# Curriculum Vitae of Jun Liu

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## RESEARCH INTERESTS

- PDE-Constrained Optimization and Optimal Control, Numerical PDEs, Numerical Linear Algebra.
- Inverse Problems, Medical Imaging, Mathematical Biology and Oncology, Numerical Optimization.
- Sinc Methods, Finite Difference Methods, Multigrid Method, Domain Decomposition Method.

## EMPLOYMENT

- Assistant Professor, Department of Mathematics and Statistics, Southern Illinois University Edwardsville, 8/2017-now.
- Assistant Professor, Department of Mathematics and Statistical Sciences, Jackson State University, 8/2015-8/2017.
- Teaching/Research Assistant, Department of Mathematics, Southern Illinois University Carbondale, 8/2010-8/2015.
- Software Engineer, China National Software and Service Co., Ltd., Guangzhou, China, 7/2004-8/2007.

## EDUCATION

- Ph.D., Computational Mathematics, Southern Illinois University (SIU) Carbondale, USA, 8/2010-8/2015.
- M.S., Computational Mathematics, South China Normal University, China, 9/2007-7/2010.
- B.S., Information and Computing Science, Guangdong University of Technology, China, 9/2000-6/2004.

## JOURNAL PUBLICATIONS

1. **Jun Liu** and Zhu Wang, *Efficient Time Domain Decomposition Algorithms for Parabolic PDE-Constrained Optimization Problems*, accepted by **Computers and Mathematics with Applications**, 2017.
2. Buyang Li, **Jun Liu**, and Mingqing Xiao, *A New Multigrid Method for Unconstrained Parabolic Optimal Control Problems*, **Journal of Computational and Applied Mathematics**, 326, pp. 358–373, 2017.
3. Ruimin Feng, **Jun Liu**, and Satya Harpalani, *Optimized pressure pulse-decay method for laboratory estimation of gas permeability of sorptive reservoirs: Part 1: Background and numerical analysis*, **Fuel**, 191, pp. 555–564, 2017.
4. Ruimin Feng, Satya Harpalani, and **Jun Liu**, *Optimized pressure pulse-decay method for laboratory estimation of gas permeability of sorptive reservoirs: Part 2: Experimental study*, **Fuel**, 191, pp. 565–573, 2017.
5. **Jun Liu**, Brittany D. Froese, Adam M. Oberman, and Mingqing Xiao, *A multigrid scheme for 3D Monge-Ampère equations*, **International Journal of Computer Mathematics**, 94(9), pp. 1850–1866, 2017.
6. **Jun Liu** and Mingqing Xiao, *A Leapfrog Multigrid Algorithm for the Optimal Control of Parabolic PDEs with Robin Boundary Conditions*, **Journal of Computational and Applied Mathematics**, 307, pp. 216–234, 2016.
7. **Jun Liu**, Yu Huang, Haiwei Sun, and Mingqing Xiao, *Numerical methods for weak solution of wave equation with van der Pol type nonlinear boundary conditions*, **Numerical Methods for Partial Differential Equations**, 32(2), pp. 373–398, 2016.
8. **Jun Liu** and Mingqing Xiao, *A leapfrog semi-smooth Newton multigrid method for semilinear parabolic optimal control problems*, **Computational Optimization and Applications**, 63(1), pp. 69–95, 2016.
9. **Jun Liu** and Mingqing Xiao, *A new semi-smooth Newton multigrid method for control-constrained semi-linear elliptic PDE problems*, **Journal of Global Optimization**, 64(3), pp. 451–468, 2016.
10. Buyang Li, **Jun Liu**, and Mingqing Xiao, *A fast and stable preconditioned iterative method for optimal control problem of wave equations*, **SIAM Journal on Scientific Computing**, 37(6), pp. A2508–A2534, 2015.
11. **Jun Liu** and Haiwei Sun, *A fast high-order Sinc-based algorithm for pricing options under jump-diffusion processes*, **International Journal of Computer Mathematics**, 91(10), pp. 2163–2184, 2014.
12. Xuejun Gao, Tingwen Huang, Yu Huang, **Jun Liu**, and Mingqing Xiao, *Observer design for axial flow compressor*, **ASME Journal of Dynamic Systems, Measurement, and Control**, 136(5), 051017-1:12, 2014.
13. Spike T. Lee, **Jun Liu**, and Haiwei Sun, *Combined compact difference scheme for linear second-order partial differential equations with mixed derivative*, **Journal of Computational and Applied Mathematics**, 264, pp. 23–37, 2014.

