1. Title Page

Annual Report (July 1, 2023 – June. 30, 2024)
Center for Applied Mathematics and Statistics (CAMS)
Director: Jiguang Sun
09/30/2024

2. Mission Statement

The mission of CAMS is to promote interdisciplinary research among mathematicians, statisticians, scientists, and engineers, and provide statistical consulting service for Michigan Tech and the community.

3. Activities and Highlights

CAMS supports its members for collaborative research by organizing research seminars/workshops and offering statistical consulting.

3.a Primary activities and highlights:

(1) Total proposal value: $5,457,540 (see appendix A.2)

(2) Total awarded value: $601,789 (see appendix A.3)

(3) CAMS organized Henes Workshop on Computational Mathematics, 09/21/24.

- Dr. Wei Cai, SMU, SOC-MartNet: A Martingale Neural Network for the Hamilton-Jacobi-Bellman Equation without Explicit inf_u H in Stochastic Optimal Controls.
- Dr. Isaac Harris, Purdue University, Anisotropic Transmission Eigenvalues with a Conductive Boundary Condition.
- Dr. Feng Bao, Florida State University, An Ensemble Score Filter for Tracking High Dimensional Nonlinear Dynamical Systems.
- Dr. Guannan Zhang, ORNL, Generative Machine Learning Models for Uncertainty Quantification.
- Dr. Yanfang Liu, MTSU, Training-free Conditional Diffusion Model for Stochastic Dynamical Systems Learning.
- Dr. Jianlin Xia, Purdue Univeristy, Fast solvers for neural network least-squares approximations.

(4) CAMS organized several seminars jointly with the Department of Math.

- Zhiqiang Cai, Purdue University, 09/29/2023.
- David Colton, University of Delaware, 10/06/2023.

- Yanzhao Cao, Auburn University, 09/20/2024.

(5) CAMS statisticians continued to offer consulting services.

The statisticians of CAMS (Kui Zhang, Fan Dai, Byungjun Kim, Ray Molzon, Xiao Zhang) continued to provide free statistical consulting services for Tech faculty, students, and staff in 23-24 (Spring 24, Fall 23, Spring 23, Fall 22, Spring 2022, Summer 2021, Fall 2022).

3.b Current CAMS member list

See Appendix A.1.

4. Budget Overview

4.a Budget Summary – FY 23-24

Carryforward Budget	$14,147.30
Faculty Supplemental Compensation (statistical consulting)	-$3,642.34
Fringe Benefits (statistical consulting)	-$743.10
Travel (seminar and workshop speakers)	-$6,497.06
Ending Balance	$3,264.89

4.b CAMS received its first IRAD transfer of $5,689.21 in FY 23-24.

4.c List of proposals - see Appendix A.2.

4.d List of funded proposals – see Appendix A.3. (FY 23-24 is the third year of CAMS).

5. Future Plans and Goals

5.a CAMS will continue to provide free Statistical Consulting Service to Tech faculty and students. CAMS plans to continue to foster interdisciplinary collaborations and proposals. CAMS plans to organize/co-organize annual workshops on applied mathematics and statistics. CAMS also plans to support members' collaboration visits.

5.b CAMS has reached its short-term goal (3 years): $2,000,000.00 for submitted proposals and $500,000.00 for funded research proposals. Six proposals were funded ($601,789 in total). The next goal is $1,300,000 total funded research proposals by the end of Year 6 (2027).

5.c Space or facility needs: n/a

5.d Financial gap: n/a

5.e Strategies to fill the gap: n/a

6. Challenges and Barriers

FY 23-24 is the third year of CAMS. There are two main challenges: 1) how to further improve research collaborations and 2) how to improve proposal success rate. CAMS would hope the VPR could provide us some help to address these challenges.

