List of Posters

Title: Hysteresis and Clumping in Swarming Models

Authors: Quentin Barth

Institution: Harvey Mudd College

Co-authors: Andrew J. Bernoff

Abstract: Swarms are groups of agents whose collective behavior emerges from individual interactions. We study a first-order swarming model in a periodic coordinate system and investigate its stable configurations for differing numbers of agents relative to the periodic width. Two states emerge from numerical simulations in one dimension: even spacing throughout the period, or clumping within a certain portion of the period. A mathematical analysis of the energy of the system allows us to determine stability of these configurations. For certain values of the periodic width relative to the number of agents, either of these states is possible depending on on starting conditions, indicating hysteresis. We speculate on how these ideas extend to higher dimensions and different swarming models.

Title: Well-Balanced Discontinuous Galerkin Methods for the Ripa Model with Moving Water Equilibrium

Authors: Jolene Britton

Institution: UC Riverside

Co-authors: Yulong Xing

Abstract: Shallow water equations with horizontal temperature gradients, also known as the Ripa model, are used to model flows when the temperature fluctuations play an important role. These equations admit steady state solutions where the fluxes and source terms balance each other. We present well-balanced discontinuous Galerkin methods for the Ripa model which preserve the general moving water equilibrium. The key idea is the recovery of well-balanced states via appropriate source term approximations and approximations of the numerical fluxes. Numerical examples are presented to verify the well-balanced property, high order accuracy, and good resolution for both smooth and discontinuous solutions.

Title: Contribution of Nascent Cohesive Fiber-Fiber Interactions to the Non-Linear Viscoelasticity of Fibrin Networks under Tensile Load

Authors: Samuel Britton

Institution: University of California Riverside

Co-authors: Oleg Kim, Francesco Pancaldi, Zhiliang Xu, Rustem Litvinov, John Weisel, Mark Alber

Abstract: Fibrin is a viscoelastic proteinaceous polymer that determines the deformability and integrity of blood clots and fibrin-based biomaterials in response to biomechanical forces. Here, a novel structural mechanism of fibrin clots' mechanical response to external tensile loads is tested using high-resolution confocal microscopy and an originally developed three-dimensional computational model. This mechanism is based on hitherto neglected nascent cohesive contacts between individual fibers in fibrin networks formed under tensile load. 3D imaging of experimentally stretched fibrin clots visualized crisscrossing of reoriented fibers. The computational model enabled us to study structural details and quantify mechanical effects of the fiber-fiber cohesive crisscrossing during stretching of fibrin gels at various spatial scales. The contribution of the fiber-fiber cohesive contacts in the viscoelasticity of stretched fibrin networks was characterized by changes in individual fiber stiffness, the length, width, and alignment of fibers, as well as the viscoelasticity, connectivity and density of the entire networks. The results show that the nascent cohesive crisscrossing of fibers in stretched fibrin networks comprise an underappreciated important structural mechanism, underlying local strain-stiffening of individual fibers as well as global stiffening of the entire network.

Title: Zero Shot Learning with the Isoperimetric Loss

Authors: Shay Deutsch

Institution: UCLA

Co-authors: Andrea Bertozzi, Stefano Soatto

Abstract: We introduce the isoperimetric loss as a regularization criterion for learning the map from a visual representation to a semantic embedding, to be used to transfer knowledge to unknown classes in a zero-shot learning setting. We use a pre-trained deep neural network model as a visual representation of image data, a Word2Vec embedding of class labels, and linear maps between the visual and semantic embedding spaces. However, the spaces themselves are not linear, and we postulate the sample embedding to be populated by noisy samples near otherwise smooth manifolds. We exploit the graph structure defined by the sample points to regularize the estimates of the manifolds by inferring the graph connectivity using a generalization of the isoperimetric inequalities from Riemannian geometry to graphs. Surprisingly, this regularization alone, paired with the simplest baseline model, outperforms the state-of-the-art among fully automated methods in zero-shot learning bechmarks such as AwA and CUB. This improvement is achieved solely by learning the structure of the underlying spaces by imposing regularity.

