KANGQI FU

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https://Kangqi.github.io

RESEARCH INTERESTS

Applied and Computational Math, Climate modeling, Machine Learning, GFD, Dynamical System, Ocean-Atmosphere-Sea ice Dyanmics, PDE, Image Processing

EDUCATION

University of Wisconsin Madison   *August 2018 - May 2021*

GPA: 3.71/4

BS-AMEP(Applied Math, Physics & Engineer), BS in Computer Science

Sichuan University, Pittsburgh Institute   *September 2016 - May 2018*

GPA: 3.81/4, Rank: 3/159

BEng in Mechanical Engineering, Transfer to UW Madison

RESEARCH EXPERIENCE

Superparameterization for Sea Ice and Atmosphere   Oct 2020 - Present

Advised by Prof.Sam Stechmann (UW Madison), Dr.Quanling Deng (UW Madison)

· Prepare for developing parallelized Fine-scale discrete element sea ice model using updated EZParallel library and Julia MPI.jl library.

· Implement a Macro-scale ocean-sea ice model - a 2 spatial dimensional system of conservation laws that consist of concentration or mass balance equation and momentum balance equations.

· Develop a solver containing Cartesian Cut-Cell and other finite volume methods including WENO, MUSCL, SWDLS, etc.

· Expand the solver to solve the generic system of conservation laws. Let the user specify the state variables and flux vector. The code can be used to simulate any conservation law.

· Study and explore the possibilities of deriving a multi-scale version of the Boltzmann equation.

Mathematics and Data Science for Improved Physical Modeling and Prediction of Arctic Sea Ice   Sep 2019 - Present

Advised by Prof.Sam Stechmann (UW Madison), Prof.Georgy Manucharyan (U-Washington)

· Develop a level-set discrete element sea ice model in Julia. The model uses both concave and convex polygon shape floes to simulate physical processes, including collisions, creations of new floes/packing, fractures, welding, and ridging.

· Implement LSTM-UNet and LSTM-Segnet to detect and reconstruct sea ice in satellite images. Generate training dataset using GVF snake algorithm and data augmentation. Projects could be further explored to understand the sea ice drift field and leverage this information to backtrack ocean turbulence characteristics.

· Construct DEM routine using the idea of assigning and tracking particle ID in EZParallel library, which is a Fortran library originally created by Prof. Stechmann in Fortran to help simplify the processes of parallelizing serial 2-D finite difference and spectral codes, using HPC cluster

· Develop some important computational geometry libraries, such as Julia-polybnd-voronoi and voronoi-diagram (Fortune's algorithm), etc

Generalized-α Methods for Quasi-Geostrophic Equations   July 2020 - Present

Advised by Dr.Quanling Deng (UW Madison)

- Study Quasi-Geostrophic equations
- Develop 2-layer QG solver in Julia based on Di Qi, and Andrew Majda's numerical scheme
- Re-prove parameter values of Generalized-α Methods for second order accuracy
- Test and analyze the third-order accuracy generalized-alpha method developed by Dr.Deng using a conceptual ENSO model after bifurcation analysis

Label-Free Reconstruction of the binary ultrasonic image through compressed sensing and deep learning methods　　　　　　　　　　　　　　　　　　　　Oct 2019 - May 2020
Advised by Prof.Chu Ma (UW Madison)

- Worked on diffraction-limited imaging systems, super-resolution imaging systems, application of compressed sensing algorithms and deep learning algorithms (Unet, conditional GANs)
- Used COMSOL to simulate imaging process (gratings, nongratings, 1D binary pattern, and 2D binary pattern) and get training and testing data as input, then adapted compressed sensing and deep learning methods for binary image reconstruction to measure the field distribution and reconstruct the image with the smallest number of measurements
- Made the MATLAB and Python simulation package

MAST-ML Package Development　　　　　　　　　　　　　　　　　　　Feb 2019 - Sep 2019
Advised by Prof.Dane Morgan (UW Madison) and Dr. Ryan Jacobs (UW Madison)

- Participated in developing MAST-ML, which is an open-source Python package designed to broaden and accelerate the use of machine learning in materials science research
- Worked on extending to support the full library of scikit-learn modules, and tensorflow with Keras
- Other works include feature engineering, Hyperparameter optimization, neural network package implementation, and computer vision on material texture analysis.

IN-PROGRESS PUBLICATIONS

Quanling Deng, **Kangqi Fu**, Nan Chen, Samuel N. Stechmann, "Superparameterization for Sea Ice and Atmosphere", Manuscript in preparation, 2020.

TEACHING EXPERIENCE

Note Taker and Tutor　　　　　　　　　　　　　　　　　　　　　　Sep 2019 - Present
McBurney Disability Resource Center

- Take and share several course notes (advanced calculus, optics, PDE, etc) for students with disabilities.
- Set up discussion sessions for a small group of students in McBurney Disability Resource Center.

Peer Mentor of Physics 208-General Physics 2　　　　　　　　　　Sep 2019 - Dec 2019
Physics Department

- Held weekly office hour to answer student's questions for physics 208 and helped them on their homework, quiz, tests.

HONORS & AWARDS

UW-Madison Dean's List	2018-2019
Research Summer Fellowship Final Qualifier ($2500)	2019
Meritorious Award in Mathematical Contest in Modeling	2018
First Class Comprehensive Scholarship, Sichuan University (Top 1%, 5000 RMB)	2018
Dean's List Scholarship, Sichuan University (Top 5 in each college, 5000 RMB)	2018

Second Place, Sichuan Province College Mathematics Competition 2017

First Place, Sichuan University Math Modeling Competition 2017

COURSE HIGHLIGHTS

Mathematics	Numerical Analysis, Advanced Calculus, Linear Algebra, ODEs, PDEs, Complex Analysis, Dynamical Systems & Chaos, Probability Theories, Methods of Computational Mathematics (Graduate)
Physics	Classical Mechanics, Electromagnetic Fields, Quantum Mechanics, Relativity, Thermal and Statistical Physics, Applied Optics, Mechanics of Continua Plasma Physics, Particle Physics, Quantum Computing (Graduate)
CS and Eng	Data Structure & Algorithms, AI & Vision, Image Processing, Circuits, Machine Learning (Graduate), Optimization, Computer Architecture, HPC (Graduate), Database, Robotics

TECHNICAL SKILLS

Programming Languages	Java, Julia, C/C++, Fortran, Python, MATLAB, Mathematica
Deep Learning Frameworks	TensorFlow, PyTorch, Caffe
Optimization Tools	JuMP, LP, CLP, Gurobi
Software & Tools	LaTex, CATIA, OpenCV, Excel, Git, COMSOL, Zemax
Parallel & HPC Tools	OpenMP, MPI, Julia Toolkit
Operating System	Linux, ROS, Windows