Preview of Award 1934568 - Annual Project Report

Cover

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PD/PI Name:	Naoki Saito, Principal Investigator Annamaria B Amenta, Co-Principal Investigator Chen-Nee Chuah, Co-Principal Investigator Thomas Chun Man Lee, Co-Principal Investigator
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Accomplishments

* What are the major goals of the project?

The UC Davis TETRAPODS Institute of Data Science (UCD4IDS)---composed of thirty-five researchers (four PIs and thirty-one senior personnel) coming from four departments (Computer Science, Electrical & Computer Engineering, Mathematics, and Statistics)---will break interdepartmental barriers and promote interdisciplinary research collaborations among faculty members, postdocs, and graduate students. Our project will encourage innovative and robust research, and provide education and mentoring of graduate students and postdocs in data science.

In particular, research at the UCD4IDS will focus on three broad themes: 1) Fundamentals of machine learning directed toward biological and medical applications; 2) Optimization theory and algorithms for machine learning including numerical solvers for large-scale nontrivial learning problems; and 3) High-dimensional data analysis on graphs and networks.

The technical goals of the above themes are: 1) geometric understanding of high-dimensional data, which may allow efficient (re)sampling from manifolds representing certain phenomena of interest and classifying subtle yet critical differences that often appear in biological and medical applications; 2) providing theoretical guarantees and efficient numerical algorithms for non-convex optimization, which is crucial to machine learning; and 3) deepening understanding of how local interactions between individual entities (e.g., neurons) lead to global coordination and decision making.

Students and postdocs engaged in this project will be trained to be the next generation of interdisciplinary data scientists: they will gain deep knowledge of some focused areas, and at the same time, broaden their perspectives in other diverse fields. The UCD4IDS will bring in the insights gained by the experience of the faculty members in the four primary departments as well as application fields such as neuroscience, medical and health sciences, and veterinary medicine.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities: * Conducted research; prepared and published some of our results; presented and disseminated some of our results at conferences and seminars

* Initiated several UC Davis internal collaborations

* Collaborated with the UC Davis Center for Data science and Artificial intelligence Research (CeDAR)

* Organized totally 13 roundtable discussions associated with regular seminar series related to data science

* Organized reading seminars on the subjects closely related to the project

* Created a website dedicated to our UCD4IDS and maintained the contents

* Successfully searched and hired three postdoctoral researchers

* Selected 28 graduate students among our four departments (CS: 8; ECE: 5; Math: 9; Stat: 11) and supported them partially as Graduate Student Researcher

Specific Objectives: 1) Improve our geometric understanding of high-dimensional data, which may allow efficient (re)sampling from manifolds representing certain phenomena of interest and classifying subtle yet critical differences that often appear in biological and medical applications
2) Investigate and develop data harnessing, feature selection, statistical unsupervised learning, data sampling/streaming methodologies and algorithms

3) Provide theoretical guarantees and efficient numerical algorithms for non-convex optimization, which is crucial to machine learning
4) Investigate and develop tools for analyzing hypergraphs, tensors, and high-volume neural data, detecting anomalies/changes over networks, analyzing network structures via random matrix theory, and making cloud-based machine learning more efficient
5) Launch more internal collaborations within our four disciplines
6) Guide graduate students for data science research and education

Significant Results: The numbering here corresponds to that of Specific Objectives section.

1) Amenta(CS)/Hass(Math)/Koehl(CS) developed a new method for approximating a surface in 3-space with a triangulation that is guaranteed to have angles in the range 35 to 102 degrees, a significant improvement to the best angles obtained in previous meshing algorithms. They also extended their earlier method to compare surface of genus zero to the more general surfaces of high genus, parameterized the high-dimensional space of 3D shapes represented with a fixed mesh, and developed mesh represetation in dihedral angle space.

De Loera(Math) obtained new stochastic geometry theorems that give: a) bounds on the probability that m random data classes, all contain a point in common in their convex hulls; b) sufficient conditions to the existence of maximum likelihood estimators in multinomial logistic regression.

Arsuaga/Vazquez(Math/MCB) worked on topological analysis of cancer genomes: they combined topological signatures of cancer genomic data with a logistic regression model to identify regions of the genome that predict specific cancer subtypes.

Jiang(Stat) worked on small area (SA) models (allocation of resources to subgroups in a population) in the class of spatial linear mixed models that can predict SA parameters and obtain the mean squared prediction error (MSPE). His unbiased MSPE estimators performed well on physician visits data for Total Respiratory Morbidity conditions in Manitoba, Canada.

Rademacher(Math) designed provably efficient algorithms to understand a notion of high-dimensional quantiles known as the floating body, which led to a better ICA when the data follows a power-law distribution.

Drake(Stat) refined propensity weighting (PE) to obtain valid estimates when sampling probabilities must be estimated from the observed samples. She used PE in assessing direct effects on short term survival due to cancer diagnosis mediated by treatment.

Chuah(ECE) explored multiple up/down-sampling methods to correct class imbalance, a common challenge in designing classifiers. With collected mechanical ventilator waveforms, she determined if a deadly respiratory condition, acute respiratory distress syndrome, was present. She also developed a CNN-based approach to automatically segment gray matter from white matter in the whole slide images by transforming the segmentation problem into a classification problem.

2) Ghiasi(ECE) developed an improved prototype of a novel transabdominal fetal oxygen saturation measurement device, which was validated via benchtop measurements and in-vivo studies in animal models. His fetal lamb model with controllable/reversible fetal hypoxia corroborates the data acquired by his device against the ground truth data.

Hsieh(Stat) developed Categorical Exploratory Data Analysis (CEDA) to discover and extract data's full information content. CEDA solved three fundamental problems: a) categorical response variable problem; b) multiple response problems; c) Extreme-K categorical sample problem.

Lopes(Stat): a) quantified the performance of simultaneous confidence intervals in high-dimensional multinomial and functional data; b) addressed the estimation of algorithmic error for randomized ensemble methods (e.g., random forests).

Burman(Stat) estimated the differences in linking proportions of chromosome reconstructions using a semi-soft thresholding; and estimated the 3D configuration of chromosomes from the contact counts.