Title: Series Representation of Jointly SαS Distribution via a New Type of Symmetric Covariations

Authors: Yujia Ding

Institution: Claremont Graduate University

Co-authors: Qidi Peng

Abstract: The main goal of this work is to find series representation for jointly symmetric α-stable distributions. More specifically, we extend covariance to non-Gaussian distributions by introducing symmetric covariation, a new measure of dependency between coordinates of a symmetric α-stable ($\alpha \in (0,2]$) random vector. We show that this symmetric covariation plays the role as covariance when the joint distribution is non-Gaussian. Properties of the symmetric covariation have been derived, and the comparison between these properties and those of covariance has been made. Based on the symmetric covariation, we then find a new representation of the characteristic function of the bivariate symmetric α-stable distribution via convergent series. This representation extends the Taylor expansion of the negative logarithm of the characteristic function of jointly Gaussian distribution when the stability parameter $\alpha = 2$.

Title: A Randomized Algorithm for Preconditioner Selection with Applications to Kernel Regression

Authors: Conner DiPaolo

Institution: Harvey Mudd College

Co-authors: Weiqing Gu

Abstract: Finding a suitable preconditioner for a given matrix is necessary to solve large linear systems quickly, but nevertheless challenging, as the best preconditioning schemes are often problem specific. For example, a variety of preconditioning schemes have been explored for Gaussian process regression, but no single preconditioner uniformly improves the convergence rate of conjugate gradients across different datasets and parameter settings. Thus, knowing which preconditioner to use among a couple candidate preconditioners remains an important challenge. To solve this problem, we introduce a randomized algorithm which takes N preconditioners and returns an approximately superoptimal one in the Tyrtyshnikov sense. The algorithm is accompanied with provably tight and informative bounds which allow the user to directly select parameters to achieve a desired error and failure probability. Moreover, the overall runtime is roughly equivalent to taking N log(N) steps of conjugate gradients, so this selection scheme can be used as a preprocessing step before running an iterative solver, without increasing the overall runtime significantly. By combining this selection process with geometric insight, we create a novel preconditioned scheme for solving kernel regression systems which is both practical and uniformly outperforms un-preconditioned conjugate gradients in standard experiments.

Title: Balanced rate and spiking model for oculomotor integrator

Authors: Stella Dong

Institution: UC Davis

Co-authors: Mark Goldman

Abstract: The oculomotor neurons integrate a transient saccade into a persistent activity. Since the persistent activity is proportional to the intended position of the eyes in their orbit, integrator neurons are said to maintain a ''memory of eye position''. Mathematically, persistent activity is described in terms of ''dynamical attractor'' which means any self-sustained and stable state of a dynamical system. The question is that whether such attractor networks can be realized in the brain, biologically constrained models of persistent activity were needed? In this project, we focus on the network of the oculomotor integrator, and we will provide the necessary constraints on the synaptic strengths and on the time constants of the synapses in order for the network to have the persistent activity. Furthermore, the persistent activity is believed to be

generated by feedback dynamics in the network. The oculomotor integrator has both positive feedback and negative feedback. In this paper, we will introduce the negative-derivative form feedback which occurs when the network has same synaptic strength but offset in time. It will be shown that the negative-derivative feedback counteracts drift in persistent activity, and the negative-derivative feedback networks are robust to common perturbations such as the change or synaptic strength and loss of neurons.

Title: TBA

Authors: Tuhtasin Ergashev

Institution: Institute of Mathematics of Uzbek Academy of Sciences

Abstract: Recently found all the fundamental solutions of a multidimensional singular elliptic equation are expressed in terms of the well-known Lauricella hypergeometric function in many variables. In this paper, we find a unique solution of the Dirichlet problem for an elliptic equation with several singular coefficients in explicit form. When finding a solution, we use decomposition formulas and some adjacent relations for the Lauricella hypergeometric function in many variables.