14. **Jun Liu**, and Mingqing Xiao, *Rank-one characterization of joint spectral radius of finite matrix family*, **Linear Algebra and its Applications**, 438(8), pp. 3258–3277, 2013.
15. Xiongping Dai, Yu Huang, **Jun Liu**, and Mingqing Xiao, *The finite-step realizability of the joint spectral radius of a pair of d-by-d matrices one of which being rank-one*, **Linear Algebra and its Applications**, 437(7), pp. 1548–1561, 2012.
16. Xiaoshan Chen, Wen Li, Xiaojun Chen, and **Jun Liu**, *Structured backward errors for generalized saddle point systems*, **Linear Algebra and its Applications**, 436(9), pp. 3109–3119, 2012.
17. **Jun Liu** and Haiwei Sun, *Sinc-Galerkin method for the option pricing under jump-diffusion model*, **East-West Journal of Mathematics**, pp. 317–327, 2009.
18. Liying Sun and **Jun Liu**, *Constraint preconditioning for nonsymmetric indefinite linear systems*, **Numerical Linear Algebra with Applications**, 17(4), pp. 677–689, 2009.

## REFEREED CONFERENCE PUBLICATIONS

1. **Jun Liu** and Mingqing Xiao, *Leapfrog Multigrid Methods for Optimal Control of Parabolic PDEs with Robin Boundary Conditions*, Proceedings of the 35th Chinese Control Conference, accepted.
2. **Jun Liu**, Buyang Li, and Mingqing Xiao, *An Effective Computational Scheme for the Optimal Control of Wave Equations*, NOLCOS 2016, IFAC-PapersOnLine Vol. 49 (18), pp. 891896, 2016.
3. Buyang Li, **Jun Liu**, and Mingqing Xiao, *Leapfrog multigrid methods for parabolic optimal control problems*, Proceedings of the 27th Chinese Control and Decision Conference, pp. 137-143, 2015. (Finalists for Zhang Si-Ying Outstanding Youth Paper Award).
4. **Jun Liu**, Tingwen Huang, and Mingqing Xiao, *A semismooth Newton multigrid method for constrained elliptic optimal control problems*, Advances in Global Optimization, Springer Proceedings in Mathematics & Statistics Vol. 95, pp. 397–405, 2015.
5. **Jun Liu** and Mingqing Xiao, *A new semi-smooth Newton multigrid method for parabolic PDE optimal control problems*, Proceedings of the 53rd IEEE Conference on Decision and Control, pp. 5568–5573, 2014.
6. **Jun Liu**, Yu Huang, Haiwei Sun, and Mingqing Xiao, *High-order numerical methods for wave equations with van der Pol type boundary conditions*, Proceedings of the SIAM Conference on Control and Its Applications, pp. 144–151, 2013.
7. **Jun Liu** and Mingqing Xiao, *Computation of joint spectral radius for network model associated with rank-one matrix set*, Neural Information Processing, Springer Lecture Notes in Computer Science, Vol. 7665, pp. 356–363, 2012.
8. Xuejun Gao, Tingwen Huang, **Jun Liu**, and Mingqing Xiao, *Local observer for axial flow aeroengine compressors*, Proceedings of the 10th World Congress on Intelligent Control and Automation, pp. 2233–2238, 2012.

## SUBMITTED MANUSCRIPTS

1. Jianliang Tang, **Jun Liu**, and Mingqing Xiao, *Direct Reconstruction of Initial States of Wave Equation via Boundary Observation*, 2017.
2. **Jun Liu** and Zhu Wang, *Non-commutative Discretize-then-Optimize Algorithms for Elliptic PDE-Constrained Optimal Control Problems*, 2017. `https://arxiv.org/abs/1706.07652`

## REPORTS AND THESES

1. **Jun Liu**, *New Computational Methods for Optimal Control of Partial Differential Equations*, Ph.D. Dissertation, 150 pages, Southern Illinois University Carbondale, 2015.
2. Bruce Bugbee, Brianna Cash, **Jun Liu**, Helen Parks, Wei Qi, Deling Wei, and Xi Zhang, *Uncertainty-enabled design of an active MEMS valve for a high-pressure micro gas analyzer*, Proceedings of the 18th Industrial Math and Statistical Modeling Workshop in Statistical and Applied Mathematical Sciences Institute (SAMSI), pp. 1–40, 2012.
3. **Jun Liu**, *Efficient preconditioners for the Helmholtz equation discretized by combined compact difference method*, Master's Thesis, 70 pages, South China Normal University, 2010.
4. **Jun Liu**, Insight and outlook of the degree/diameter problem, Bachelor's Thesis, 54 pages, Guangdong University of Technology, 2004.

## SUBMITTED PROPOSALS

- "CBMS Conference: Computational Methods in Optimal Control", Role: PI, submitted to NSF, 4/2017.

- "Efficient Numerical Methods for PDE-Constrained Optimization", Simons Foundations Collaboration Grants for Mathematicians, Role: sole PI, **Not Funded**, 1/2017.
- "Efficient Sinc Numerical Methods for PDE-Constrained Optimization", Role: sole PI, **Not Funded**, 11/2016.

