

Kai Sun - VITA

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EDUCATION

Ph.D. in Mechanical and Aerospace Engineering August 2015 - June 2020
College of Engineering and Computer Science, Syracuse University (SU)
Dissertation: Solving Process Planning and Scheduling Problems Using the Concept of Maximum Weighted Independent Set
Advisor: Dr. Utpal Roy

M.S. in Mechanical and Aerospace Engineering August 2013 - May 2015
College of Engineering and Computer Science, SU

B.E. in Automotive Engineering September 2009 - July 2013
School of Mechanical and Automobile Engineering, Hefei University of Technology, Hefei, Anhui, China

RESEARCH INTERESTS

- Data-driven optimization
- Graph-based models and algorithms
- Multi-objective programming
- Data analytics and machine learning
- Healthcare operations
- Service systems

PROFESSIONAL EXPERIENCE

Postdoctoral Fellow October 2020 - Present
Department of Management Science and Statistics, the Carlos Alvarez College of Business, the University of Texas at San Antonio (UTSA)
Supervisor: Dr. Arkajyoti Roy

Adjunct Assistant Professor June 2023 - Present
Department of Anesthesiology, the Long School of Medicine, the University of Texas Health San Antonio (UTHealthSA)

Mechanical and Research Engineer Intern January 2018 - August 2018
UsPLM, Inc., Syracuse, NY
Development of digital twin for drone fleet management, web-based flight simulation and analysis in 3D virtual reality.

Research Engineer Intern May 2016 - August 2016
Filtertech, Inc. Manlius, NY
Development and customization of product lifecycle management (PLM) system (secondary development based on Aras Innovator) with visual analytics tools.

HONORS and AWARDS

Poster Award Finalist, 2021 American Association of Clinical Directors Preoperative Leadership Summit, Virtual

Summer Dissertation Fellowship, 2019 Department of Mechanical and Aerospace Engineering at SU, Syracuse, NY

FUNDING

AMTEC (Advanced Manufacturing, Thermal, and Environmental Controls) SyracuseCoE Industry Collaboration Summer Internship Award

Issued by the SyracuseCoE (New York State's Center of Excellence in Environmental and Energy Systems), SU, May 2016

- Co-PI \$5,000, awarded for the research project titled "Development of Smart PLM Platform for Filtertech, Inc."

RESEARCH EXPERIENCE

PUBLICATIONS

Accepted/Printed

1. **Sun, K.**, Li, Y., Roy, U. (2017). A PLM-based data analytics approach for improving product development lead time in an engineer-to-order manufacturing firm. *Mathematical Modeling of Engineering Problems*, 4(2), 69–74. <https://doi.org/10.18280/mmep.040201>

Submitted/Under Revision

2. **Sun, K.**, Sun, M., Agrawal, D., Dravenstott, R., Rosinia, F., Roy, A. (2023). Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming. Minor revision submitted to *Production and Operations Management*.
3. **Sun, K.**, Roy, A., Tobin, J. (2023). Artificial Intelligence and Machine Learning: Definition of Terms for Critical Care Research. Revision submitted to *Journal of Critical Care*.

Work-In-Progress

4. **Sun, K.**, Sun, M., Dannenhoffer, J., Rosinia, F., Roy, A. (2023). Solving Resource Allocation Problems Using the Method of Maximum Weighted Independent Set. To be submitted.
5. **Sun, K.**, Dannenhoffer, J., Roy, U. (2020). An Algorithm Framework for the Exact Solution and Improved Approximation of the Maximum Weighted Independent Set Problem (arXiv:2008.01961). arXiv. <https://doi.org/10.48550/arXiv.2008.01961>
6. **Sun, K.**, Dannenhoffer, J., Roy, U. (2020). A Novel Approach for the Process Planning and Scheduling Problem Using the Concept of Maximum Weighted Independent Set (arXiv:2008.01960). arXiv. <https://doi.org/10.48550/arXiv.2008.01960>

ORAL PRESENTATIONS

1. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming
2023 INFORMS (The Institute for Operations Research and the Management Sciences) Annual Meeting, October 17th, 2023
2. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming

Podium Presentation, at 9th annual San Antonio Military Health and Universities Research Forum (SURF), June 15th, 2023

3. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming

33rd Annual POMS (Production and Operations Management Society) Conference, May 23rd, 2023

4. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming

2023 INFORMS Annual Meeting, October 16th, 2022

5. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming

10th Annual San Antonio Postdoctoral Research Forum at UTHealthSA, September 20th, 2022

6. Optimal Physician Scheduling Solution Using the Method of Maximum Weighted Independent Set (MWIS)

32nd Annual POMS Conference, April 22nd, 2022

7. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming

Seminar, Department of Management Science and Statistics at UTSA, April 22nd, 2022

