Ran Wei

Senior Lecturer (Associate Professor) in Computer Science

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My research combines Model Driven Engineering (MDE), Model Based Systems Engineering (MBSE), formal methods and assurance for safety-critical systems. I am developing a new research frontier in AI-augmented software engineering, guided by the slogan *LLMs draft, formal methods discriminate, and assurance cases explain*: LLMs propose code and system models, formal methods check them against requirements and safety properties, and assurance cases present the evidence and reasoning behind the results. I contribute to the OMG SACM and ACWG GSN standards and lead development of Principia (https://principia-modelling.com/), a commercial-grade MBSE toolchain. I am a certified ISO 26262 Functional Safety Engineer and a Fellow of the Higher Education Academy (FHEA).

Google Scholar (September 2026): 890 citations · h-index 18 · i10-index 34

Education

PhD, Computer Science, University of York 2012 – 2016
MSc, Software Engineering, University of York 2007 – 2008
BSc, Computer Science, University of Kent 2004 – 2007

Appointments

Senior Lecturer (Associate Professor) 06/2024 – present
School of Computing and Communications, Lancaster University

Research Assistant Professor 2023 – 2024
Department of Engineering, University of Cambridge — ongoing visiting collaboration; postdoctoral researcher of Lucy Cavendish College (2023 – present)

Associate Professor 2020 – 2023
School of Artificial Intelligence, Dalian University of Technology

Research Fellow 2013 – 2020
Department of Computer Science, University of York

Software Engineer 2011 – 2012
Motorola China

Software Engineer 2009 – 2011
Intel China Labs

Research Funding

Three awards as lead investigator totalling approximately £239,929; a further £205,501 as project manager. Combined approximately £445,430.

Lead Investigator

Model Based Assurance for High Power Critical Systems 2022 – 2023
Chinese Academy of Sciences — CNY 1,000,000 (approx. £120,451)

Model Based Safety Assurance of Complex Systems 2021 – 2022
Chinese Academy of Sciences — CNY 800,000 (approx. £90,172)

High Precision Metrology Software for Micro AC Current Signals 2021 – 2022
Chinese Academy of Sciences — CNY 260,000 (approx. £29,306)

Project Manager

d-HYDROFLEX: Digital solutions for hydropower assets 2023 – 2024
European Commission — £205,501

Pipeline

UKAEA has expressed interest in a pilot applying Principia within LIBRTI (Lithium Breeding Tritium Innovation), with potential for a larger follow-on project. In discussion; not yet awarded.

Planned applications

EPSRC New Investigator Award for AI-augmented software engineering, following decisions on the TOSEM and *Communications Engineering* papers; collaborative Horizon Europe proposal with international partners.

Research Software and Direction

- **Principia** — commercial-grade MBSE platform combining SysML v2, GSN/CAE assurance cases, Ecore metamodelling and Modelica simulation; lead designer and developer of an 8.86-million-line codebase.
- **AI-augmented software engineering** — with Jim Woodcock, work on model extraction from generated code, traceable model generation from requirements, formal verification and evidence-led repair.
- **ACME** — led development of the Eclipse-based Assurance Case Management Environment for SACM and GSN; used by MITRE and the University of York.
- **Epsilon (Eclipse)** — contributions to the model-management platform ecosystem, including automated generation of UML profile graphical editors for Papyrus.

Selected Publications

Under review and preprints (2025 – 2026)

[1] Wei, R., Zhu, L., Wang, H., Woodcock, J., Yan, F., Foster, S., Ji, X. *Formal-Method-Guided Vibe Coding: Closing the Verification Loop on AI-Generated Safety-Critical Software Through Model-Driven Engineering.* arXiv:2606.22413. **Major revision, ACM TOSEM.**

[2] Wang, H., Zhu, L., Wei, R., Gao, J., Woodcock, J., Zhang, H., Ji, X. *Formal-Method-Guided Risk Ranking: Closing the Comparative Residual-Risk Loop on Verification-Passing Controllers.* **Submitted to ACM TOSEM, July 2026.**

[3] Wei, R., Zhu, L., Wang, H., Yang, R., Guan, J., Ji, S., Hu, Y., Jiang, Z., Ji, X. *Model-Driven Discipline for Multi-Agent LLMs: Requirement-to-Verification Generation of Traceable System Models.* arXiv:2607.16708. **Submitted to Communications Engineering (Nature Portfolio).**

[4] Woodcock, J., Leite, G., Sampaio, A., Wei, R. *CAPRI: Contract-Aware Proof Repair for Isabelle.* arXiv:2608.13459. **Submitted to SBMF 2026.**