Y.J.Lee(CS) proposed a novel content-aware low-pass filtering layer in CNNs, which predicts separate filter weights for each spatial location and feature channel group of the feature maps, which effectively adapts to the different feature frequencies to avoid aliasing while preserving useful information for visual recognition.

Rajaratnam(Stat) obtained a novel method for feature selection in DAG graphical models using a Cholesky-based optimization approach with convergence guarantees and solved a long standing open problem in the area of Bayesian graphical models regarding the existence of high dimensional Bayes estimators.

3) Strohmer(Math) proved that spectral clustering can achieve exact recovery of the planted community structure for the celebrated stochastic block model under conditions that match the information-theoretic limits.

Fannjiang(Math) developed theoretical guarantee and efficient numerical algorithms for nonconvex optimization in phase retrieval and ptychography whose global optimizer is unique up to a minimum class of ambiguity depending on the prior information.

Balasubramanian(Stat) proved results on SGD, multi-level stochastic composition optimization, stochastic Frank-Wolfe method, stochastic cubic-Newton method, and minimax optimization, which broaden the understanding to these algoirthms and their applications in statistics and deep learning.

De Loera(Math) developed a machine learning analysis of the performance of discrete optimization algorithms to efficiently automate the selection of algorithms or their parameter configurations.

Tagkopoulos(CS) proposed OPEX, an optimal experimental design method to identify informative omics experiments for both experimental space exploration and model training. It demonstrates how active learning can be used to guide omics data collection for training accurate predictive models, evidence-driven decision making and accelerated knowledge discovery in life sciences.

Ma(Math)/Lai(ECE) deepened their understanding of nonsmooth optimization over Riemannian manifolds: a) the manifold proximal gradient method, the first algorithm for solving this class of nonconvex optimization problems without using subgradient information; b) the Riemannian optimization algorithms in data science.

Koeppe(Math) developed next-generation cutting plane theory: a) complete characterization of maximal general dual feasible functions for combinatorial optimization problems, and developing approximation theorems and algorithms; b) resolution of the long-standing open question related to the Gomory-Johnson problem in integer linear optimization problems.

Li(Stat) proposed a generic framework for matrix completion with parameterized factors, related to recommender systems with side information; derived sharp theoretical results on the sampling rate requirement. He also showed hierarchical spectral clustering is consistent under a broad class of multiscale sparse networks.

4) Chaudhuri(Math/NPB) showed how sparsely-connected neurons can allow for the efficient identification/correction of errors in noisy distributed networks; introduced a new class of biologically-plausible unsupervised learning rules that convert dense networks into sparse ones while preserving network dynamics.

Chen(Stat) developed: a) a nonparametric change-point detection framework for neural recordings using a graph-based method; b) a dynamic stochastic block model to characterize the development of neural circuits during embryogenesis of zebrafish.

Aue/T.Lee(Stat) developed a new methodfor simultaneous change-point detection/community identification for network time series.

Aue/Paul(Stat) developed a computationally efficient/consistent method to detect community structures in sparse networks via a multi-stage hypothesis testing scheme, which relies upon the behavior of the extreme eigenvalues of the adjacency matrix of a large/sparse/random graph.

T.Lee proposed a novel consistent graphon estimation method utilizing feature information, which improved estimates if the feature information is useful.

Le(Stat) proposed a linear regression model with nonparametric network effects and derived a novel method for the parameter estimation with asymptotic inference results under either deterministic or random perturbation of the network structure.

Saito(Math) successfully extended classical wavelet packet dictionaries to the graph setting.

Sharpnack(Stat) generalized the multiarmed bandit so that the player is presented with features to guide his/her actions.

Key outcomes or Other achievements:

5) Launch more internal collaborations within our four disciplines
During this period the following new collaborations within UC Davis have been initiated by the participants on this grant, which should be considered as key

outcomes.

* Amenta(CS): with Tim Weaver (Anthropology), his PhD student Chelsea Carolyn Cataldo-Ramirez, on analysis of body size from Dual X-ray Absorptiometry (DEXA) scans.

* Arsuaga/Vazquez(Math/MCB): with Raymond Rodriguez (Molecular & Cellular Biology) on developing machine learning algorithms to study mutation space of the COVID-19 virus with the grants from the UC Davis CeDAR and an NSF RAPID award. One graduate student (Ryan Polyschuck, Physics), one undergraduate (Sofia Jakovcevick, Physics and CS) are being trained.

* Arsuaga(Math/MCB)/Burman(Stat)//Vazquez(Math/MCB): on statistics of topological analysis in evaluation and reproducibility of 3D chromatin reconstruction; directed the PhD dissertation of Maxine Pouokam (Stat).

* Aue/Paul(Stat): with Dalia Ghanem/Aaron Smith (Agricultural & Resource Economics) on integrating data science approach for agricultural and environmental sciences: Harnessing remote sensing data for California's agriculture (Funded by the CeDAR Seed Grant).

* Balasubramanian/Burman/Paul(Stat): on shrinkage-based prediction strategies for high-dimensional linear models.

* Balasubramanian/Le(Stat): on distinguishing different network models by data obtained from random walks on the corresponding networks.

* Balasubramanian/Polonik(Stat): on the shape of kernel-based low-dimensional embeddings, which may improve corresponding clustering algorithms. The goal is to expand the considerations of Schiebinger et al. (2015) and Garcia Trillos et al. (2019) from graph Laplacian embeddings to other embeddings used in data science, including Kernel PCA and the Hodge-Laplacian. This work also involves Rui Hu, a PhD student in Statistics.

* Burman/Polonik(Stat): on the statistics of topological analysis in evaluation and reproducibility of 3D chromatin reconstruction.

* Chaudhuri(Math/NPB): with Timothy Hanks (Neurology) on manifold learning methods on neural population data to investigate the mechanisms by which information is maintained and integrated over time when rats perform a decision-making task, supported by the UC Davis seed grant from the Memory and Plasticity (MAP) program

* Chuah(ECE)/Balasubramanian(Stat): with Prabhu Shankar (Public Health Sciences) on development of predictive machine learning algorithms with fine-grained confidence intervals for imbalanced classification problems arising in healthcare applications. The developed methodology will be applied to two healthcare problems: Venous Thromboembolism Episodes (VTE) prediction and postoperative Surgical Site Infections (SSI) prediction (Funding: CeDAR Seed Grant 2020).

