Yifan Tang

AI for Sustainable Engineering Systems across Aerospace, Manufacturing, and Transportation

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Research Summary

My research focuses on *Artificial Intelligence (AI) for Sustainable Engineering Systems*, where I integrate AI and digital twin technologies to create generalizable and efficient data-driven and physics-informed methods for process modeling, engineering optimization, monitoring, and decision-making. These approaches are applied to complex systems, with emphasis on *aerospace, additive manufacturing, and large-scale transportation systems*.

Education

2021.09-2025.08 *Ph.D. in Mechatronic Systems Engineering*

University:	Simon Fraser University, Surrey, Canada
Dissertation:	Digital twin modeling and updating for metal additive manufacturing processes
Supervisor:	Prof. G. Gary Wang

2017.09-2020.06 *Master of Science in Aeronautical & Astronautical Science & Technology*

University:	Beijing Institute of Technology, Beijing, China
Dissertation:	Small-sample learning-based optimization for flight vehicle design
Supervisor:	Prof. Teng Long

2013.09-2017.06 *Bachelor of Science in Flight Vehicle Design & Engineering*

University:	Beijing Institute of Technology, Beijing, China
Dissertation:	Sequential radial basis function based optimization method using virtual sample generation
Supervisor:	Prof. Teng Long

Research Interests

- Acritical Intelligence in Sustainable Lifecycle Systems
- Transfer Learning, Deep Learning, Reinforcement Learning, Foundation Models
- Low-cost System Modeling, Design, and Optimization
- Digital Twin for Intelligent Systems
- Green Transportation
- Aerospace System Design
- Sustainable Manufacturing

Grants & Fellowships

2024	CACSE Travel Award for WCCM Conference	Canadian Association for Computational Science and Engineering (CACSE)
2024-2025	Travel & Research Award	Simon Fraser University, Canada
2022	Mitacs Globalink Research Award	Mitacs, Canada
2022-2025	Graduate Dean's Entrance Scholarship	Simon Fraser University, Canada
2022-2024	Graduate Fellowships	Simon Fraser University, Canada
2020-2021	PhD Full Scholarship	Cranfield University, UK
2013-2019	Scholarships for Merit Students	Beijing Institute of Technology, China

Publications

Peer-Reviewed Journal Articles

[1]   Pouyan Sajadi, Mostafa Rahmani Dehaghani, *Yifan Tang*, G. Gary Wang. "Two-dimensional temperature field prediction with in-situ data in metal additive manufacturing using physics-informed neural networks." *Engineering Applications of Artificial Intelligence 150* (2025): 110636. (*IF 7.5*)

[2]   *Yifan Tang*, Mostafa Rahmani Dehaghani, Pouyan Sajadi, G. Gary Wang. "A systematic online update method for reduced-order-model-based digital twin." *Journal of Intelligent Manufacturing* (2024): 1-29. (*IF 5.9*)

[3]   *Yifan Tang*, Mostafa Rahmani Dehaghani, Pouyan Sajadi, G. Gary Wang. "Selecting subsets of source data for transfer learning with applications in metal additive manufacturing." *Journal of Intelligent Manufacturing* (2024): 1-22. (*IF 5.9*)

[4]   Mostafa Rahmani Dehaghani, Pouyan Sajadi, *Yifan Tang*, J. Akhavan, G. Gary Wang. "MIMO system identification and uncertainty calibration with a limited amount of data using transfer learning." *International Journal of Systems Science* 56.3 (2024): 598–617. (*IF 4.9*)

[5]   Mostafa Rahmani Dehaghani, Atieh Sahraeidolatkhaneh, Morgan Nilsen, Fredrik Sikström, Pouyan Sajadi, *Yifan Tang*, G. Gary Wang. "System identification and closed-loop control of laser hot-wire directed energy deposition using the parameter-signature-quality modeling scheme." *Journal of Manufacturing Processes* 112 (2024): 1-13. (*IF 6.1*)

[6]   Pouyan Sajadi, Mostafa Rahmani Dehaghani, *Yifan Tang*, G. Gary Wang. "Physics-informed online learning for temperature prediction in metal AM." *Materials* 17.13 (2024): 3306. (*IF 3.1*)

[7]   *Yifan Tang*, Mostafa Rahmani Dehaghani, Pouyan Sajadi, Shahriar Bakrani Balani, Akshay Dhalpe, Suraj Panicker, Di Wu, Eric Coatanea, G. Gary Wang. "Online thermal field prediction for metal additive manufacturing of thin walls." *Journal of Manufacturing Processes* 108 (2023): 529-550. (*IF 6.1*)