Title: AsyncQVI: an Asynchronous Q-Value Iteration for Reinforcement Learning

Authors: Fei Feng

Institution: UCLA, Math Department

Co-authors: Yibo Zeng, Wotao Yin

Abstract: In this work, we propose AsyncQVI, an asynchronous-parallel Q-value iteration for Reinforcement Learning problems. AsyncQVI is the first asynchronous-parallel algorithm for reinforcement learning with a convergence rate and a sample complexity. Its sample complexity nearly matches the theoretical lower bound. The relatively low memory footprint and parallel ability of AsyncQVI make it suitable for large-scale applications. In numerical tests, we compare AsyncQVI with two sample-based value iteration methods. The test results show AsyncQVI is highly efficient and achieves linear parallel speedup.

Title: Neural Networks as Tests for Uniformity on Circular Data

Authors: Madelyn Gaumer

Institution: Harvey Mudd College

Abstract: Given the rise in new applications of neural networks to all sorts of interesting problems, it seems natural to compare them with classical statistical tests. This project begins a conversation about the relationship between neural networks and a class of tests for uniformity on circular data including the Rayleigh Test, the Watson Test, and the Ajne Test. Specifically, this project compares the accuracy, type I, and type II error of various neural networks when asked to classify circular data as uniform or nonuniform with that of the more commonly used statistical tests for uniformity on circular data.

Title: Influence of filter parameters on PSNR/SSIM results after Gaussian noise removal in images

Authors: Maria C. Gonzalez

Institution: University of California, Davis

Abstract: The power spectrum of natural images as recorded by cameras or perceived by the human visual system decreases with frequency. On the other hand, noise as a random phenomenon is assumed to exist at all frequencies. A low pass filtering action will remove the noise existing at frequencies beyond the cutoff frequency, improving the signal-to-noise ratio (PSNR).
The filter characteristics depend on the desired cutoff frequency, filter length, sidelobe attenuation of the window, and the window type. To assess the influence of these characteristics in the final PSNR and structural similarity index measure (SSIM) of the filtered image, we apply different filters over a test image "House" with pixel intensity range between 0-255 contaminated with Gaussian noise with the standard deviations σ_n of 10, 20, 30, and 40. We need to point out that the best filter's characteristic is also image dependent. The results are obtained using the ideal low pass filter definition with a 2D window over the image. The PSNR/SSIM calculation is between the noise free and the filtered image after the original image is distorted with Gaussian noise.
A 2D FIR filter can be constructed in a way similar to the 1D case by applying a 2D window to the 2D infinite impulse response. The frequency response of an ideal low

pass filter has a sharp truncation that requires infinite terms in the impulse response. A practical implementation of the filter is to multiply the filter's impulse response by a window function. The window characteristics affect the sharpness of the filter transition width at the cutoff frequency and the energy level of the sidelobes, as in the 1D case. Here, to build the filter we use the windows: Chebyshev, Kaiser, ultraspheric, and based on the zero-order Discrete Prolate Spheroidal Sequence (DPSS).
Here, we present PSNR and SSIM result versus the cutoff frequency, window's sidelolobe attenuation, filter size on 6 standard images distorted with Gaussian noise.

Title: Analyzing Greedy Projection Methods

Authors: Jamie Haddock

Co-Authors: Jesus De Loera, Deanna Needell, Anna Ma

Institution: UCLA

Abstract: Stochastic iterative algorithms have gained recent interest for solving large-scale systems of equations, Ax=y. One such example is the Randomized Kaczmarz (RK) algorithm, which acts only on single rows of the matrix A at a time. While RK randomly selects a row, Motzkin's algorithm employs a greedy row selection; the Sampling Kaczmarz-Motzkin (SKM) algorithm combines these two strategies. In this talk, we present a convergence analysis for SKM which interpolates between RK and Motzkin's algorithm.