[5] Woodcock, J., Leite, G., Sampaio, A., Wei, R. *Contract-Aware Rescue of a Drifted Isabelle Development: The Double-Tank Case Study.* arXiv:2608.18822. **Submitted to FMAS 2026.**

[6] Tian, Y., Wei, R., Zhang, J., Zhang, X., Hu, W., Zhu, L. *A Model-Based Digital Twin for Predicting Deterioration of Mogao Polychrome Sculpture.* Research Square, DOI 10.21203/rs.3.rs-10388873/v1. **Submitted to npj Heritage Science.**

Journal articles

[1] Reja, V.K., Yin, M., Davletshina, D., Wei, R., Fauth, J., Perrotta, F., Brilakis, I., 2026. Establishing and Fulfilling Information Requirements for Computer Vision–Enabled Digital Twin–Based Control of Roadside Vegetation. *J. of Construction Engineering and Management*, 152(9), 04026147.

[2] Blay, K.B., Darko, A., Hwang, S., Brilakis, I., Foster, F., Wei, R., 2025. Ensuring information security resilience in Digital-enabled Construction Projects (DCP) through quantum security technologies. *Automation in Construction*, 179, 106480.

[3] You, D., Jiang, J., Wang, X., Du, Y., Tan, Z., Xu, W., Wang, H., Guan, J., Wei, R., Zhao, S., Jiang, Z., 2025. MERE: Hardware-software co-design for masking cache miss latency in embedded processors. *ACM TECS*, 24(5s), 1–26.

[4] Zhu, J., Nisbet, N., Yin, M., Wei, R., Brilakis, I., 2025. Releasing the power of graph for building information discovery. *Automation in Construction*, 172, 106034.

[5] Yin, M., Reja, V.K., Wei, R., Brilakis, I., Sheil, B., Perrotta, F., d'Avigneau, A.M., Lu, L., 2025. Exploring the value of digital twins for information management in highway asset maintenance. *Developments in the Built Environment*, 21, 100614.

[6] Jiang, R., Dong, P., Ding, Y., Wei, R., Jiang, Z., 2025. Thetis-lathe: Guidance on Reducing Residual Safety Obstacle in System Software from Rust Source Codes. *ACM TECS*, 24(4), article 56, 1–25.

[7] Pan, Y., Wang, M., Lu, L., Wei, R., Cavazzi, S., Peck, M., Brilakis, I., 2024. Scan-to-graph: automatic generation and representation of highway geometric digital twins from point cloud data. *Automation in Construction*, 166, 105654.

[8] Zhou, S., Wang, H., Li, D., Ng, S.T., Wei, R., Zhao, Y., Zhou, Y., 2024. Revealing public attitudes toward mobile cabin hospitals during Covid-19 pandemic. *Sustainable Cities and Society*, 107, 105440.

[9] Wei, R., Foster, S., Mei, H., Yan, F., Yang, R., Habli, I., O'Halloran, C., Tudor, N., Kelly, T., Nemouchi, Y., 2024. ACCESS: Assurance Case Centric Engineering of Safety-critical Systems. *J. of Systems and Software*, 213, 112034.

[10] Wei, R., Yang, R., Liu, S., Fan, C., Zhou, R., Wu, Z., Wang, H., Cai, Y., Jiang, Z., 2024. Towards an extensible model-based digital twin framework for space launch vehicles. *J. of Industrial Information Integration*, 41, 100641.

[11] Yang, D., Wang, Y., Wei, R., Guan, J., Huang, X., Cai, W., Jiang, Z., 2024. An efficient multi-task learning CNN for driver attention monitoring. *J. of Systems Architecture*, 148, 103085.

[12] Xu, J., N'Zebo, R.A., Taha-Abdalgadir, H., d'Avigneau, A.M., Palin, D., Wei, R., Hadjidemetriou, G., Schaefer, S., De Silva, L., Al-Tabbaa, A., Iida, F., 2024. Highway digital twin-enabled Autonomous Maintenance Plant: a perspective. *Data-Centric Engineering*, 5, e24.

[13] Wei, R., Jiang, Z., Guo, X., Yang, R., Mei, H., Zolotas, A., Kelly, T., 2023. DECISIVE: Designing Critical Systems with Iterative Automated Safety Analysis. *IEEE TCAD*.

[14] Wei, R., Jiang, Z., Mei, H., Barmpis, K., Foster, S., Kelly, T., Zhuang, Y., 2023. Automated Model Based Assurance Case Management Using Constrained Natural Language. *IEEE TCAD*.