[8]   *Yifan Tang*, M. Rahmani Dehaghani, G. Gary Wang, "Review of transfer learning in modeling additive manufacturing processes." *Additive Manufacturing* 61 (2023): 103357. (*IF 10.3*)

[9]   Mostafa Rahmani Dehaghani, *Yifan Tang*, G. Gary Wang. "Iterative uncertainty calibration for

modeling metal additive manufacturing processes using statistical moment-based metric." *Journal of Mechanical Design* 145.1 (2023): 012001. (*IF 2.9*)

[10] Mostafa Rahmani Dehaghani, *Yifan Tang*, Suraj Panicker, Di Wu, Eric Coatanea, G. Gary Wang. "Modeling and optimization of height-related geometrical parameters for thin wall structures manufactured by metal additive manufacturing." *The International Journal of Advanced Manufacturing Technology* 129.9 (2023): 4663-4675. (*IF 2.9*)

[11] Teng Long, Nianhui Ye, Renhe Shi, Yufei Wu, *Yifan Tang*. "Surrogate-assisted differential evolution using knowledge-transfer-based sampling for expensive optimization problems." *AIAA Journal* 60.5 (2022): 3251-3266. (*IF 2.1*)

[12] *Yifan Tang*, Teng Long, Renhe Shi, Yufei Wu, G. Gary Wang. "Sequential radial basis function based optimization method using virtual sample generation." *Journal of Mechanical Design* 142.11 (2020): 111701. (*IF 2.9*)

[13] Zhao Wei, Teng Long, Renhe Shi, *Yifan Tang*, Huaijian Li. "Multidisciplinary design optimization of long-range slender guided rockets considering aeroelasticity and subsidiary loads." *Aerospace Science and Technology* 92 (2019): 790-805. (*IF 5.0*)

[14] Teng Long, Yufei Wu, Zhu Wang, *Yifan Tang*, Di Wu, Yong Yu. "Efficient aero-structure coupled wing optimization using decomposition and adaptive metamodeling techniques." *Aerospace Science and Technology*, 95 (2019): 105496. (*IF 5.0*)

[15] Renhe Shi, Li Liu, Teng Long, Yufei Wu, *Yifan Tang*. "Filter-based adaptive Kriging method for black-box optimization problems with expensive objective and constraints." *Computer Methods in Applied Mechanics and Engineering* 347 (2019): 782-805. (*IF 6.9*)

[16] Renhe Shi, Li Liu, Teng Long, Yufei Wu, *Yifan Tang*. "Filter-based sequential radial basis function method for spacecraft multidisciplinary design optimization." *AIAA Journal* 57.3 (2019): 1019-1031. (*IF 2.1*)

Preprints

[1] *Yifan Tang*, Mostafa Rahmani Dehaghani, G. Gary Wang. "Capturing lifecycle system degradation in digital twin model updating." arXiv preprint arXiv:2503.08953 (2025). (submitted to *Applied Soft Computing, IF 6.6, Under Review*)

[2] *Yifan Tang*, Mostafa Rahmani Dehaghani, G. Gary Wang. "Comparison of transfer learning based additive manufacturing models via a case study." arXiv preprint arXiv:2305.11181 (2023).

Conference Proceedings

[1] *Yifan Tang*, Pouyan Sajadi, Mostafa Rahmani Dehaghani, G. Gary Wang. "An online sequential update method for reduced-order-model-based digital twin." ASME IDETC CIE 2024. Washington, DC, USA. August 25–28, 2024. V03BT03A030.

[2] Mostafa Rahmani Dehaghani, Pouyan Sajadi, *Yifan Tang*, G. Gary Wang. "Low-cost melt pool temperature prediction using visible light camera and machine learning in laser hot-wire directed energy deposition." ASME IDETC CIE 2024. Washington, DC, USA. August 25–28, 2024. V02AT02A029.

[3] *Yifan Tang*, Shahriar Bakrani Balani, Akshay Dhalpe, Mostafa Rahmani Dehaghani, Suraj Panicker, Eric Coatanea, Di Wu, G. Gary Wang. "Layer-to-layer thermal history prediction for thin walls in

metal additive manufacturing." ASME IDETC CIE 2023. Boston, Massachusetts, USA. August 20-23, 2023. V002T02A076.

[4] Mostafa Rahmani Dehaghani, *Yifan Tang*, Suraj Panicker, Di Wu, Eric Coatanea, G. Gary Wang. "Defining and modeling of height-related geometrical parameters for thin wall structures manufactured by metal additive manufacturing." ASME IDETC CIE 2023. Boston, Massachusetts, USA. August 20-23, 2023. V002T02A082.