Title: A Generalized Lieb's Theorem and its Applications to Spectrum Estimates for a Sum of Random Matrices

Authors: De Huang

Institution: Caltech

Abstract: In this work we prove the concavity of the k-trace functions, $A \mapsto ({}_k[\exp(H + \ln A)])^{1/k}$, on the convex cone of all positive definite matrices. ${}_k[A]$ denotes the k_{th} elementary symmetric polynomial of the eigenvalues of A. As an application, we use the concavity of these k-trace functions to derive tail bounds and expectation estimates on the sum of the k largest (or smallest) eigenvalues of a sum of random matrices.

Title: Multiple Strain Avian Influenza Dynamics Under Periodic Environmental Conditions with Respect to Temperature

Authors: Jillian Kiefer

Institution: San Diego State University

Co-authors: Naveen K. Vaidya

Abstract: Avian influenza (AI) viruses are most commonly found among wild aquatic birds and contain varying pathogenic strains that can potentially pose a serious threat if the infection is transmitted to humans. A better understanding of AI viruses is necessary to predict how cross-species infection will affect humans and what counter measures can be implemented to prevent a serious outbreak. Wild birds shed the AI virus into aquatic environments, which play a crucial role in the method of transmission in AI since the viral persistence in water is highly sensitive to environmental conditions, such as temperature. The temperature of these aquatic environments varies seasonally and geographically based on the migratory patterns of the targeted wild birds. It can be concluded that with a warmer temperature, there is a significant reduced likelihood of an AI virus epidemic in the population. In this project, two different strains of the AI virus are evaluated to determine under what specific environmental conditions a dominant strain may be surmounted by its subordinate strain, taking into consideration factors such as fitness cost, temperature, and the strength of environmental factor.

Title: Ensemble Kalman Methods With Constraints

Authors: Matthew Levine

Institution: Caltech

Co-authors: David J. Albers, Paul-Adrien Blancquart, Elnaz Esmaeilzadeh Seylabi, Andrew Stuart

Abstract: Ensemble Kalman methods constitute an increasingly important tool in both state and parameter estimation problems. Their popularity stems from the derivative-free nature of the methodology which may be readily applied when computer code is available for the underlying state-space dynamics (for state estimation) or for the parameter-to-observable map (for parameter estimation). There are many applications in which it is desirable to enforce prior information in the form of equality or inequality constraints on the state or parameter. This poster establishes a general framework for doing so, describing a widely applicable methodology and a set of numerical experiments exemplifying it. In particular, we formulate application-agnostic constrained versions of ensemble kalman filtering and ensemble kalman inversion. We demonstrate applications to personalized biomedical predictions and to seismologic inference.

Title: Using geometric phases to separate overall rotation and internal motions in classical and quantum molecular dynamics

Authors: Florence Lin

Institution: F. J. Lin Research

Abstract: Almost sixty years ago, Aharonov and Bohm pointed out that electrons could be affected by vector potentials without an external magnetic field. They described an ad hoc phase shift required for wave functions in vector potentials, e.g., representing magnetic fields. The phase shift exemplifies a geometric phase (or Berry's phase). Similarly, Mead and Truhlar described an ad hoc phase shift required for nuclear wave functions for three-body molecular dynamics in the Born-Oppenheimer approximation. In their "molecular Aharonov-Bohm effect," Mead and Truhlar assumed decoupled overall rotation and internal motion and considered the effects of a conical intersection. Instead of neglecting coupled overall rotation and internal motion, now the coupling is used to create a frame with decoupled overall rotation and vanishing classical and quantum geometric phases. An extension of the classical dynamics describes the quantum dynamics of the three-body molecular dynamics in the Born-Oppenheimer approximation. This theoretical approach agrees with spectra of rare gas-diatomic molecule complexes and with triatomic photodissociation dynamics.

Title: Solving signomial programs via SAGE certificates and partial dualization

Authors: Riley Murray

Institution: Caltech

Co-authors: Venkat Chandrasekaran and Adam Wierman

Abstract: We show how SAGE nonnegativity certificates are compatible with a technique known as partial dualization, whereby computationally tractable constraints are incorporated into a dual problem without being moved to the Lagrangian. We consider the resulting "generalized SAGE cone" as it pertains to signomial programming (SP). Matters such as coordinate system invariance, sparsity preservation, and error bounds are addressed. Our provided implementation shows that this approach can solve many SPs from the literature to global optimality, without resorting to cutting planes, or branch-and-bound.