## AWARDS AND HONORS

- SIAM Early Career Travel Award for SIAM Conference on Control and Its Applications (CT17), July, 2017.
- Funded travel to AIM REUF workshop at ICERM, June, 2017.
- Funded travel to IMA Optimization Course, August, 2016.
- Funded travel to AIM REUF workshop on the Mathematics of Data at Duke university, July, 2016.
- Funded travel to IMA workshop on Control of Infinite-dimensional Systems, March, 2016.
- IEEE Student Travel Award for the 53rd IEEE Conference on Decision and Control, December, 2014.
- Dissertation Research Assistantship Award, Southern Illinois University, 2014 Fall-2015 Spring (9 months).
- Funded travel to IMA Control Course, June, 2014.
- SIAM Student Travel Award for SIAM Conference on Optimization, May, 2014.
- Doctoral Fellowship Award, Southern Illinois University, 2013 Fall-2014 Summer (11 months).
- Fully funded travel to participate the SAMSI Industrial Math/Stat Modeling Workshop, July, 2012.
- Excellence Award for Master's Thesis, South China Normal University, July, 2010.
- Innovation Award for Bachelor's Thesis, Guangdong University of Technology, July, 2004.
- 3rd, 2nd, and 3rd Prize in the Undergraduate Math Contest in Modeling, Guangdong, 2001-2003.

## PRESENTATIONS

- "Efficient Time Domain Decomposition Algorithms for PDE-constrained Optimization Problems", Invited Minisymposium Talk, The 3rd Annual Meeting of SIAM Central States Section, Fort Collins, CO, October, 2017.
- "Efficient Time Domain Decomposition Algorithms for Time-dependent PDE-constrained Optimization Problems", SIAM Conference on Control and Its Applications (CT17), Pittsburgh, PA, July, 2017.
- "Time domain decomposition algorithms for Parabolic PDE-Constrained Optimization", Langenhop Lecture and Applied Mathematics Conference, Department of Mathematics, Southern Illinois University, May, 2017.
- "Efficient Numerical Methods for PDE-Constrained Optimization Problems", Applied and Computational Mathematics Seminar Talk, Department of Mathematics, University of South Carolina, April, 2017.
- "Efficient Iterative One-Shot Methods for PDE-Constrained Optimization", Seminar Talk, Department of Mathematics and Statistics, Mississippi State University, Feburary, 2017.
- "From Real Analysis to Numerical Analysis", Colloquium Talk, Department of Mathematics and Statistical Sciences, Jackson State University, Jackson, Mississippi, November, 2016.
- "Multilevel Discretize-then-Optimize Algorithms for PDE-Constrained Optimizations", Invited Minisymposium Talk, The 2nd Annual Meeting of SIAM Central States Section, Little Rock, Arkansas, October, 2016.
- "New Second-order Time Schemes for Optimal Control of PDEs," Poster Presentation, IMA Workshop on Computational Methods for Control of Infinite-dimensional Systems, March 14-18, 2016.
- "Iterative One-shot Methods for PDE-Constrained Optimization," Colloquium Talk, Department of Mathematics, The University of Southern Mississippi, November, 2015.
- "A Fast Iterative Method for Optimal Control of Wave Equations," Seminar Talk, Electrical and Computer Engineering Department, Southern Illinois University, April, 2015.
- "A Stable Leapfrog Scheme for Optimal Control of Wave Equations," The 1st Annual Meeting of SIAM Central States Section, Rolla, Missouri, April, 2015.
- "A New Semi-Smooth Newton Multigrid Method for Parabolic PDE Optimal Control Problems," The 53rd IEEE Conference on Decision and Control, Los Angeles, CA, December, 2014.
- "Multigrid method for Optimization Problems governed by Partial Differential Equations," Seminar Talk, Electrical and Computer Engineering Department, Southern Illinois University, October, 2014.
- "A Fast Leapfrog Scheme for the Numerical Solution of Parabolic Optimal Control Problems," The 34th Southeastern-Atlantic Regional Conference on Differential Equations, The University of Memphis, Memphis, October, 2014.
- "A New Semi-smooth Newton Multigrid Method for Parabolic PDE Optimal Control Problems," SIAM Annual Meeting, Chicago, Illinois, July, 2014.

- "A New Semi-Smooth Newton Multigrid Method for Control-Constrained Semi-Linear Elliptic PDE Problems," SIAM Conference on Optimization, San Diego, California, May, 2014.
- "High-Order Numerical Methods for Wave Equations with Van Der Pol Type Boundary Conditions," Session Chair, SIAM Conference on Control and Its Applications, San Diego, California, July, 2013.
- "Rank-one Characterization of Joint Spectral Radius," School of Mathematical Sciences, South China Normal University, Guangzhou, China, May, 2013.
- "Joint Spectral Radius of Finite Rank-One Matrix Family," SIAM Conference on Control and Its Applications, Baltimore, Maryland, July, 2011.
- "A Fast Sinc Method and its Application in Option Pricing," Department of Mathematics, Chinese University of Hong Kong, Hong Kong, China, December, 2009.
- "Sinc Method and its Application in Option Pricing," Department of Mathematics, University of Macau, Macao, China, March, 2009.

