SALTdenoiseR: *Statistical software for the SALT Observatory*
Available at https://capolitsch.github.io/SALTdenoiseR

R package trendfilteringSupp: *Optimal one-dimensional data analysis with trend filtering*
Available at https://github.com/capolitsch/trendfilteringSupp

R package aardvark: *COVID-19 forecasters from Carnegie Mellon's Delphi research group*
Available at https://github.com/cmu-delphi/covid-19-forecast

Experience

Carnegie Mellon University
Postdoctoral Fellow 08/2020 – 08/2021

Lab: The Delphi Research Group
PI/co-PI(s): Roni Rosenfeld, Ryan J. Tibshirani
Personal role: Lead of COVID-19 forecasting development and evaluation team
Description:

I was a core member of the CMU-based Delphi Research Group and Lead of the forecasting development and evaluation team. Our research was devoted to developing statistical models for forecasting COVID-19 incidence in the United States in order to help inform a data-driven national response to the COVID-19 pandemic.

Graduate Research Assistant, McWilliams Center for Cosmology 01/2019 – 06/2020

Project: Intensity Mapping the Universe
Funding: NASA Grant #NNX17AK56G
PI: Rupert A.C. Croft

Graduate Research Assistant, Department of Statistics & Data Science 01/2015 – 08/2016

Project: Nonparametric Procedures that Exploit Structured Data and Models
Funding: NSF Grant #1521786
PI/co-PI(s): Ann Lee, Chad Schafer, Shirley Ho

Project: Statistics and Machine Learning for Scientific Inference
Funding: NSF Grant #1043903
PI: Larry Wasserman

Uber Technologies, Inc. San Francisco, CA
Data Scientist Intern 06/2018 – 08/2018

Team: UberEverything Data Science
Project: A Holistic Approach to Uber Eats Home Feed Ranking Optimization
Description:

I completed an end-to-end project which culminated in a new personalized ranking and recommendation algorithm for the Uber Eats iOS/Android home feed that showed significant improvement over the current ranking algorithm in both offline evaluation and online A/B testing, and was subsequently launched.

Association of Universities for Research in Astronomy Observatory — La Serena, Chile
La Serena School for Data Science: Applied Tools for Astronomy — 08/2015

Project: Cosmology with the Cosmic Microwave Background Through Cross Correlations
Funding: NSF Grant #1637359, MAS, CONICYT
Mentors: Jeffrey McMahon, Chris Miller

North Carolina State University — Raleigh, NC
Undergraduate Research Assistant — 05/2013 – 07/2013

Project: Portfolio Optimization with Conditional Value-at-Risk (CVaR)
Funding: NSF Grant #1461148, NSA
PI: Tao Pang

University of Kansas — Lawrence, KS
Undergraduate Research Assistant — 01/2013 – 05/2014

Project: Optimal Control of Stochastic Systems Driven by Fractional Brownian Motions
Funding: U.S. Army Research Contract #W911NF-10-1-0248
PI/co-PI(s): Tyrone E. Duncan, Bozenna Pasik-Duncan

Project: Optimal and Adaptive Control of Stochastic Systems
Funding: Air Force Office of Scientific Research Grant #FA9550-09-1-0554
PI/co-PI(s): Tyrone E. Duncan, Bozenna Pasik-Duncan

Project: Control of Stochastic Systems
Funding: NSF Grant #1108884
PI/co-PI(s): Tyrone E. Duncan, Bozenna Pasik-Duncan

Teaching and Advising

Carnegie Mellon University
Graduate Teaching Assistant — January 2015 – December 2018

- 10/36-702: *Statistical Machine Learning* — Head TA, PhD course
- 10/36-705: *Intermediate Statistics* — Head TA, PhD course
- 36-618: *Experimental Design & Time Series* — Head TA, MSc course
- 36-467/667: *Special Topics: Data over Space & Time* — Head TA, MSc course
- 36-401/607: *Modern Regression* — Head TA, BSc/MSc course
- 36-402/608: *Advanced Methods for Data Analysis* — BSc/MSc course
- 36-225: *Introduction to Probability Theory* — Head TA, BSc course
- 36-226: *Introduction to Statistical Inference* — Head TA, BSc course
- 36-217: *Probability Theory and Random Processes* — Head TA, BSc course

Lecturer

- **Summer Lecture Series**, Carnegie Mellon University, Summer Undergraduate Research Experience in Statistics, Pittsburgh, PA. *Introduction to Statistics in R.* June – July 2015.
- **Guest Lecture**, Carnegie Mellon University, STAT 217 (Probability Theory and Random Processes), Pittsburgh, PA. *Introduction to Markov Chains.* Nov. 2015.
- **Guest Lecture**, Carnegie Mellon University, STAT 401 (Modern Regression), Pittsburgh, PA. *Introduction to Programming in R and R Markdown.* Aug. 2017.

Research Advisor May 2015 – August 2015

Undergraduate student: Benjamin Leroy (received Ph.D. in Statistics & Data Science from CMU in 2021)
Project: Dynamical Mass Measurements of Galaxy Clusters
Award: NSF Grant #1043903

Professional Service

Referee	*Journal of Cosmology and Astroparticle Physics (JCAP)* *NASA Experimental Program to Stimulate Competitive Research* *Astronomy and Computing (A&C)* *CHANCE Magazine*
Session Organizer	*Statistical Challenges in Cosmology*, JSM 2021, Seattle, WA.
Session Chair	*Computing, Graphics, and Programming Statistics*, JSM 2017, Baltimore, MD.
Judging Panel	*Tartan Data Science Cup 2017*, Carnegie Mellon University.
Outreach Talks	*Astrostatistics*, Hillel Academy of Pittsburgh, AP Statistics class, 2017.

Professional Memberships

AAS	*American Astronomical Society*
ASA	*American Statistical Association*
COIN	*Cosmostatistics Initiative*
IAA	*International Astrostatistics Association*
IAIA	*International AstroInformatics Association*

In the News

- *CMU Statistics and Data Science Graduate Students Keep Winning Big*
- Mr. Indispensable, from Lionel Messi to Virgil Van Dijk: Which player can your team not live without? (Joint work with Francesca Matano, Lee Richardson, et al.)
- *NBA Hackathon 2017 Recap*