* Chuah(ECE): with Heather Siefkes/Satyanarayana Lakshminrusimha (Pedriatic Critical Care) on creating a machine-learning driven screening algorithm that will

improve critical congenital heart disease (CCHD) detection, preventing mortality associated with diagnoses missed by SpO2 screening by introducing non-invasive measurements of perfusion & oxygenation and real-time waveform analysis (Funding NIH R21).

* Chuah(ECE)/Strohmer(Math): Started writing a joint NSF STTR proposal on sensors for Health-AI.

* De Loera(Math): with Colin Reardon (Veterinary medicine) on topological data analysis to analyze sophisticated 3D-images arising in neuroscience, supported by the CeDAR grant.

* Drake(Stat): with Paramita Ghosh (Urology, Biochemistry, Molecular Biology) on testing some hypotheses to understand function and mechanism of LLS80 in castration-resistant prostate cancer, supported by a grant from the US Department of Veterans Affairs.

* Drake(Stat): with Caroline Rodier (Institute of Transportation Studies) on assessing the effect of access to electric cars on the use of internal combustion engine vehicles and ability to have transport when needed in select communities of the CA Central Valley, supported by a grant from California Department of Transportation.

* Ghiasi(ECE)/Saito(Math): with Aijun Wang (Surgery) and Herman L Hedriana (Ob/Gyn) on fetal signal isolation for transabdominal fetal pulse oximetry, supported by UC Davis CeDAR Innovative Data Science Seed Funding Program.

* Le(Stat): with Jingwen Zhang (Communications) on the influence of online interactions on off-line activities aiming to show the causal effect of online interactions on off-line activities.

* Polonik/Balasubramanian(Stat) on extending the shape of kernel-based low-dimensional embeddings from graph Laplacian setting to the Hodge Laplacian setting. Understanding the shape of the embeddings can be expected to result in improvements of corresponding clustering algorithms.

* Saito(Math): with Fernanda Ferreira (Veterinary Med) & Daniela Bruno (UC Cooperative Extension Fresno County) on the use of machine learning algorithms on daily milk production and electrical conductivity data to implement an economically optimal subclinical mastitis management program in dairy herds.

* Saito/Strohmer(Math): Initiated a joint research project on interpretable machine learning and AI on edge devices with potential support from Dell Technologies.

* Strohmer(Math): with Nicholas Anderson (Health); Sean Peisert (CS) on democratizing health research through privacy-protecting synthetic data, supported by the CeDAR grant.

Also during this review period, some of the UCD4IDS members received the following noteworthy awards:

* Vazquez(Math/MCB) was elected as a 2020 Fellow of the American

Mathematical Society (AMS) in November 2019.

* Jiang and T.Lee(Stat) were elected as 2019 Fellows of the American Association for the Advancement of Science (AAAS) in November 2019.

* Chuah(ECE) and De Loera(Math) received the 2020 ADVANCE Scholar Awards from the UC Davis Office for Diversity, Equity and Inclusion, through the ADVANCE Program and its Center for the Advancement of Multicultural Perspectives in Science (CAMPOS) in July 2020.

* Ghiasi(ECE) and team has received a R21 research grant ($413K) from the NIH to study the device in a larger number of animal models (collect more data for statistical significance). Moreover, they are working to spin off the technology into a startup (Storx Technologies). Storx is working to license the technology from UC Davis, and received a NSF STTR Phase I grant ($225K) with the goal of demonstrating commercial feasibility.

* What opportunities for training and professional development has the project provided?

* We organized 13 roundtable discussions many of which were tailored for our graduate students. In Fall 2019, we have 10 such roundtable discussions weekly, i.e.,immediately after either Statistics seminar talks or Mathematics of Data and Decision at Davis (MADDD) seminar talks. These 10 roundtable discussions were centered round the talks given by Yong-Jae Lee (CS); Pantelis Loupos (Grad School of Management); Meisam Razaviyayn (USC); Julie Novak (Netflix); Yu Zhang (UC Santa Cruz); Thomas Strohmer (Math); Rishidev Chaudhuri (Math/NPB); Grace Yi (Univ. Western Ontario); Javad Lavaei (UC Berkeley); and Krishna Balasubramanian (Stat).
We typically conducted Q&A between the speaker, the moderator (Saito), and the audience about the following:
 - What are the current obstacles and challenges in speakers' field of research?
 - What would be interesting and promising directions of research?
And then, for those speakers from other institutions, we always asked data science and machine learning activities at their institutions including the organizations, research projects, and education.

In Winter 2020, we changed the time and frequency of roundtable discussions to before these seminars and in a monthly basis. These three roundtable discussions
were centered around the invited seminar speakers, i.e., Yilin Zhang (Facebook), Bin Yu (UC Berkeley), and Ken Clarkson (IBM Research). Those with Drs. Zhang and Clarkson, both from industry, were particularly targeted toward our graduate students, and we asked the following questions to them, and did further Q&A with the audience:
 - What would a data scientist in industry recommend our graduate students (in Stat, Math, CS, ECE) to do or study if they want to be data scientists in industry?
 - What would you suggest our faculty to teach our graduate students who are interested in data science from your viewpoint?
 - What do you think would be future directions of data science research?
At the roundtable discussion with Bin Yu, we learned her extensive experience and her perspective on data science and how the Berkeley campus reached the current status of data science including the establishment of the Division of Computing, Data Science, and Society (CDSS) headed by Associate Provost Jennifer Chayes.

* We have organized two regular weekly seminar series throughout the year, i.e.,
The Mathematics of Data and Decisions at Davis (MADDD) seminars and the Statistics Seminars. These seminars are targeted toward not only faculty experts but also graduate students interested in data science and machine learning.

* Devanbu (CS) gave a lecture as a part of the MADDD seminar series, particularly focused on the use of containerization (including the Docker system) for reproducible data analysis, at which many graduate students

attended.