[5] *Yifan Tang*, Mostafa Rahmani Dehaghani, G. Gary Wang, "Review of transfer learning in additive manufacturing modeling." ASME IDETC CIE 2022. St. Louis, Missouri, USA. August 14–17, 2022. V002T02A013.

[6] Mostafa Rahmani Dehaghani, *Yifan Tang*, G. Gary Wang, "Iterative uncertainty calibration for modeling metal additive manufacturing processes using statistical moment-based metric." ASME IDETC CIE 2022. St. Louis, Missouri, USA. August 14–17, 2022. V03BT03A029.

[7] *Yifan Tang*, Yan Xu, "Multi-agent deep reinforcement learning for solving large-scale air traffic flow management problem: a time-step sequential decision approach." IEEE/AIAA 40th Digital Avionics Systems Conference (DASC). San Antonio, TX, USA. 03-07 October, 2021, pp. 1-10.

[8] *Yifan Tang*, Jing Sun, Teng Long, Yan Wang, Renhe Shi. "Aero-structure coupled optimization for high aspect ratio wings using multi-model fusion method." IEEE CYBER 2019. Suzhou, China. Jul 29-Aug 2, 2019, pp. 1107-1114.

[9] Renhe Shi, Li Liu, Teng Long, Yufei Wu, *Yifan Tang*. "Dual-sampling based Co-Kriging method for design optimization problems with multi-fidelity models." 2018 Multidisciplinary Analysis and Optimization Conference. Atlanta, Georgia, US. Jun 28-29, 2018, pp. 3747.

Conference Presentations

[1] "An online sequential update method for ROM-based digital twin", WCCM 2024 / PANACM 2024. Vancouver, Canada. July, 2024.

[2] "Small-sample learning enhanced sequential radial basis function for expensive aerospace system design optimization", Proceedings of Asian Joint Symposium on Aerospace Engineering, Gyeongju, Korea, Oct 31-Nov 3, 2018.

Research Experience

1. AI for Green Transportation

Research Assistant (Oct 2024 – Sep 2025) / Postdoctoral Fellow (Sep 2025 – Present)

Research Topic: Combinatorial Optimization for Vehicle Routing Problems (VRP)

School of Mechatronic Systems Engineering, Simon Fraser University, Canada

- Contributed to the Mitacs project AI-driven methods for patrol vehicle dispatch and route optimization under uncertainty.

- Developed *a VRP solver using graph neural networks, Transformer, and Mixture-of-Experts*, achieving solutions for 251-customer problems within 3 seconds, outperforming actual operations.

- Developed a *clustering assisted Adaptive Large Neighborhood Search* method, solving large-scale VRPs with 251 variables and strong time window constraints efficiently.

Research Assistant (Sep 2020 – June 2021)

Research Topic: Reinforcement Learning for Air Traffic Flow Management (ATFM)

School of Aerospace, Cranfield University, UK

- Contributed to the European Union's Horizon 2020 project ISOBAR: Artificial intelligence solutions to Metro-based DCB imbalances for network operations planning.

- Developed a *multi-agent reinforcement learning framework with proximal policy optimization* to solve large-scale ATFM problems.

- Achieved 70% reduction in average delays and 60% fewer delayed flights using EUROCONTROL datasets, outperforming industry baselines.

2. AI for Sustainable Manufacturing

PhD Research Assistant (Sep 2021 – Aug 2025)

Research Topic: Digital Twin for Metal Additive Manufacturing (AM)

School of Mechatronic Systems Engineering, Simon Fraser University, Canada

Contributed to Eureka! SMART project (S0410) TANDEM: Tools for adaptive and intelligent control of discrete manufacturing processes.

- Digital Twin Updating for Systems Degrading during Lifecycle   2024.06-2025.03

  - Developed *a lifelong update method using Autoencoder-LSTM* to capture degradation effects without requiring prior knowledge or expensive aging experiments.

  - Achieved superior predictions on Oxford battery and NASA engine datasets, improving accuracy across 80% of future degradation stages.

- Online Updating for Reduced Order Model based Digital Twin   2023.11-2024.05

  - Developed *a real-time digital twin updating method* using incremental POD with forgetting factor and regression modeling for systems lacking dynamic models.

  - Improved accuracy by 60% compared with offline digital twin models in three benchmarks and a metal AM case study.