[15] Jiang, Z., Dai, X., Wei, R., Gray, I., Gu, Z., Zhao, Q., Zhao, S., 2023. NPRC-I/O: A NoC-based Real-Time I/O System with Reduced Contention and Enhanced Predictability. *IEEE TCAD*, 42(12), 4629–4642.

[16] Jiang, Z., Wei, R., Zhao, S., Yang, D., Paterson, R., Guan, N., Zhuang, Y., Audsley, N.C., 2021. Bridging the pragmatic gaps for mixed-criticality systems in the automotive industry. *IEEE TCAD*, 41(4), 1116–1129.

[17] Jiang, Z., Dai, X., Dong, P., Wei, R., Yang, D., Audsley, N.C., Guan, N., 2021. Toward an Analysable, Scalable, Energy-Efficient I/O Virtualization for Mixed-Criticality Systems. *IEEE TCAD*, 41(2), 320–333.

[18] Foster, S., Nemouchi, Y., Gleirscher, M., Wei, R., Kelly, T., 2021. Integration of Formal Proof into Unified Assurance Cases with Isabelle/SACM. *Formal Aspects of Computing*, 33(6), 855–884.

[19] Chang, W., Wei, R., Zhao, S., Wellings, A., Woodcock, J., Burns, A., 2020. Development automation of real-time Java: Model-driven transformation and synthesis. *ACM TECS*, 19(5), 1–26.

[20] Wei, R., Zolotas, A., Hoyos Rodriguez, H., Gerasimou, S., Kolovos, D.S., Paige, R.F., 2020. Automatic generation of UML profile graphical editors for Papyrus. *Software and Systems Modeling*, 19(5), 1083–1106.

[21] Zhao, S., Chang, W., Wei, R., Liu, W., Guan, N., Burns, A., Wellings, A., 2020. Priority Assignment on Partitioned Multiprocessor Systems with Shared Resources. *IEEE Trans. on Computers*, 70(7), 1006–1018.

[22] Wei, R., Kelly, T.P., Dai, X., Zhao, S., Hawkins, R., 2019. Model based system assurance using the structured assurance case metamodel. *J. of Systems and Software*, 154, 211–233.

Conference and workshop papers

[1] Elsokary, A., Ishida, H., Wei, R., Henshaw, M.J. de C., Ji, S., 2026. *Model-Driven Digital Twin Framework for Quantum Networks.* 1st Workshop on Quantum and Model-Driven Engineering (MODELS 2026). **Accepted research preview.** arXiv:2607.10367.

[2] Ji, S., Ishida, H., Elsokary, A., Powley, S., White, C., Zagoskin, A., Wei, R., Aslam, M., Henshaw, M.J. de C., 2026. *A Framework for Managing the Models of Engineered Quantum Systems.* 1st Workshop on Quantum and Model-Driven Engineering (MODELS 2026). **Accepted short paper.** arXiv:2607.10347.

[3] Guan, J., Zhang, J., Zhou, H., Wei, R., You, D., Wang, H., Wang, Y., Wang, T., Zhao, X., Li, J., Jiang, Z., 2026. Strix: Re-thinking NPU Reliability from a System Perspective. *DAC 2026*, accepted. arXiv:2604.10484.

[4] Zhang, J., Guan, J., Zhou, H., Han, X., Wang, T., Wei, R., Jiang, Z., 2026. From Characterization to Microarchitecture: Designing an Elegant and Reliable BFP-Based NPU. *DAC 2026*, accepted. arXiv:2604.10494.

[5] Zhou, H., Guan, J., Zhang, J., Wei, R., Zhao, X., Jiang, Z., Ji, X., 2026. S2VD: A Subspace-Aware SVD Method for Efficient LLM Compression. *IEEE ICASSP 2026*. doi:10.1109/ICASSP55912.2026.11463557.

[6] Wang, T., Li, Y., Tang, W., Guan, J., Guo, Z., Jiang, R., Wei, R., Li, J., Jiang, Z., 2025. FlexStep: Enabling Flexible Error Detection in Multi/Many-core Real-time Systems. *DAC 2025*, 1–7.

[7] Nascimento, L., de Oliveira, A.L., Villela, R., Fonseca, H., Branco, K.C., Wei, R., Hawkins, R., Kelly, T., 2025. ACEditor: A Modeling Tool for Specifying and Synthesizing Executable Assurance Cases from Fault Trees. *IMBSA 2025*, 299–317.