Title: Heterogeneous Vesicles with Phases having Different Preferred Curvatures: Shape Fluctuations and Mechanics of Active Deformations

Authors: David Rower

Institution: UCSB

Co-authors: Paul Atzberger

Abstract: We investigate the elastic mechanics of heterogeneous vesicles having a collection of phase-separated domains with different preferred curvatures. This results in domain coarsening, raft interactions, non-spherical equilibrium shapes, and shape transformations. We consider the mechanics of such heterogeneous vesicles in processes such as microchannel transport and plate compression. We perform simulation studies and develop theory to investigate the elastic responses of vesicles both using passive shape fluctuations and using active deformations. Our approach is based on a single-particle implicit-solvent lipid model for membranes. We develop spectral analysis methods for analyzing passive shape fluctuations to relate our simulation results to continuum mechanics. We further explore the mechanics through active deformations that compress heterogeneous vesicles between two flat plates or subject vesicles to insertion into slit-like channels. We find significant domain rearrangements can arise in our heterogeneous vesicles in response to these deformations. Relative to homogeneous vesicles, we find that heterogeneous vesicles can exhibit smaller resisting forces to compression and larger variance in the insertion times into microchannels. We expect the underlying mechanisms discovered in our investigations may be potentially useful in the design of binary unilamellar vesicles in microfluidic systems or provide further insights into biological processes involving heterogeneous vesicles.

Title: Stability of Phase Retrieval Problem

Authors: Palina Salanevich

Institution: UCLA

Abstract: Phase retrieval is a non-convex inverse problem of signal reconstruction from intensity measurements with respect to a measurement frame. Not every frame has the injective associated phaseless measurement map, so reconstruction is not always possible. One of the main research directions in phase retrieval therefore is to determine when is the measurement map injective. In the case when phaseless measurements are corrupted by noise, injectivity is not enough to guarantee accurate reconstruction of a signal, and the measurement map has to satisfy some stronger assumptions. More precisely, we want to ensure that, if the measurements of two signals are close, then the signals are also close up to a global phase factor. This leads to the notion of stability of the measurement map.

We address the question of stability of phase retrieval for two classes of random measurement maps, namely, frames with independent frame vectors satisfying bounded fourth moment assumption, and frames with correlated frame vectors. We propose a new method based on the frame order statistics, which can be used to establish stability of the measurement maps also for other classes of frames.

Title: Learning without the Phase: Regularized PhaseMax Achieves Optimal Sample Complexity

Authors: Fariborz Salehi

Institution: Caltech

Co-authors: Ehsan Abbasi, Babak Hassibi

Abstract: The problem of estimating an unknown signal, $\mathbf{x} \in \mathbb{R}^n$, from a vector $\in \mathbb{R}^m$ consisting of m magnitude-only measurements of the form $y_i = |\mathbf{a}_i \mathbf{x}_0|$, where $\mathbf{a}$i's are the rows of a known measurement matrix $\mathbf{A}$ is a classical problem known as phase retrieval. This problem arises when measuring the phase is costly or altogether infeasible. In many applications in machine learning, signal processing, statistics, etc., the underlying signal has certain structure (sparse, low-rank, finite alphabet, etc.), opening of up the possibility of recovering $\mathbf{x}_0$ from a number of measurements smaller

than the ambient dimension, i.e., $m < n$. Ideally, one would like to recover the signal from a number of phaseless measurements that is on the order of the "degrees of freedom" of the structured $\mathbf{x}_0$. To this end, inspired by the PhaseMax algorithm, we formulate a convex optimization problem, where the objective function relies on an initial estimate of the true signal and also includes an additive regularization term to encourage structure. The new formulation is referred to as regularized PhaseMax. We analyze the performance of regularized PhaseMax to find the minimum number of phaseless measurements required for perfect signal recovery. The results are asymptotic and are in terms of the geometrical properties (such as the Gaussian width) of certain convex cones. When the measurement matrix has i.i.d. Gaussian entries, we show that our proposed method is indeed order-wise optimal, allowing perfect recovery from a number of phaseless measurements that is only a constant factor away from the degrees of freedom. We explicitly compute this constant factor, in terms of the quality of the initial estimate, by deriving the exact phase transition. The theory well matches empirical results from numerical simulations.