* Department of Statistics is now offering two new graduate courses on data science:
 - STA 220 - Data & Web Technologies for Data Analysis
 This course covers: essentials of using relational databases and SQL. Processing data in blocks. Scraping Web pages and using Web services/APIs. Basics of text mining. Interactive data visualization with Web technologies. Computational data workflow and best practices. Statistical Methods. Sharpnack taught this course in Winter 2020 with 35 enrollment.
 - STA 221 - Big Data & High Performance Statistical Computing
   This course covers: high-performance computing in high-level data analysis languages; different computational approaches and paradigms for efficient analysis of big data; interfaces to compiled languages; R and Python programming languages; high-level parallel computing; MapReduce; parallel algorithms and reasoning. Balasubramanian taught this course in Spring 2020 with 30 enrollment.

The enrollment size of both courses are clearly greater than normal "topics" graduate courses.

* How have the results been disseminated to communities of interest?

Beyond our publications and other products listed in the Products section, we gave at least 65 seminar talks, conference/workshop presentations during this review period. Below is a partial list of such talks.

Amenta(CS): Keller Colloquium, Computing and Mathematical Sciences, Caltech, Pasadena, CA, Feb. 2020
French Computational Geometry Days, Centre International de Recontres Mathematiques (CIRM), Nice, France, Mar. 2020

Arsuaga(Math/MCB): International Symposium "Polymers and networks via topology and entanglement," Tokyo, Japan Aug. 2019
Math Bio seminar, UC Davis, Oct. 2019
Plenary speaker, Conference of the Southern Africa Mathematical Sciences Association (SAMSA), Blantyre, Malawi, Nov. 2019
Geotop-A. Virtual talk organized by CIMAT. May 2020
NSF DMS Mathematics Division COVID-19 PI meeting, online, Jun. 2020
NSF MPS Chemistry Division COVID-19 PI Meeting, online, Aug. 2020

Aue(Stat): JSM, online, Aug. 2020
Big Ag Data Conference, UC Davis, Jan. 2020
Research School of Finance, Actuarial Studies and Statistics 2019 Summer Research Camp, Australian National University, Dec. 2019

Balasubramanian(Stat); Seminar, Dept. Statistics, UC Davis, Dec. 2019

Chuah(ECE): Inaugural CeDAR (Center for Data Science and Artificial Intelligence Research) Workshop, UC Davis, Dec. 11, 2019
ECExpo, Texas Instruments Conference Center, Silicon Valley, Feb. 26, 2020

De Loera(Math): BIRS Workshop on Helly and Tverberg type Theorems, CMO, Oaxaca, Mexico, Oct. 2019.
Colloquium, Dept. Mathematics, San Diego State Univ., Oct. 2019
Combinatorics Seminar, UC Berkeley, online, Apr. 2020
Combinatorial Optimization Seminar, London School of Economics, online Jul. 2020

Drake(Stat): The Thirteenth Workshop on Nonstationary Systems and Their Applications Feb. 2020, Gródek nad Dunajcem, Poland.
Brown Bag Lunch – Dept. of Psychology UC Davis, Jan. 2020

Fong(ECE, graduate student): Society for Maternal-Fetal Medicine Conference, Grapevine, TX, Feb. 2020
ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), online, Apr. 2020

Ghiasi(ECE): Inaugural CeDAR Workshop, UC Davis, Dec. 2020
Seminar, UC Center for Accelerated Innovation, UC Davis, Feb. 2020

Koeppe(Math): Graduate Seminar, Dept. Industrial Engineering, Virginia Tech, Blacksburg, VA, Dec. 2019
Optimization seminar, Dept. Applied Mathematics and Statistics, Johns Hopkins University, Baltimore, MD, Feb. 2020
Tutorial for developers, Global Virtual SageDays 109, online, May 2020

Le(Stat): Seminar, Dept. Statistics, UC Davis, Apr. 2020

Li(Stat): Seminar, Dept. Statistics, UC Davis, Oct. 2020

T.Lee(Stat): Big Ag Data Conference, UC Davis, Jan.2020

Lopes(Stat): CMStatistics, London, Dec. 2019
Random Matrices and Data Analysis Workshop, Shanghai, Dec. 2019
Seminar, Dept. Biostatistics, UC Berkeley, online, Apr. 2020
ICML, online, Jul. 2020

Ma(Math): The 53rd Annual Asilomar Conference on Signals, Systems, and Computers. Pacific Grove, CA. Nov., 2019
Seminar, Dept. Combinatorics & Optimization, Univ. Waterloo, Feb. 2020
Seminar, Dept. Industrial & Enterprise Systems Engineering, Univ. Illinois Urbana-Champaign, Feb. 2020
Plenary speaker, Mathematical Optimization Conference, Guangxi Univ., China, online, Jul. 2020
Seminar, Shanghai Univ. of Finance and Economics, China, online, Jul. 2020

Paul(Stat): International Indian Statistical Association Annual Conference, Mumbai, India, Dec. 2019
International Conference on Strategic Management, Decision Theory and Data Science, Kolkata, India, Jan. 2020
Seminar, Dept. Statistical Science, Duke Univ., NC, Jan. 2020
Seminar, Dept. Economics, UC Davis, online, Jun. 2020

Rademacher(Math): Information Theory and Applications Workshop, San Diego, CA, Feb. 2020

Saito(Math): NSF-TRIPODS PI Meeting, online, Apr. 2020
Minisymposium on Multiscale data science inspired by physical and biological systems, SIAM Annual Meeting, online, Jul. 2020

Sharpnack(Stat): GeoVet Conference, Senior Presentation, UC Davis, Oct. 2019
Mathematics of Data and Decisions at Davis (MADDD), UC Davis, Nov. 2019
Fall Sectional Meeting of AMS, Special Session on Data Science, UC Riverside, Nov. 2019
Symposium on Data Science and Statistics, Invited Session: Anomaly Detection in Complex Data, online, Pittsburgh, PA, Jun. 2020

Strohmer(Math): Algorithms for Threat Detection Workshop, George Washington Univ., Washington DC, Oct. 2019
Seminar, Dept. Statistics, UC Davis, Nov. 2019
Colloquium, TU-Berlin, Germany, Nov. 2019
Special Session on Mathematical Analysis in Data Science, JMM, Denver, CO, Jan. 2020
Data Science Retreat, Baden, Austria, Feb. 2020
IM-Workshop on Signals, Images, and Approximation, Bernried, Germany, Feb. 2020

One World MINDS Seminar, online, Apr. 2020

Vazquez(Math/MCB): GEOTOP seminar, Oct. 2019
Seminar MIC291: Selected topics in microbiology, UC Davis, Nov. 2019
CAMPOS Research Colloquium, UC Davis, Jan. 2020
Cibercoloquio Latinoamericano de Matemáticas, online, Jun. 2020

Wang(ECE, Postdoc): Joint AAPM & COMP Virtual Meeting, online, Jul. 2020
SIAM Conference on Image Science (IS20), online, Jul. 2020

Weber(Math; Graduate Student): Bay Area Scientific Computing Day (BASCD), Dec. 2019

In addition, some of our team members disseminated their software packages to public including:

Koeppe(Math) has become the lead developer of SageMath, an open source mathematical system whose importance in data science research is rising. The details are listed in our Products section.