- Similarity-based Transfer Learning in Digital Twin Model Construction   2023.05-2023.10

  - Developed a *Pareto-frontier source data selection method* across multiple similarity metrics, enabling target models 40% smaller yet more accurate than larger models with unfiltered data.

  - Validated across *instance-based and model-based transfer learning* with metal AM cases.

- Digital Twin Model Construction for Online Thermal Prediction   2022.05-2023.05

  - Proposed *an online thermal field prediction method* with feedforward neural networks with reduced-order models for yet-to-print layers.

  - Demonstrated transferability of the method across multiple wire-arc AM simulation settings (error < 4%) and generalizability from simulation to physical experiments (error < 9%).

- Transfer Learning in Metal AM   2021.09-2022.04

  - Published a literature review on transfer learning in metal AM process modeling.

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    o   Conducted a comparative study on several datasets, showing positive transfer occurs when the target-to-source data size ratio is between 0.2 and 0.7.

Visiting Researcher (Oct 2022 – Dec 2022)

Faculty of Engineering and Natural Sciences, Tampere University, Finland

- Fabricated thin-wall structures and measured temperature and geometric data using the wire arc AM system with sensors and laser scanners.

3. AI for Aerospace Design and Optimization

Research Assistant (June 2017 – June 2020)

Research Topic: Optimization for Aerospace Systems under Data Scarcity

School of Aerospace Engineering, Beijing Institute of Technology, China

- Participated in multiple projects from National Natural Science Foundation of China and other research institutes.
- Proposed a *transfer learning-based optimization framework*, enhancing convergence efficiency and solution optimality in engineering design.
- Developed a *classification based feasible region identification*, reducing computational cost for constrained optimization.
- Advanced *sequential radial basis function with virtual sample generation*, applied to observation satellite multidisciplinary design optimization, trajectory design, and airfoil aerodynamic optimization tasks.
- Performed CFD and FEA simulations to support optimization of airfoils and high-aspect-ratio wings.

Visiting Researcher (Feb 2017 – May 2017)

Research Topic: Capstone Project - Small Sample Learning based Optimization

School of Mechatronic Systems Engineering, Simon Fraser University, Canada

- Proposed *sequential radial basis function using virtual sample generation* for optimization in complex engineering designs with limited data.
- Improved optimization efficiency by 10% for unconstrained problems.

4. Optimization in AI

Data Scientist (Sep 2022 – Mar 2023)

Hyperparameter Optimization for Deep Learning Models

Empower Operations, Canada

- Developed a novel *hyperparameter optimization method with OASIS* to identify the minimal architectures for neural networks while maintaining high learning performance.
- Reduced neural network size by 70% on MNIST while preserving accuracy.

Grant Writing & Proposal Development

School of Aerospace Engineering, Beijing Institute of Technology, China   *2017.06-2020.06*

Assisted in writing proposals for multiple projects during my Master's study.

- Surrogate model-based design optimization tools for complex systems
- Multidiscipline approximation design optimization for conceptual design of flight vehicles
- Design optimization for morphing flight vehicles
- Digital twin system and digital prototypes of automotive products

Teaching Experience

1. Teaching Assistant

(a) Machine Design (MSE320)

School of Mechatronic Systems Engineering, Simon Fraser University, Canada   *2024 Fall*

- Assisted with student project management, grading exams and assignments.

(b) Introduction to Engineering Design Optimization (MSE426/726)

School of Mechatronic Systems Engineering, Simon Fraser University, Canada   *2023&2024 Spring*

- Delivered lab tutorials and supported student projects.
- Assisted in course instruction, exam design, and grading of assignments.

(c) Engineering Optimization

School of Aerospace Engineering, Beijing Institute of Technology, China   *2018-2020 Fall*

- Delivered lab tutorials, guided student projects, and graded assessments.

2. Mentor

School of Mechatronic Systems Engineering, Simon Fraser University, Canada   *2024 Fall – Present*

- Mentor co-op undergraduate students on engineering optimization.
- Supervise graduate students on foundation models in combinatory optimization and generative design.

Services

Peer Reviewer (2023-2025)

- Additive Manufacturing, Advanced Engineering Informatics, Applied Thermal Engineering, Automation in Construction, Engineering Optimization, Expert Systems with Applications, Engineering Applications of Artificial Intelligence, Energy and AI, Intelligent Systems with Applications, Journal of Manufacturing Processes, Journal of Supercomputing, Knowledge-based Systems, Materials and Design, Next Nanotechnology, Results in Engineering

Professional Memberships

- Student Member, American Society of Mechanical Engineers (ASME)
- Student Member, Canadian Society for Mechanical Engineering (CSME)