# 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-$\alpha$ 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* — 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: 2020-'21 Umesh K. Gavaskar Memorial Award for Best Ph.D. Dissertation

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**
   Collin A. Politsch, Jessi Cisewski-Kehe, Rupert A.C. Croft, Larry Wasserman
   In preparation. Pre-submission inquiry approved by *Nature*.

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

    * **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**
   Collin A. Politsch, Jessi Cisewski-Kehe, Rupert A.C. Croft, Larry Wasserman
   *Monthly Notices of the Royal Astronomical Society*, Volume 492, Issue 3, March 2020, Pages 4019-4032. Publisher. arXiv. GitHub.
    * **Finalist for best paper in the 2020 ASA Astrostatistics Student Paper Competition**, sponsored by the Astrostatistics Interest Group.

4. **Evaluation of individual and ensemble probabilistic forecasts of COVID-19 mortality in the US**
   Estee Y. Cramer, Evan L. Ray, Velma K. Lopez, et al.
   Submitted to *Proceedings of the National Academy of Sciences*. medRxiv.

5. **An Open Repository of Real-Time COVID-19 Indicators**
   Alex Reinhart, Logan Brooks, Maria Jahja, Aaron Rumack, Jingjing Tang, et al.
   Submitted to *Proceedings of the National Academy of Sciences*. medRxiv.

6. **Augmenting Adjusted Plus-Minus in Soccer with FIFA Ratings**
   Francesca Matano, Lee F. Richardson, Taylor Pospisil, Collin A. Politsch, Jining Qin
   Submitted to *Journal of Quantitative Analysis in Sports*. arXiv. Player Rankings.

## Other Publications

1. **Mapping the Large-scale Universe through Intergalactic Silhouettes**
   Collin A. Politsch and Rupert 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*, YouTube talk, Aug. 2021.
  - University of Chicago, Machine Learning in Complex Phenomena, 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.
  - NSF AI Planning Institute: Physics of the Future & STAMPS@CMU. Oct. 2020.
  - 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.
  - NSF AI Planning Institute for Data-Driven Discovery in Physics @CMU. Oct. 2019.

- *From Mapping the Universe to Forecasting the Pandemic*
  - OnSolve Nexus 2021: Managing Uncertainty for Organizational Resiliency. April 2021.

- *A Multi-Resolution 3D Map of the Intergalactic Medium via the Lyman-$\alpha$ Forest*
  - Uber Technologies, Inc., San Francisco, CA. Aug. 2018.
  - 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-$\alpha$ Forest*
  - SAMSI Astronomy Transition Workshop, Durham, NC. May 2017.

- *Multi-resolution Regression, Divide and Conquer Risk Estimation, and the Large-scale Universe*
  - Carnegie Mellon University, Pittsburgh, PA. May 2017.
  - Statistical and Applied Mathematical Sciences Institute, Durham, NC. April 2017.

- *Exploring the Intergalactic Medium*
  - 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 `aardvark`: *COVID-19 forecasters from Carnegie Mellon's Delphi research group.*
Available at https://github.com/cmu-delphi/covid-19-forecast

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

## 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
Award: 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
Award: National Science Foundation (Award #1521786)
PI/co-PI(s): Ann Lee, Chad Schafer, Shirley Ho

Project: Statistics and Machine Learning for Scientific Inference
Award: National Science Foundation (Award #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 (Award #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 (Award #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
Award: U.S. Army Research Office (Contract W911NF-10-1-0248)
PI/co-PI(s): Tyrone E. Duncan, Bozenna Pasik-Duncan

Project: Optimal and Adaptive Control of Stochastic Systems
Award: 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
Award: National Science Foundation (Award #1108884)
PI/co-PI(s): Tyrone E. Duncan, Bozenna Pasik-Duncan

## Teaching and Advising

**Carnegie Mellon University**
*Graduate Teaching Assistant* 01/2015 - 12/2018

- 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, MS course
- 36-467/667: *Special Topics: Data over Space & Time* — Head TA, MS course
- 36-401/607: *Modern Regression* — Head TA, BS/MS course
- 36-402/608: *Advanced Methods for Data Analysis* — BS/MS course
- 36-225: *Introduction to Probability Theory* — Head TA, BS course
- 36-226: *Introduction to Statistical Inference* — Head TA, BS course
- 36-217: *Probability Theory and Random Processes* — Head TA, BS 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* *05/2015 - 08/2015*

Undergraduate student: Benjamin Leroy (UC Berkeley; now CMU PhD student)
Project: Dynamical Mass Measurements of Galaxy Clusters
Award: National Science Foundation (Award #1043903)

## Professional Service

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| **Referee** | *Journal of the Royal Statistical Society: Series B*<br>*Journal of Cosmology and Astroparticle Physics (JCAP)*<br>*NASA Experimental Program to Stimulate Competitive Research*<br>*Astronomy and Computing (A&C)*<br>*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

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| **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*