Weber(Math; Graduate Student) developed and disseminated his FourierFilterFlux.jl Julia package, which allows for GPU and CPU based Fourier transform computation and auto-differentiation of filtering operations. The details are listed in our Products section.

* What do you plan to do during the next reporting period to accomplish the goals?

With three postdocs hired, we will make further progress on every front of research, teaching, and training of our graduate students. One of our postdocs already agreed to organize the Mathematics of Data and Decision at Davis (MADDD) seminar series for Spring 2021. In addition, we will make sure the availability of GPUs for our participants as explained in the Impact section.

Products

Books

Book Chapters
Gonzalez, G.; Ushakova, A.; Sazdanovic, R.; Arsuaga, J. (2020). Prediction in Cancer Genomics Using Topological Signatures and Machine Learning. *Topological Data Analysis* 15. Baas, N.; Carlsson, G.; Quick, G.; Szymik. M.; Thaule, M.. Springer, Cham.. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; DOI:

Strohmer, T.; Wertz, T. (2020). Almost eigenvalues and eigenvectors for almost Mathieu operators. *Applied and Numerical Harmonic Analysis: In Honor of John Benedetto's 80th Birthday* Springer. . Status = ACCEPTED; Acknowledgement of Federal Support = No ; Peer Reviewed = Yes ; DOI:

Inventions

Journals or Juried Conference Papers
View all journal publications currently available in the [NSF Public Access Repository](#) for this award.

The results in the NSF Public Access Repository will include a comprehensive listing of all journal publications recorded to date that are associated with this award.

Yamashiro, Kaeli and Galganski, Laura and Fong, Daniel D. and Ghiasi, Soheil and Lee Farmer, Diana and Stephenson, Jacob and Hirose, Shinjiro and Neff, Lucas and Williams, Timothy and Johnson, M.

Austin. (2020). 1168: Fetal tolerance of maternal resuscitative endovascular balloon occlusion of the aorta in a sheep model. *American Journal of Obstetrics and Gynecology*. 222 (S) S718 to S719. Status = Deposited in NSF-PAR doi:10.1016/j.ajog.2019.11.1180 ; Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/11/2020) Full text   Citation details

Fong, Daniel D. and Yamashiro, Kaeli J. and Johnson, Michael Austin and Vali, Kourosh and Galganski, Laura A. and Pivetti, Christopher D. and Farmer, Diana L. and Hedriana, Herman L. and Ghiasi, Soheil. (2020). Validation of a Novel Transabdominal Fetal Oximeter in a Hypoxic Fetal Lamb Model. *Reproductive Sciences*. . Status = Deposited in NSF-PAR doi:10.1007/s43032-020-00215-5 ; Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/11/2020) Full text   Citation details

Fong, Daniel D. and Vali, Kourosh and Ghiasi, Soheil. (2020). Contextually-aware Fetal Sensing in Transabdominal Fetal Pulse Oximetry. *2020 ACM/IEEE 11th International Conference on Cyber-Physical Systems (ICCPS)*. 119 to 128. Status = Deposited in NSF-PAR doi:10.1109/ICCPS48487.2020.00019 ; Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/11/2020) Full text   Citation details

Fong, Daniel D. and Yamashiro, Kaeli and Johnson, M. Austin and Vali, Kourosh and Galganski, Laura and Pivetti, Christopher and Lee Farmer, Diana and Hedriana, Herman L. and Ghiasi, Soheil. (2020). 98: Validation of a novel transcutaneous fetal oximeter in a hypoxic fetal sheep model. *American Journal of Obstetrics and Gynecology*. 222 (S) S80. Status = Deposited in NSF-PAR doi:10.1016/j.ajog.2019.11.114 ; Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/11/2020) Full text   Citation details

Jiang, Jiming and Rao, J. Sunil. (2020). Robust Small Area Estimation: An Overview. *Annual Review of Statistics and Its Application*. 7 (1) 337 to 360. Status = Deposited in NSF-PAR doi:10.1146/annurev-statistics-031219-041212 ; Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/11/2020) Full text   Citation details

Bolya, D. and Zhou, C. and Xiao, F. and Lee, Y. J.. (2019). YOLACT: Real-time Instance Segmentation. *Proceedings of the IEEE International Conference on Computer Vision (ICCV)*. . Status = Deposited in NSF-PAR Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/10/2020) Full text   Citation details

Singh, K. K. and Mahajan, D. and Grauman, K. and Lee, Y. J. and Feiszli, M. and Ghadiyaram, D.. (2020). Don't Judge an Object by Its Context: Learning to Overcome Contextual Bias. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. . Status = Deposited in NSF-PAR Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/10/2020) Full text   Citation details

Xiao, F. and Liu, H. and Lee, Y. J.. (2019). Identity from here, Pose from there: Self-supervised Disentanglement and Generation of Objects using Unlabeled Videos. *Proceedings of the IEEEInternational Conference on Computer Vision (ICCV)*. . Status = Deposited in NSF-PAR Federal Government's License = Acknowledged. (Completed by Saito, Naoki on 08/10/2020) Full text   Citation details

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Contextually aware fetal sensing in transabdominal fetal pulse oximetry. *Patent No. US16/820,388*. UNITED STATES. Application Date = 03/16/2020. Status = Submitted

Technologies or Techniques

Thesis/Dissertations
Chen, Ji. *Nonconvex Matrix Completion: From Geometric Analysis to Algorithmic Analysis*. (2020). UC Davis. Acknowledgement of Federal Support = Yes

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Websites
FourierFilterFlux.jl
https://github.com/dsweber2/FourierFilterFlux.jl

This package, entirely written in the Julia programming language, allows for GPU and CPU based Fourier transform computation and auto-differentiation of filtering operations.

