

Alexej Gossmann

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AREAS OF INTEREST

Development of statistical and machine learning techniques for feature selection and prediction on big high-dimensional datasets, with focus on understanding how false research findings can arise, and how they can be avoided; applications in genomics and neuroimaging, and other medical applications of machine learning; translation of the statistical and machine learning methodology into a useful (software) product.

SKILLS

Core: Data science, statistics, machine learning, (applied) mathematics, scientific research.
Software, programming, tools: R, Python, Ruby, C, C++, Matlab, L^AT_EX, Linux/Unix, Git and Github, HTML, CSS, Vim, AWS and Google Cloud.
Domain knowledge: Genomics and medical imaging.
Language knowledge: German, Russian, English.

EDUCATION

PhD, Bioinnovation

Tulane University, New Orleans, Louisiana, expected August 2018
GPA: 3.967

Doctoral research, Mathematics (PhD candidacy, all but dissertation, withdrawn)

Tulane University, New Orleans, Louisiana, through January 2017
GPA: 3.978

MS, Statistics

Tulane University, New Orleans, Louisiana, May 2014
GPA: 3.975

BS, Mathematics

Technische Universität Darmstadt, Darmstadt, Germany, May 2012
GPA: 3.7 (1.54 German grade)

Workshops and summer schools

IPAM New Deep Learning Techniques, Los Angeles, CA, February 2018. | SAMSI Distributed and Parallel Data Analysis Workshop, September 2016. | SAMSI Optimization Opening Workshop, August 2016. | SAMSI Optimization Summer School, August 2016. | 2nd Summer Institute in Statistics for Big Data, University of Washington, Seattle, June 2016. | 21st Summer Institute in Statistical Genetics, University of Washington, Seattle, WA, June 2016. | 20th Summer Institute in Statistical Genetics, University of Washington, Seattle, WA, June 2015. | SAMSI Industrial Mathematical and Statistical Modeling Workshop for Graduate Students, June 2014.

EXPERIENCE

Research assistantship (doctoral research)

The Multiscale Bioimaging and
Bioinformatics Laboratory

Tulane University, New Orleans, LA

Jan 2015 – present

Research in statistics and machine learning with application in genomics and neuroimaging under the supervision of Dr. Yu-Ping Wang, resulting in six peer-reviewed publications (Gossmann et al. [2015], Cao et al. [2015, 2016], Gossmann et al. [2018a,c], Brzyski et al.

[2018]), presentations at multiple conferences and workshops, and several open source software packages (developed in R and C++).

Student intern (ORISE)

Division of Imaging, Diagnostics, and
Software Reliability (CDRH/OSEL/DIDSR)
at the U.S. Food & Drug Administration
May – Aug 2017, and Jan – Feb 2018

FDA, Silver Spring, MD

Machine learning research (with software implementation in R) resulting in a conference presentation and associated publication Gossmann et al. [2018b] related to the evaluation of machine learning systems in medicine.

Student developer

Google Summer of Code 2015

Remote position

May – August 2015

Project: Adding Linear Mixed Effects Models Support to SciRuby (supervised by Piotr Prins from the Ruby Science Foundation). The created statistical software package (implemented in Ruby) received about 2700 downloads (https://rubygems.org/gems/mixed_models), and was considered for deployment at <http://www.genenetwork.org>.

Research assistantship

Department of Mathematics

Tulane University, New Orleans, LA

Jun – Aug 2014

Worked under the supervision of Dr. Oleksandr Gromenko on statistical methods for the analysis of spatio-temporal processes with software implementation in R and C++, and with application in weather prediction (results unpublished).

Statistics MS research project

Department of Mathematics

Tulane University, New Orleans, LA

Sept 2013 – May 2014

Analysis of bone growth data using mixed-effects smoothing spline ANOVA methods (supervised by Dr. Michelle Lacey) with data analyses performed in R, resulting in a journal publication Sammarco et al. [2015].