Title: Analysis of a spherical harmonic discontinuous Galerkin method for solving radiative transfer equations with periodic boundary conditions

Authors: Qiwei Sheng

Institution: California State University, Bakersfield

Co-authors: Cheng Wang

Abstract: We propose and analyze a spherical harmonic discontinuous Galerkin (SH-DG) method for solving the radiative transfer equation with periodic boundary conditions. To construct our SH-DG method, the spherical harmonic method and discontinuous Galerkin method are sequentially employed to discretize the angular and spatial variables, which leads to semi-discrete P_N equations and a fully discrete system, respectively. We then establish the existence and uniqueness of the linear symmetric first-order hyperbolic system resulting from the angular discretization. We also design the bilinear form such that the periodic boundary condition and numerical flux are naturally incorporated and then prove a well-posedness result of the fully discrete scheme. Complete error estimates of the discrete systems are derived. Numerical examples are included to validate the theoretical results.

Title: Learning to Fail: Predicting Fracture Evolution in Brittle Material Models using Recurrent Graph Convolutional Neural Networks

Authors: Zhengming Song, Yadong Ruan

Institution: Claremont Graduate University

Co-authors: Max Schwarzer, Bryce Rogan, Diana Y. Lee, Allon G. Percus, Viet T. Chau, Bryan A. Moore, Esteban Rougier, Hari S. Viswanathan, Gowri Srinivasan

Abstract: We propose a machine learning approach to address a key challenge in materials science: predicting how fractures propagate in brittle materials under stress, and how these materials ultimately fail. Our methods use deep learning and train on simulation data from high-fidelity models, emulating the results of these models while avoiding the overwhelming computational demands associated with running a statistically significant sample of simulations. We employ a graph convolutional network that recognizes features of the fracturing material and a recurrent neural network that models the evolution of these features, along with a novel form of data augmentation that compensates for the modest size of our training data. We simultaneously generate predictions for qualitatively distinct material properties. Results on fracture damage and length are within 3\% of their simulated values, and results on time to material failure, which is notoriously difficult to predict even with high-fidelity models, are within approximately 15\% of simulated values. Once trained, our neural networks generate predictions within seconds, rather than the hours needed to run a single simulation.

Title: Two-dimensional Stokes Immersed Boundary Problem and its Regularizations: Well-posedness, Singular Limit, and Error Estimates

Authors: Jiajun Tong

Institution: UCLA

Co-authors: Fanghua Lin

Abstract: Studying coupled motion of immersed elastic structures and surrounding fluid is important in science and engineering. In this work, we first study 2-D Stokes immersed boundary problem that models a 1-D closed elastic string immersed and moving in a 2-D Stokes flow, and we prove its well-posedness. Inspired by the numerical immersed boundary method, we then introduce a regularized version of the problem, in which a regularized delta-function is used to mollify the flow field and

singular forcing. We prove global well-posedness of the regularized problems, and show that as the regularization parameter diminishes, the string dynamics in the regularized problems converge to that in the un-regularized problem under certain assumptions. Viewing the singular problem as a benchmark, we derive error estimates for the string dynamics under various norms. Our rigorous analysis shows that the regularized problems achieve improved accuracy if the regularized delta-function is suitably chosen, of which the heuristics is also given. This may imply potential improvement in the numerical immersed boundary method, which is worth further investigation. This is joint work with Fanghua Lin.