UC Davis TETRAPODS Institute of Data Science
https://ucd4ids.ucdavis.edu

This is our main website for announcing and disseminate important information about our NSF TRIPODS activities.

[Sage 9.0] The SageMath developers, SageMath, version 9.0, January 2020
https://www.sagemath.org/

Contributions by Matthias Köppe in the form of 2 merged tickets listed at https://www.sagemath.org/changelogs/sage-9.0.txt

[Sage 9.1] The SageMath developers, SageMath, version 9.1, May 2020
https://www.sagemath.org/

Contributions by Matthias Köppe in the form of 133 merged tickets listed at https://www.sagemath.org/changelogs/sage-9.1.txt

[cgf 1.4.1] cutgeneratingfunctionology
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Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Saito, Naoki	PD/PI	5
Amenta, Annamaria	Co PD/PI	1
Chuah, Chen-Nee	Co PD/PI	1
Lee, Thomas Chun Man	Co PD/PI	1
Arsuaga, Javier	Faculty	1
Aue, Alexander	Faculty	1
Balasubramanian, Krishna	Faculty	2
Burman, Prabir	Faculty	1
Chaudhuri, Rishidev	Faculty	1
Chen, Shizhe	Faculty	2
De Loera, Jesus	Faculty	1
Devanbu, Premkumar	Faculty	0
Ding, Zhi	Faculty	1
Drake, Christiana	Faculty	3
Fannjiang, Albert	Faculty	4
Ghiasi, Soheil	Faculty	1
Hass, Joel	Faculty	2

Name	Most Senior Project Role	Nearest Person Month Worked
Hsieh, Fushing	Faculty	2
Jiang, Jiming	Faculty	0
Koehl, Patrice	Faculty	0
Koeppe, Matthias	Faculty	8
Lai, Lifen	Faculty	1
Le, Can	Faculty	2
Lee, Yong Jae	Faculty	1
Li, Xiaodong	Faculty	2
Lopes, Miles	Faculty	4
Ma, Shiqian	Faculty	2
Paul, Debashis	Faculty	1
Polonik, Wolfgang	Faculty	1
Rademacher, Luis	Faculty	1
Rajaratnam, Balakanapathy	Faculty	2
Sharpnack, James	Faculty	1
Strohmer, Thomas	Faculty	2
Tagkopoulos, Ilias	Faculty	0
Vazquez, Mariel	Faculty	1
Roy, Abhishek	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Schonsheck, Stefan	Postdoctoral (scholar, fellow or other postdoctoral position)	2

Name	Most Senior Project Role	Nearest Person Month Worked
Wang, Chao	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Bhattacharjee, Samayita	Graduate Student (research assistant)	1
Chak, Wai	Graduate Student (research assistant)	1
Chamain, Hewa Gamage	Graduate Student (research assistant)	3
Chen, Ji	Graduate Student (research assistant)	3
Chen, Xiaotie	Graduate Student (research assistant)	3
Deng, Shaofeng	Graduate Student (research assistant)	3
Ding, Qin	Graduate Student (research assistant)	3
Eetemadi, Ameen	Graduate Student (research assistant)	3
He, Ye	Graduate Student (research assistant)	1
Hu, Rui	Graduate Student (research assistant)	3
Huang, Minhui	Graduate Student (research assistant)	3
Jesse, Kevin	Graduate Student (research assistant)	3
Kim, Tae	Graduate Student (research assistant)	1
Lai, Zhengfeng	Graduate Student (research assistant)	1
Liu, Yucheng	Graduate Student (research assistant)	1
Lou, Xingmei	Graduate Student (research assistant)	3
Saffarpour, Mahya	Graduate Student (research assistant)	9
Sheng, Jun-Da	Graduate Student (research assistant)	1
Tang, Tongyi	Graduate Student (research assistant)	3
Vali, Kourosh	Graduate Student (research assistant)	1
Wan, Qianhui	Graduate Student (research assistant)	1

Name	Most Senior Project Role	Nearest Person Month Worked
Wang, Jue	Graduate Student (research assistant)	1
Weber, David	Graduate Student (research assistant)	3
Wei, Zhenyu	Graduate Student (research assistant)	3
Xiao, Tesi	Graduate Student (research assistant)	1
Xu, Cong	Graduate Student (research assistant)	1
Zhang, Zhenyang	Graduate Student (research assistant)	3
Zou, Xueyan	Graduate Student (research assistant)	3

Full details of individuals who have worked on the project:

Naoki Saito
Email: saito@math.ucdavis.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 5

Contribution to the Project: Coordinated and managed almost all the activities of the UCD4IDS; Organized the Mathematics of Data and Decision seminar series (Winter 2020); Organized 13 roundtable discussions (Fall 2019 + Winter 2020); Created and managed the dedicated UCD4IDS website; Conducted research; supervised one Ph.D. student; gave presentations on our research and projects at various conferences and seminars.

Funding Support: NSF Grant IIS-1631329; NSF RTG Grant DMS-1148643; ONR Grant N00014-20-1-2381; UC Davis CeDAR Seed Grant

International Collaboration: No
International Travel: No

Annamaria B Amenta
Email: amenta@cs.ucdavis.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised postdocs and graduate students; attended seminars; participated in the roundtable discussions; searched and hired a postdoc

Funding Support: To be added

International Collaboration: No
International Travel: No

Chen-Nee Chuah
Email: chuah@ucdavis.edu

Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised postdocs and graduate students; attended seminars; participated in the roundtable discussions; searched and hired a postdoc

Funding Support: NIH grant 1R21HD099239-01; DoD CDMRP grant #W81XWH1820072,

International Collaboration: No
International Travel: No

Thomas Chun Man Lee
Email: tcmlee@ucdavis.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; searched and hired a postdoc

Funding Support: None

International Collaboration: No
International Travel: No

Javier Arsuaga
Email: jarsuaga@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Performed and directed research; attended seminars; participated in roundtable discussions