Academic Mentor

Tulane University, New Orleans, LA

Tulane University, New Orleans, LA

Oct 2017 – May 2018

Design, mentoring, and guidance of an undergraduate research project applying machine learning methods to a large neuroimaging-genomics dataset, resulting in two presentations by the mentored undergraduate student, entitled “*Exploratory Analysis and Predictive Modeling of Neurodevelopmental Phenotypes from fMRI Data*” at the 2018 Health Sciences Research Days at Tulane University, and at the 2018 Tulane School of Science and Engineering Poster Days (top 3 finalist in the poster competition).

Co-Mentor

Google Summer of Code 2016 (with the
Ruby Science Foundation)

Remote position

May – August 2016

Involved with project proposals, selection/interviewing of students, mentoring. Mentored project: Categorical data support for Daru, Statsample and Statsample-glm. The mentored student (Lokesh Sharma) made major improvements to several open source software packages for data analysis in Ruby.

Co-Mentor

Google Summer of Code 2017 (with the
Ruby Science Foundation)

Remote position

May – August 2017

Involved with project proposals, selection/interviewing of students, mentoring. Mentored project: Creating the fastest math libraries for Ruby by using the GPU through OpenCL and ArrayFire. Outcome: a Ruby library for scientific computing on the GPU (<https://github.com/arrayfire/arrayfire-rb>) and multiple conference presentations by the

mentored student (Prasun Anand).

Instructor, co-teacher, teaching assistant	Technische Universität Darmstadt, and Tulane University
Darmstadt, Germany, and New Orleans, LA	Fall semester 2010 – Fall semester 2014
Instructor for Calculus 1, co-teacher for Statistics for Scientists, and teaching assistant for Real Analysis 1 and 2 as well as for various undergraduate courses in mathematics and statistics.	

PUBLICATIONS

- [Brzyski et al., 2018] Damian Brzyski, Alexej Gossmann, Weijie Su, and Małgorzata Bogdan. Group SLOPE – Adaptive Selection of Groups of Predictors. *Journal of the American Statistical Association*, pages 1–15, January 2018. ISSN 0162-1459. doi:10.1080/01621459.2017.1411269.
- [Cao et al., 2015] Shaolong Cao, Huaizhen Qin, Alexej Gossmann, Hong-Wen Deng, and Yu-Ping Wang. Unified tests for fine scale mapping and identifying sparse high-dimensional sequence associations. In *Proceedings of the 6th ACM Conference on Bioinformatics, Computational Biology and Health Informatics*, BCB '15, pages 241–249, New York, NY, USA, 2015. ACM. doi:10.1145/2808719.2808744.
- [Cao et al., 2016] Shaolong Cao, Huaizhen Qin, Alexej Gossmann, Hong-Wen Deng, and Yu-Ping Wang. Unified tests for fine-scale mapping and identifying sparse high-dimensional sequence associations. *Bioinformatics*, 32(3):330–337, February 2016. doi:10.1093/bioinformatics/btv586.
- [Gossmann et al., 2015] Alexej Gossmann, Shaolong Cao, and Yu-Ping Wang. Identification of significant genetic variants via SLOPE, and its extension to Group SLOPE. In *Proceedings of the 6th ACM Conference on Bioinformatics, Computational Biology and Health Informatics*, BCB '15, pages 232–240, New York, NY, USA, 2015. ACM. doi:10.1145/2808719.2808743.
- [Gossmann et al., 2018a] Alexej Gossmann, Shaolong Cao, Damian Brzyski, Lan-Juan Zhao, Hong-Wen Deng, and Yu-Ping Wang. A sparse regression method for group-wise feature selection with false discovery rate control. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, 15(4):1066–1078, July 2018a. ISSN 1545-5963, 1557-9964. doi:10.1109/TCBB.2017.2780106.
- [Gossmann et al., 2018b] Alexej Gossmann, Aria Pezeshk, and Berkman Sahiner. Test data reuse for evaluation of adaptive machine learning algorithms: Over-fitting to a fixed “test” dataset and a potential solution. In *Proceedings of SPIE: Medical Imaging 2018*. International Society for Optics and Photonics, March 2018b. doi:10.1117/12.2293818.
- [Gossmann et al., 2018c] Alexej Gossmann, Pascal Zille, Vince Calhoun, and Yu-Ping Wang. FDR-Corrected Sparse Canonical Correlation Analysis with Applications to Imaging Genomics. *IEEE Transactions on Medical Imaging*, 37(8):1761–1774, August 2018c. ISSN 0278-0062, 1558-254X. doi:10.1109/TMI.2018.2815583.
- [Sammarco et al., 2015] Mimi C Sammarco, Jennifer Simkin, Alexander J Cammack, Danielle Fassler, Alexej Gossmann, Luis Marrero, Michelle Lacey, Keith Van Meter, and Ken Muneoka. Hyperbaric oxygen promotes proximal bone regeneration and organized collagen composition during digit regeneration. *PloS one*, 10(10), 2015. doi:10.1371/journal.pone.0140156.