[8] Jiang, Z., Zhao, S., Wei, R., Si, X., Chen, G., Guan, N., 2024. ROTA-I/O: Hardware/Algorithm Co-design for Real-Time I/O Control with Improved Timing Accuracy and Robustness. *IEEE RTSS 2024*, 174–186.

[9] Guan, J., Wei, R., You, D., Wang, Y., Yang, R., Wang, H., Jiang, Z., 2024. MESC: Re-thinking Algorithmic Priority and/or Criticality Inversions for Heterogeneous MCSs. *IEEE RTSS 2024*, 1–14.

[10] Wen, Y., Wang, M., Ariyachandra, M., Wei, R., Brilakis, I., Xiao, L., 2024. Knowledge Driven Rule-Based Building Geometric Digital Twin Construction — State of Art Review. *EC3 2024*.

[11] Yin, M., Reja, V.K., Wei, R., Sheil, B., Brilakis, I., 2024. How Can Digital Twins be Used in Highway Maintenance? A Questionnaire Survey for Industry Practitioners. *EC3 2024*.

[12] Jiang, Z., Zhao, S., Wei, R., Gao, Y., Li, J., 2024. A cache/algorithm co-design for parallel real-time systems with data dependency on multi/many-core system-on-chips. *DAC 2024*, 1–6.

[13] Reja, V.K., Davletshina, D., Yin, M., Wei, R., Adam, Q.F., Brilakis, I., Perrotta, F., 2024. A Digital Twin Based Approach to Control Overgrowth of Roadside Vegetation. *ISARC 2024*, 661–668.

[14] Wei, R., Jiang, Z., Guo, X., Mei, H., Zolotas, A., Kelly, T., 2022. Designing critical systems with iterative automated safety analysis. *DAC 2022*, 181–186.

[15] Chang, W., Zhao, S., Wei, R., Wellings, A., Burns, A., 2019. From Java to Real-Time Java: A Model-Driven Methodology with Automated Toolchain. *LCTES 2019*, 123–134.

[16] Wei, R., Kolovos, D.S., Garcia-Dominguez, A., Barmpis, K., Paige, R.F., 2016. Partial loading of XMI models. *MODELS 2016*, 329–339.

[17] Shah, S.M., Wei, R., Kolovos, D.S., Rose, L.M., Paige, R.F., Barmpis, K., 2014. A framework to benchmark NoSQL data stores for large-scale model persistence. *MODELS 2014*, 586–601.

Academic Leadership and Service

Deputy Director for Postgraduate Research, School of Computing and Communications, Lancaster — 2024 – present
Contributor to OMG SACM metamodel and implementation — 2017 – present
Contributor to ACWG Goal Structuring Notation metamodel and implementation — 2017 – present
Member, academic committee (teaching), School of AI, Dalian University of Technology — 2020 – 2023

Peer review

Journal of Systems and Software; Journal of Industrial Information Integration; Software and Systems Modeling; IEEE/ASME Transactions on Mechatronics; Reliability Engineering & System Safety; The Journal of Supercomputing; Journal of Intelligent & Robotic Systems; IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems; Artificial Intelligence Review.

Selected research collaborations

Cambridge, York, Liverpool and Loughborough; Fraunhofer IESE and Siemens; MITRE and Carnegie Mellon University SEI; McMaster University.

Teaching and Supervision

Lancaster University (2024 – present)

Module Convener: Algorithms — 2024 – present
Module Convener: Software Design — 2025 – present
Module Convener: DevOps — 2026 (current term)
Co-supervisor of four PhD students — current

University of Cambridge (2023 – 2024)

Supervised 11 MSCA postdoctoral fellows (Digital Twins) — 09/2023 – 06/2024

Dalian University of Technology (2020 – 2023)

Module Convener: Data Structures and Algorithms (curriculum, delivery, assessment) — 2020 – 2023
UG and PG final-year project supervisor — 2020 – 2023

University of York (2013 – 2020)

Associate Lecturer: Safety Case Development and Review; Safety Critical Systems Engineering — 2017 – 2020
Teaching Assistant: Fundamentals of Computing; Model Driven Engineering — 2013 – 2020

Qualifications and Memberships

Fellow of the Higher Education Academy (FHEA) — 2025 – present
Certified ISO 26262 Functional Safety Engineer (TÜV SÜD) — 2020 – present
Professional memberships — 2017 – present
Object Management Group (OMG)
Safety-Critical Systems Club (SCSC)
Institute of Electrical and Electronics Engineers (IEEE)
UK Chapter of the International Council on Systems Engineering (INCOSE UK; now the Institute for Systems Engineering, IfSE)