## PROFESSIONAL DEVELOPMENT

- ICERM Research Experiences for Undergraduate Faculty (REUF), Providence, RI, June 26-30, 2017.
- NSF/CBMS: Nonlocal Dynamics: Theory, Computation and Applications, Chicago, IL, June 4-9, 2017.
- Participated JSU ADVANCE Implicit Bias Think Tank, Jackson, Mississippi, March 22-23, 2017.
- A faculty leader in Interdisciplinary Engagement Team of JSU's First in the World (FITW) program, 2016-2017.
- IMA New Directions Short Course: Mathematical Optimization, IMA, Minneapolis, August 1-12, 2016.
- AIM Research Experiences for Undergraduate Faculty (REUF) on the Mathematics of Data, Information Initiative at Duke (iiD), Duke University, Durham, July 18-22, 2016.
- IMA Workshop: Computational Methods for Control of Infinite-dimensional Systems, University of Minnesota, Minneapolis, March 14-18, 2016.
- Cohort IV of the Academy for Research and Scholarly Engagement at Jackson State University, 2015-2016.
- XSEDE HPC workshop in Southern University at New Orleans, October 23-24, 2015.
- IMA New Directions Short Course: Topics in Control Theory, IMA, Minneapolis, May 27-June 13, 2014.
- SAMSI Industrial Math/Stat Modeling Workshop, North Carolina State University, Raleigh, July 16-24, 2012.
- Workshop on Computational Issues in Nonlinear Control, Monterey, California, November 7-8, 2011.
- The 3rd Winter School on Applied Mathematics, City University of Hong Kong, December 1-11, 2009.

## PROFESSIONAL SERVICE

- Thesis Committee Member of
  Tyisha Graves (M.S. in Biology, Title: *Xanthohumol inhibits Metastatic Lung Cancer Cells Migration*)
- Advised 2 teams (6 students) to participate in 2017 COMAP's Mathematical Contest in Modeling (MCM).
- Committee Chair of the 2017 (37th) Annual Mathematics and Engineering Fair at Jackson State University.
- Department Committees:
  - Employment, Curriculum, Recruitment, Assessment, Calculus, Research, Hospitality.
- Referee for 2017 IEEE Conference on Control Technology and Applications
- Referee for the 10th IFAC Symposium on Nonlinear Control Systems (NOLCOS 2016).
- Referee for the 2016 American Control Conference.
- Reviewer for Mathematical Review (American Mathematical Society), 2013-present.
- Referee for the 10th World Congress on Intelligent Control and Automation, 2012
- Referee for the SIAM Conference on Control and Its Applications (2013,2015).
- Judge for the annual Illinois Junior Academy of Science Region 8 Science Fair at SIU, 2013-2015.
- Assistant for the annual Math Field Day organized by Department of Mathematics, SIU, 2011-2014.
- Referee for Journals :
  - Computers & Mathematics with Applications
  - International Journal of Computer Mathematics
  - IEEE Transactions on Automatic Control
  - European Journal of Control
  - Nonlinear Analysis: Hybrid Systems

- Cognitive Computation

## PROFESSIONAL MEMBERSHIPS

- American Mathematical Society (AMS) Student Member, 2010-2015.
- Society for Industrial and Applied Mathematics (SIAM) Student Member, 2010-2015.
- Institute of Electrical and Electronics Engineers (IEEE) Student Member, 2014-2015.

## COMPUTATIONAL RESOURCES AWARDS

- XSEDE Startup Allocation Award (PI, TG-DMS150016, 7/2015–7/2016)
  Topic: Time Domain Decomposition Methods for Time-Dependent PDE-Constrained Optimization.
- XSEDE Renewal Startup Allocation Award (PI, TG-DMS150016, 7/2016–7/2017)
  Topic: Parallelize algorithms for PDE-Constrained Optimization using Domain Decomposition Methods.

## PROGRAMMING SKILLS

- C/C++, Java, MATLAB, Mathematica, SAS, R, PETSc, Trilinos, deal.II, FreeFem++, etc.

## TEACHING EXPERIENCE

Taught undergraduate courses:
- Introduction to Contemporary Mathematics
- College Algebra
- Business Calculus
- Calculus (I,II,III) with Laboratory Session (using Mathematica)

Taught graduate courses:
- Numerical Methods (I, II) (using MATLAB/Octave)
- Real Analysis
- Numerical Analysis
- Engineering Numerical Analysis
- Ordinary Differential Equations