Funding Support: NSF DMS-1854770

International Collaboration: No
International Travel: No

Alexander Aue
Email: aaue@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; served as a member of the Steering Committee

Funding Support: California DPR grant 15-C0055

International Collaboration: No
International Travel: No

Krishna Balasubramanian
Email: kbala@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; organized Statistics Seminar series (Winter 2020)

Funding Support: UC Davis CeDAR Innovative Data Science Seed Funding Program

International Collaboration: No
International Travel: No

Prabir Burman
Email: pburman@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; co-supervised a graduate student in Biostatistics (Maxime Pouokam); attended seminars; participated in the roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Rishidev Chaudhuri
Email: rchaudhuri@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; gave talks; wrote papers

Funding Support: UC Davis New Faculty Startup Funds

International Collaboration: No
International Travel: No

Shizhe Chen
Email: szdchen@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; attended seminars; presented the project; organized Statistics Seminar series (Spring 2020)

Funding Support: NSF DMS-1916476

International Collaboration: Yes, China
International Travel: No

Jesus De Loera
Email: deloera@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; organized MADDD seminar (Spring 2020); participated in the roundtable discussions. Help with organization of TRIPODS events, attended NSF events for TRIPODS; served as a member of the Steering Committee

Funding Support: NSF DMS-1818969

International Collaboration: No
International Travel: No

Premkumar Devanbu
Email: ptdevanbu@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 0

Contribution to the Project: Gave a lecture to the TRIPODS group on the use Containeraization for reproducible data analysis; Continued work on Big Code/Naturalness project, and interacted with TRIPODS group.

Funding Support: NSF 1414172

International Collaboration: No
International Travel: No

Zhi Ding
Email: zding@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Planning research directions; supervising graduate student researchers; Taking part in seminars; participating in discussions; served as a member of the Steering Committee

Funding Support: NSF 1711823

International Collaboration: No
International Travel: No

Christiana Drake
Email: cmdrake@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: CA Dept. Transportation grant 65A0686; US Dept. Veterans Affairs grant 1BX004423-01A1

International Collaboration: No
International Travel: No

Albert Fannjiang
Email: fannjiang@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 4

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: Simons Foundation Grant FDN 2019-24

International Collaboration: Yes, Taiwan
International Travel: No

Soheil Ghiasi
Email: ghiasi@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions

Funding Support: NSF grants IIS-1838939 & CBET-1937158; UC Davis CeDAR Innovative Data Science Seed Funding Program

International Collaboration: No
International Travel: No

Joel Hass
Email: hass@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: NSF DMS-1719582 & DMS-1760485

International Collaboration: No
International Travel: No

Fushing Hsieh
Email: fhsieh@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions

Funding Support: UC Davis CeDAR Innovative Data Science Seed Funding Program

International Collaboration: No
International Travel: No

Jiming Jiang
Email: jimjiang@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 0

Contribution to the Project: Attended seminars

Funding Support: None

International Collaboration: No
International Travel: No

Patrice Koehl
Email: pakoehl@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 0

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; served as a member of the Steering Committee

Funding Support: NSF grants DMS-1760485 & DMS-1719582

International Collaboration: No
International Travel: No

Matthias Koeppe
Email: mkoeppe@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 8

Contribution to the Project: Conducted research; supervised graduate students; developed software

Funding Support: NSF DMS-2012764

International Collaboration: No
International Travel: No

Lifen Lai
Email: lflai@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Can Le
Email: canle@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions

Funding Support: NSF grant DMS-2015134

International Collaboration: No
International Travel: No

Yong Jae Lee
Email: yongjaelee@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; gave a seminar talk

Funding Support: NSF IIS-1751206

International Collaboration: No
International Travel: No

Xiaodong Li
Email: xdgli@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; give talks on these projects.

Funding Support: NSF DMS-1848575

International Collaboration: No
International Travel: No

Miles Lopes
Email: melopes@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 4

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; organized Statistics Seminar series in Fall 2019

Funding Support: NSF grants DMS-1613218 & DMS-1915786

International Collaboration: No
International Travel: No

Shiqian Ma
Email: sqma@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions; organized MADDD Seminar series (Fall 2019)

Funding Support: NSF grantsDMS-1953210 & CCF-2007797; UC Davis CeDAR Innovative Data Science Seed Funding Program

International Collaboration: Yes, Hong Kong
International Travel: No

Debashis Paul
Email: debpaul@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students (Tae Yen Kim and TongyiTang, both supported through the TRIPODS grant); attended seminars; participated in the roundtable discussions

Funding Support: NSF grants DMS-1713120, DMS-1811405 and DMS-1915894

International Collaboration: Yes, United Kingdom
International Travel: No

Wolfgang Polonik
Email: wpolonik@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; participated in the roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Luis Rademacher
Email: lrademac@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Studying the complexity of problems in optimization, machine learning and computational geometry; supervised graduate students; attended seminars; participated in the roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Balakanapathy Rajaratnam
Email: brajaratnam@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; attended seminars; served on graduate students thesis defense committees; participated in roundtable discussions

Funding Support: NSF DMS-1916787

International Collaboration: No
International Travel: No

James Sharpnack
Email: jsharpna@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: NSF DMS-1712996

International Collaboration: No
International Travel: No

Thomas Strohmer
Email: strohmer@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research; supervised graduate students; attended seminars; gave seminar talk; participated in a roundtable discussion, developed data science graduate course

Funding Support: NSF DMS-1234567 & DMS 1737943; UC Davis CeDAR Innovative Data Science Seed Funding Program

International Collaboration: No
International Travel: No

Ilias Tagkopoulos
Email: itagkopoulos@ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 0

Contribution to the Project: Conducted research; supervised graduate students; attended seminars

Funding Support: NSF/USDA/NIH grants

International Collaboration: No
International Travel: No

Mariel Vazquez
Email: mariel@math.ucdavis.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; supervised undergraduate andgraduate students; organized Math Bio seminar and attended some meetings of the MADDD seminar; participated in some roundtable discussions.