8. Equitable Anesthesiologist Scheduling under Demand Uncertainty Using Multi-Objective Programming

2022 Research Symposium at UTHealthSA, April 18th, 2022

9. Optimal and Equitable Staffing Solutions for Anesthesiologist Scheduling

2021 INFORMS Annual Meeting, October 27th, 2021

10. Optimal and Equitable Staffing Solutions for Operating Room Scheduling

31st Annual POMS Conference, April 30th - May 5th, 2021

11. An Integrated Optimal and Equitable Staffing Solution for Anesthesia Scheduling

2021 American Association of Clinical Directors Perioperative Leadership Summit, March 19th, 2021

12. Developing a Visual Analytics Tool for Engineering Tasks Assignment for Small and Medium-sized Manufacturing Firm

2019 Engineering and Computer Science (ECS) Research Day, March 19th, 2019

13. Utilizing sPLM System in MFE 692 Design for Manufacturing Application and Customization of Product Lifecycle Management (PLM) System for Engineering Education

2018 ECS Research Day, March 30th, 2018

14. Aras Innovator in Engineering Education and Research

Invited Presentation, Aras Community Event (ACE) US 2018, Premier PLM conference by Aras Innovator, March 21st, 2018

15. A PLM-Based Data Analytics Approach for Improving Product Development

Lead Time in an Engineer-To-Order Manufacturing Firm
2017 ECS Research Day, March 30th, 2017

16. Product Development Process Improvement Using Smart Product Lifecycle Management (sPLM) Platform at Filtertech Company
Syracuse NEXT Conference 2016 - The Event for Technology, Manufacturing, and Innovation, October 11th, 2016

PROJECTS

1. **Optimal Scheduling of Physicians and Certified Registered Nurses**, at UTSA and UTHealthSA;

- Developed data-driven scheduling and analytics framework with novel mixed-integer multi-objective programming formulation and solution methods to support clinical operations and strategic decisions,
- Embedded in the Department of Anesthesiology, working hand-in-hand with the front-line clinicians and administrators from UTHealthSA,
- The developed framework has been implemented and deployed for anesthesiology scheduling and operational analysis with more than 200 providers. This improved physician schedule satisfaction from 3.13/5 to 3.44/5, and relieved at least 82% of scheduling burdens on departmental leaders.

2. **Development and Application of Smart PLM systems**, at SU and collaborated with two local companies, i.e., Filtertech, Inc. and UsPLM, Inc.;

- Built product design libraries (25+ products and 300+ components) for small kitchen appliances and unmanned aerial vehicles (UAVs);
- Developed data analytics, product configuration, and process planning and scheduling optimization modules for the Smart PLM system;
- Developed and deployed visual analytics, product configuration, and resource allocation optimization tools with the Smart PLM system for the engineering design department at Filtertech, Inc.;
- Developed and deployed digital twin and flight mission configuration services for the drone fleet management solution at UsPLM, Inc.;
- Developed educational and training materials for UAV design and fleet management curriculums at SU.

TEACHING EXPERIENCE

Alvarez College of Business, UTSA

2021, 2022

Guest Lectures in:

DA 6813: Data Analytics Applications (GRAD)

MS 4203: Business Analytics Applications (UGRAD)

Department of Anesthesiology, UTHealthSA

2022

Grand Rounds lecture titled, "What can you trust? AI risk in healthcare."

Graduate Teaching Assistant

September 2015 - May 2020

College of Engineering and Computer Science, SU

Teaching and tutoring experience centered on courses related to PLM systems, which manage a product and associated data through all stages of the product lifecycle, including:

- Product design, development, and manufacturing that are the activities managed by the PLM systems;

- Data analytics that are the functionalities built into the PLM systems;
- Project management and decision making that is supported by the PLM systems;
- The associated software tools that are interacting with the PLM systems.

The courses included:

- MAE 284: Introduction to CAD (UGRAD), 100+ students 2016-2019
Topics: • 2D and 3D engineering drawing with SolidWorks for engineering designers (consisting of half course credit hours)
- MAE 333: Data Analysis for Engineers (UGRAD), 70+ students 2018-2019
Topics: • Introduction to R • Data structures • Data processing and cleaning • Probability and distributions • Visualization • Machine learning techniques, i.e., regression, clustering, association rules mining
- MEE 431: Manufacturing Processes (UGRAD), 70+ students 2019
Topics: • Introduction to Fusion 360 • Prepare homework problems and solution manual
- MEE 571: Computer-Aided Design (GRAD), 20+ students 2015-2019
Topics: • Fundamentals of geometry representation with modern computer-aided design software package (PTC Creo) • Advanced computer-aided design, i.e., 3D modeling for continuous smooth surface geometry, e.g., spoon, duck, and car projects
- MFE 639: CAD/CAM Systems (GRAD), 20+ students 2015-2018
Topics: • Introduction to CAM systems with applications (SolidWorks and Solid-CAM)
- MFE 692: Design for Manufacturing (GRAD), 20+ students 2016-2018
Topics: • Introduction to 3D printing • Introduction to PLM systems • PLM data management, analysis, and visualization • Guiding the student term projects, i.e., redesign projects of small kitchen appliances and UAVs

SERVICE

JOURNAL REVIEW

Ad hoc reviewer for • *European Journal of Operational Research* • *INFORMS Journal on Computing*

PROFESSIONAL

INFORMS: Will serve as a session chair at INFORMS Annual Meeting 2023

SKILLS

Programming Languages: Python, R, MATLAB, JavaScript, C#, C++
Optimization: Gurobi, Pyomo, OR-tools, CPLEX, GLPK