CONFERENCE PRESENTATIONS

- Gossmann A., Pezeshk, A., Sahiner, B., Test data reuse for evaluation of adaptive machine learning algorithms: over-fitting to a fixed “test” dataset and a potential solution;

(Paper 10577-19). Presented at the *SPIE Medical Imaging symposium, Image Perception, Observer Performance, and Technology Assessment conference*, February 11, 2018, Houston, TX.

- Gossmann A., Wang Y.-P., SlopeCCA and gslopeCCA: sorted L1 penalized canonical correlation analysis; (Abstract/Program #2803W). Presented at the *66th Annual Meeting of The American Society of Human Genetics*, October 19, 2016, Vancouver, Canada.
- Gossmann A., Cao S., Wang Y.-P., Identification of Significant Genetic Variants via SLOPE, and its Extension to Group SLOPE; (Abstract/Program #1343F). Presented at the *65th Annual Meeting of The American Society of Human Genetics*, October 9, 2015, Baltimore, MD.
- Gossmann A., Cao S., Wang Y.-P., Identification of Significant Genetic Variants via SLOPE, and its Extension to Group SLOPE. The *6th ACM Conference on Bioinformatics, Computational Biology, and Health Informatics*, Atlanta, GA, September 2015.

SOFTWARE

- **grpSLOPE** – Group SLOPE (Group Sorted L1 Penalized Estimation) is a penalized linear regression method that is used for adaptive selection of groups of significant predictors in a high-dimensional linear model. This R package has been used to perform simulations and/or analyses of real genomic data as reported in Gossmann et al. [2018a], Brzyski et al. [2018]. Project repository: <https://github.com/agisga/grpSLOPE>. CRAN: <https://cran.r-project.org/web/packages/grpSLOPE/index.html>.
- **grpSLOPEMC** – An extension package to the R package grpSLOPE, which contains additional Monte Carlo based methods implemented in R and C++ (interfaced to R via Rcpp). This R package has been used to perform simulation studies and analyses of real genomic data presented in Gossmann et al. [2018a]. Project repository: <https://github.com/agisga/grpSLOPEMC>.
- **FDRcorrectedSCCA** – Codes associated with the publication Gossmann et al. [2018c] with all methods and algorithms conveniently organized as functions in an R package. Project repository: <https://github.com/agisga/FDRcorrectedSCCA>.
- **mixed_models** – Fit statistical linear models with fixed and random effects in Ruby. It was created during Google Summer of Code 2015, and has been considered for deployment at <http://www.genenetwork.org>. Project repository: https://github.com/agisga/mixed_models. RubyGems: https://rubygems.org/gems/mixed_models.
- For my contributions to several other open source software projects see <https://github.com/agisga>.

EXTRA-CURRICULAR ACTIVITIES

- Elected *President* of the SIAM student chapter at Tulane University (Society for Industrial and Applied Mathematics), September 2014 – September 2016.
- Organized the Graduate Student Colloquium at the Department of Mathematics, Tulane University, September 2014 – September 2016.
- Participation in *Google Summer of Code* as a student developer in 2015, and as a mentor in 2016 and 2017, working on scientific open source software.
- Participation in the middle school outreach program *Girls in STEM at Tulane (GIST)*, November 2017.

HONORS & AWARDS

- Finalist poster at the Tulane School of Science and Engineering Poster Days 2018.
- Reviewers' Choice Abstract, 66th Annual Meeting of The American Society of Human Genetics, October 19, 2016, Vancouver, Canada.
- SIAM Student Chapter Certificate of Recognition, SIAM (Society for Industrial and Applied Mathematics), April 2015.