Funding Support: NSF DMS-2030491; DMS-1817156; DMS-1716987; the UC Davis CeDAR Seed Grant

International Collaboration: No
International Travel: No

Abhishek Roy
Email: abroy@ucdavis.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Contributed to research on nonconvex and nonstationary optimization

Funding Support: Partial support from the College of Letters & Science Dean's office

International Collaboration: No
International Travel: No

Stefan C. Schonsheck
Email: scschonsheck@ucdavis.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research on the stability of geometric convolutions; geometric normal flows; robustness and stability of graph scattering. Attended online seminars: MADS, One World IMAGINE, GROOTS

Funding Support: Partially supported by the A. J. Krener Assistant Professorship, Department of Mathematics, UC Davis

International Collaboration: No
International Travel: No

Chao Wang
Email: ecewang@ucdavis.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Conducted research on medical image analysis and processing.

Funding Support: None

International Collaboration: No
International Travel: No

Samayita Bhattacharjee
Email: saabhattacharjee@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: TAship from Stat. Dept.

International Collaboration: No
International Travel: No

Wai Ho Chak
Email: wchak@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Hewa Gamage Lahiru Dulanjana Chamain
Email: hdchamain@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Ji Chen
Email: ljichen@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions; served as a scribe for a roundtable discussion

Funding Support: NSF CAREER Award DMS-1848575

International Collaboration: No
International Travel: No

Xiaotie Chen
Email: xtchen@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Shaofeng Deng
Email: sfdeng@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in the roundtable discussions; write papers; served as a scribe for a roundtable discussion

Funding Support: NSF DMS-620455 & DMS-1737943

International Collaboration: No
International Travel: No

Qin Ding
Email: qding@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions; served as a scribe for a roundtable discussion

Funding Support: None

International Collaboration: No
International Travel: No

Ameen Eetemadi
Email: eetemadi@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Ye He
Email: leohe@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Rui Hu
Email: rhhu@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Minhui Huang
Email: mhhuang@ucdavis.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Kevin Jesse
Email: krjesse@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Tae Yen Kim
Email: atykim@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Zhengfeng Lai
Email: lzhengfeng@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Yucheng Liu
Email: yucliu@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Xingmei Lou
Email: xmlou@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Mahya Saffarpour
Email: msaff@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Conducted research; attended seminars

Funding Support: NSF IIS-1838939 & CBET-1937158

International Collaboration: No
International Travel: No

Jun-Da Sheng
Email: sheng@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Tongyi Tang
Email: tyitang@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions; served as a scribe for a roundtable discussion

Funding Support: None

International Collaboration: No

International Travel: No

Kourosh Vali
Email: kvali@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Qianhui Wan
Email: qhswan@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Jue Wang
Email: jujwang@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

David Weber
Email: dsweber@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions; served as a scribe for roundtable discussions; heled PI to maintain the project website.

Funding Support: ONR grant N00014-20-1-2381

International Collaboration: No
International Travel: No

Zhenyu Wei
Email: zywei@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions; served as a scribe for a roundtable discussion

Funding Support: None

International Collaboration: No
International Travel: No

Tesi Xiao
Email: texiao@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Cong Xu
Email: cngxu@ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

Zhenyang Zhang
Email: zhenyangz@math.ucdavis.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: NSF DMS-181896

International Collaboration: No
International Travel: No

Xueyan Zou
Email: xyzou@ucdavis.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Conducted research; attended seminars; participated in roundtable discussions

Funding Support: None

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?
Nothing to report.

What other collaborators or contacts have been involved?

Please see the Key outcomes/Other achievments part of the Accomplishments section.

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The theory, algorithms, and software tools that have been and are being developed will be likely to make a positive impact in solving practical data-analysis and machine-learning problems in our core disciplines, i.e., computer science (analyzing social networks and website links); electrical engineering (monitoring and controlling sensor networks); mathematics (nonconvex optimization theory and algorithms); and statistics (inverse problems, statistical graph and network analysis).

What is the impact on other disciplines?

Our research and development above will also be likely to make a positive impact on other disciplines, e.g., civil engineering (monitoring traffic flow on a road network); biology and medicine (analyzing data measured on real neural networks, detecting changes in the brain structures due to diseases, imaging live biological cells for analyzing their growth, etc.); algriculture and veterinary medicine (monitoring and improving milk reproduction management), etc.

What is the impact on the development of human resources?

Through this project, many of our students have become familiar with data obtained from scientists in the different fields such as neuroscience, computer science, electrical engineering, civil engineering, and anthropology, etc. Also, through the MADDD seminars, the Statistics seminars, and the roundtable discussions, students in each of our four departments had opportunities to get to know the students from the other three departments better. In addition, they had opportunities to meet and discuss with invited speakers from industry to hear their experience in industry and what kind of knowledge and skills are expected in industry.

What is the impact on physical resources that form infrastructure?

The project will be likely to contribute the campus-wide High Performance Computing (HPC) center via purchase of the CPUs/GPUs.

What is the impact on institutional resources that form infrastructure?

UC Davis administration plans to allocate space for our activities in the first and ground floors of the Physical Sciences and Engineering Library.

What is the impact on information resources that form infrastructure?
Nothing to report.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology?
Nothing to report.

Changes/Problems

Changes in approach and reason for change
Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

We initially planned to purchase two cluster nodes with the budget of
$10K in Year 1 to participate in the College of Engineering (CoE) High
Performance Computing Cluster (HPC1). However, there has been delay due
to the following reasons.

Last fall quarter (not long after our TRIPOD funding arrived), the CoE
stopped accommodating addition of new nodes, in preparation of the next
generation cluster - HPC2, with the plan to add GPU nodes *after* HPC-2
is rolled out. Unfortunately, with the departure of key CoE IT architect
and campus closure due to covid-19, estimated ship date for HPC2 is now
end of August 2020. There is also a concurrent plan to merge CoE HPC2
with campus HPC.

We have reached out to the faculty director of campus HPC-2, John
Conway, about hosting our TRIPOD GPU-nodes within campus HPC. Meanwhile,
we have acquired quotes for potential GPU server from Lambda lab, but we
are waiting for Nvidia's planned of release RTX 3080ti/3070ti to make
the final decision on the hardware.

In parallel to this discussion, the PI has been discussing a possibility
to collaborate with Dell Technologies that would allow us to use
clusters in their HPC.

Changes that have a significant impact on expenditures
Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.