Appendix

A.1 Current CAMS member list

Kitchen, Sarah - MTRI
Wei, Hairong - CFRES
Zhou, Weihua – Applied Computing, COC
Chatterjee, Snehamoy - Geological and Mining Engineering and Sciences, COE
Ghosh, Susanta - Mechanical Engineering-Engineering Mechanics, COE
Jiang, Jingfeng - Biomedical Engineering, COE
Masoud, Hassan - Mechanical Engineering, COE
Chen, Qinghui - Kinesiology and Integrative Physiology, CSA
Dai, Fan - Mathematical Sciences, CSA
Hemmer, David - Mathematical Sciences, CSA
Iyer, Kartik - Physics, CSA
Kim, Byung-Jun - Mathematical Sciences, CSA
Labovsky, Alexander - Mathematical Sciences, CSA
Molzon, Ray - Mathematical Sciences, CSA
Ong, Benjamin - Mathematical Sciences, CSA
Piret, Cecile - Mathematical Sciences, CSA
Robert Schneider - Mathematical Sciences, CSA
Sun, Jiguang - Mathematical Sciences, CSA
Xu, Zhengfu - Mathematical Sciences, CSA
Yang, Yang - Mathematical Sciences, CSA
Zhang, Kui - Mathematical Sciences, CSA
Zhang, Qian - Mathematical Sciences, CSA
Zhang, Xiao - Mathematical Sciences, CSA

A2. Submitted Proposals 23-24 (Total: $5,457,540)

1. Understand interplays between hemodynamics and intraluminal thrombosis in abdominal aortic aneurysms, Snehamoy Chatterjee, AHA, $100,820.
2. Modular representation theory of symmetric groups and related objects. David Hemmer, NSF, $421,960.
3. Analytic properties of partition zeta functions, Robert Schneider, NSF, $668,320.
4. McIntire Stennis FY24: Elucidating the genetic regulation of the physiological and metabolic processes governed by the TORC regulatory module in poplar, Hairong Wei, US Dept of Agriculture/National Institute of Food and Agriculture (NIFA), $12,520.

5. Collaborative Research: Robust numerical methods for flow and transport in fractured porous media, Yang Yang, NSF, $236,082.
6. Validation and Development of Large Eddy Simulation with Correction - a recently proposed class of turbulence models. Alexander Labovsky, NSF, $220,281.
7. Robust numerical methods for convection-diffusion equations, Yang Yang, NSF, $238,430.
8. Parameter-robust high-order enriched Galerkin methods for linear elasticity, poroelasticity, and couple stress problems, Qian Zhang, NSF, $181,020.
9. Improving management of small abdominal aortic aneurysms, Jingfeng Jiang, NSF, $2,991,575.
10. Characterization and Visualization of Large and Complex Data, Fan Dai, NSF, $122,953.
11. Systematic Approaches to Construct Coarse-Grid Operators for Multigrid Reduction in Time. Benjamin Ong, Lawrence Livermore National Laboratory, $45,000.
12. LEAPS-MPS: Pressure-robust and/or Helicity conserving enriched Galerkin methods for (Navier)-Stokes equations, Zhang Qian, NSF, $218,579.

A3. Awarded Proposals 23-24 (through CAMS. Total: $601,789)

1. Bayesian modeling of multivariate mixed longitudinal responses with scale mixtures of multivariate normal distributions, Xiao Zhang, NIH, 425,790.
2. Measurement of in-situ geomechanical properties using hydraulic techniques. Snehamoy Chatterjee, VirginiaTech, $19,999.
3. Novel Finite Element Methods for Nonlinear Eigenvalue Problems- A Holomorphic Operator Function Approach, Jiguang Sun, NSF, $100,000.
4. Systematic Approaches to Construct Coarse-Grid Operators for Multigrid Reduction in Time. Benjamin Ong, Lawrence Livermore National Laboratory, $45,000.
5. McIntire Stennis FY24: Elucidating the genetic regulation of the physiological and metabolic processes governed by the TORC regulatory module in poplar. Hairong Wei, US Dept of Agriculture/National Institute of Food and Agriculture (NIFA), $12,520.
6. Pairwise Likelihood with Latent Variables for Detecting Genetic Variants Associated with Diabetes Using Multiple Types of Phenotypes, Kui Zhang, $4,695.