Title: Determining the Presence of Stem Cell Enrichment in Tumors

Authors: Lora Weiss

Institution: UC Irvine

Co-authors: Natalia Komarova

Abstract: Healthy tissue is composed of multiple compartments and is thought to be maintained by a small compartment of stem cells. The introduction of a cancerous mutation into the network will cause the populations to evolve over time, altering the ratio of the populations. For cancer treatment, stem cells have traditionally offered a more difficult challenge than differentiated cells, so a greater ratio is undesirable. Here, we investigate the evolution of this ratio over time to determine which conditions lead to this phenomenon, which we call stem cell enrichment.

Title: Mathematically modeling the coral reef microbiome

Authors: Maya Weissman

Institution: San Diego State University

Co-authors: Lais Lima, Elizabeth Dinsdale, Naveen K. Vaidya

Abstract: Coral reefs are some of the most diverse and valuable ecosystems on the planet, but an estimated 20% of the world's coral reefs have been decimated due to stressors such as climate change, coral bleaching, and diseases. Pseudodiploria strigosa is a reef-building species abundant in the Caribbean that is currently being threatened by black band disease. P. strigosa, like all other coral colonies, functions as a holobiont where the coral animal relies on a symbiotic relationship with a complex microbiome. The composition and health of the microbiome is affected by high temperatures, eutrophication, and other stress conditions. In this poster, we present mathematical models, developed based on P. strigosa coral colonies data collected from Bermuda (Dinsdale Lab at SDSU), in order to investigate the relationship between the environmental conditions, the coral reef microbiome, and black band disease dynamics. In particular, we focus on evaluating the effects of temperature on the coral reef microbiome, which emulates the periodic changes in microbiome composition found in nature. The microbiome model is further extended to predict black band disease dynamics and identify the environmental threshold conditions that would cause the reef holobiont to shift from a healthy to a disease-associated microbial community. Our results show that temperature can have significant impact on the coral reef holobiont health, and can account for susceptibility to black band disease. Our models can be used to investigate potential strategies to protect reef ecosystems from black band disease and other stressors.

Title: TBA

Authors: Fanghui Xue

Co-Authors: Jack Xin

Institution: UC Irvine

Abstract: We study the sparsification of convolutional neural networks (CNN) by a relaxed variable splitting method (RVSM) of l_0 and transformed Tl_1 penalties. Compared to the traditional way of applying SGD directly to the penalized loss function, RVSM achieves a better sparsity. Moreover, the RVSM is also applicable to discontinuous penalties like l_0, which can be a trouble to many other methods. The data we consider is consisted of complex curves such as texts written in different fonts, and planar shapes drawn with trembling hands simulating those of Parkinson's disease patients. The CNN contains 3 convolutional layers, each followed by a maximum pooling, and finally a fully connected layer which contains the largest number of network weights. With l_0 penalty, we achieved over 99 % test accuracy in distinguishing shaky vs. regular handwritings with above 86 % of the weights in the fully connected layer being zero. Comparable sparsity and test accuracy are also reached with a proper choice of Tl_1 penalty. We believe the RVSM can also produce a CNN of high sparsity if applied to other data sets, with an infinitesimal loss to the accuracy, if any.

Title: Image and Data Processing Methodologies for Remote Sensing Applications

Authors: Igor Yanovsky

Institution: JPL/Caltech and UCLA

Co-authors: Bjorn Lambrigtsen, Jing Qin, Alan Tanner, Luminita Vese, Wotao Yin, Ali Behrangi, Yixin Wen, Mathias Schreier, Van Dang, Benjamin Holt, Francois Ayoub, Konstantin Dragomiretskiy, Anthony Davis, Veljko Jovanovic

Abstract: The development of a variety of novel sensors for capturing remote sensing and atmospheric data gave rise to many new applications and the need for solving new computational problems arising in these fields. There exists a broad range of remote sensing problems that are immensely important for scientific understanding. We derive state-of-the-art robust computational models and show applications that leverage sparsity in remote sensing datasets. This work showcases several applications, including spatio-temporal super-resolution of microwave imagery, fusion of microwave and infrared atmospheric data for enhancing its spatial resolution, stripe removal in remote sensing imagery, cloud layer separation in atmospheric images, and deriving velocity fields of small-scale ocean eddies.