

Yu-Kai Wang

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RESEARCH INTERESTS

Engineering risk and reliability; Bayesian modeling and decision-making under uncertainty; system safety and verification; risk-informed testing and design for complex aerospace systems

EDUCATION

Purdue University

West Lafayette, IN
Aug 2023 - May 2027 (expected)

Ph.D. Candidate in Aeronautics and Astronautics; GPA: 3.9/4.0

Dissertation *An Adaptive Probabilistic Framework to Support Mission Success Assessment in Launch Vehicle Development*

Advisor Dr. Karen Marais

Coursework Machine Learning; Statistical Quality Control; Complex System Safety; Advanced Rocket Propulsion; Multidisciplinary Design Optimization

National Yang Ming Chiao Tung University

Hsinchu, Taiwan
Sep 2016 – Jan 2023

M.S. and B.S. in Mechanical Engineering; GPA: 4.2/4.3 (top 3%); Dean's List

M.S. Thesis *Generalized Model of Fuel Regression Rate of Hybrid Rocket Engine with Different Swirling Conditions and Chamber Pressures*

Advisor Dr. Jong-Shinn Wu

RESEARCH EXPERIENCE

Graduate Researcher

Aug 2023 – Present

Value through Reliability, Safety, and Sustainability Lab, Purdue University

- Developing an adaptive Bayesian framework to assess launch-vehicle readiness and mission-success probability when reliability data are sparse. The framework combines structured engineering assessments with test evidence and represents uncertainty explicitly.
- Designed a hierarchical readiness model with 29 indicators spanning seven lifecycle stages to identify dominant residual risks and prioritize additional verification.
- Evaluating the framework through launch-system applications, including a TASA turbopump case using engineering assessments and limited test evidence; the assessment identified eight manufacturing, testing, and operational issues for readiness review.
- Investigated the transferability of ARP4754B/ARP4761A safety-assessment processes to launch-vehicle development through vehicle-level hazard analysis and safety requirements.

Research Engineer

Mar 2019 – Feb 2023

Advanced Rocket Research Center, National Yang Ming Chiao Tung University

- Developed a generalized model of hybrid-rocket fuel regression across geometric swirl number SN_g of 1–3 and chamber pressures of 10–40 bar, supporting engine sizing over a wider operating range.
- Designed and tested a 200 N-class hydrogen-peroxide/ethanol liquid rocket engine with re-ignition capability and 1 kN-class hybrid rocket engines through iterative design-build-test cycles.
- Led more than 30 liquid- and hybrid-rocket hot-fire tests; investigated injector-mixing and leakage failures and used ANSYS Fluent simulations to improve injector mixing by up to 50%.
- Developed an automated post-test analysis pipeline that reduced data-processing time from five hours to ten minutes and programmed LabVIEW data acquisition for more than five test configurations.

PROFESSIONAL EXPERIENCE

Systems Safety Engineer Intern

May 2025 – Aug 2025

Taiwan Space Agency, Hsinchu, Taiwan

- Performed FHA and Preliminary System Safety Assessment for the MARAHO sounding rocket, analyzing more than 25 functions, identifying more than 100 failure conditions, and deriving vehicle-level safety requirements.
- Adapted ARP4754B/ARP4761A methods into three launch-vehicle safety guides and two reusable analysis templates covering FHA, FTA, FMECA, and ZSA.
- Analyzed failure modes in the STV-1 propellant-feed control system and derived more than 20 safety requirements, including fail-safe valve states after loss of command or power.

Systems Engineer

Mar 2023 – Aug 2023

Taiwan Space Agency, Hsinchu, Taiwan

- Built a high-level launch-vehicle architecture in CATIA Magic using MBSE and SysML, defining subsystem interfaces and reusable modeling practices for future programs.
- Developed and managed more than 100 system-level requirements with end-to-end traceability and authored the Systems Engineering Management Plan for a launch-vehicle program.
- Authored the TASA ONGLAISAT Bus Specification, documenting functional and interface requirements, technical specifications, and verification methods across eight spacecraft subsystems.

Research Intern

Jul 2019 – Jan 2020

Nokia Bell Labs, Dublin, Ireland

- Developed and implemented a Kalman-filter-based algorithm in C++ and MATLAB/Simulink to reduce IMU noise and drift for a real-time head-tracking spatial-audio device.

TEACHING EXPERIENCE

Teaching Assistant

2024 – Present

School of Aeronautics and Astronautics, Purdue University

- **AAE 439 – Rocket Propulsion (2026):** Fundamentals, performance, and design of rocket propulsion systems. Held office hours, answered technical questions, and supported homework and quiz development.
- **AAE 539 – Advanced Rocket Propulsion (2026):** Advanced analysis and design of rocket propulsion systems. Held office hours and delivered one lecture on behalf of the instructor.
- **AAE 571 – Complex System Safety (2025):** Hazard identification, risk assessment, and safety analysis for complex engineered systems. Held office hours and helped students apply system-safety methods to engineering problems.
- **AAE 550 – Multidisciplinary Design Optimization (2024):** Formulation and solution of coupled engineering design-optimization problems. Held office hours and supported students in defining optimization problems, interpreting constraints and sensitivities, and implementing methods in MATLAB.

PROJECTS

AIAA 2027 Aircraft Design Competition

Aug 2026 – Present

Propulsion and Reliability Lead, Purdue University

- Leading propulsion-system definition for an 8-seat, 400 nmi hybrid-electric STOL commuter concept, including engine, motor, battery, power-distribution, thermal-management, and airframe-integration assumptions.
- Building a propulsion and reliability compliance matrix from the AIAA RFP and applicable FAA Part 23 requirements, including critical loss of thrust, battery-only emergency range, system safety, and design substantiation.

Orbiting Deorbiting Depot Architecture Trade Study

Feb 2025

Purdue University

- Developed the concept of operations and seven top-level requirements for a space-based logistics platform supporting repeated debris-removal missions; generated and evaluated eight candidate architectures using mass, sensitivity, and risk analyses.
- Evaluated eight architectures using launch and resupply mass, weighted trade study, sensitivity analysis, and risk assessment; selected a multi-orbit, reusable catch-and-take concept and identified four catastrophic hazards.

MANUSCRIPTS AND PUBLICATIONS

Manuscripts in Preparation

- [1] **Wang, Y.-K.**, and Marais, K. *Applying Civil Aircraft Safety Assessment to Launch Vehicle Development*. Manuscript in preparation for submission to the *Journal of Spacecraft and Rockets*.
- [2] **Wang, Y.-K.**, and Marais, K. *An Adaptive Probabilistic Framework to Support Mission Success Assessment in Launch Vehicle Development*. Abstract accepted for AIAA SciTech Forum 2027; manuscript in preparation.

Conference Publications

- [1] **Wang, Y.-K.**, Chen, Z.-R., Huang, J.-W., Wei, S.-S., and Wu, J.-S. (2022). "Spiral-V Model: A Novel Rapid Developing Approach for the HTTP-4 VTVL Hybrid Rocket Project." *International Conference on Astronautics and Space Exploration (iCASE)*, Hsinchu, Taiwan.
- [2] **Wang, Y.-K.**, Lin, Y.-T., Wei, S.-S., and Wu, J.-S. (2021). "Development of a 20-kgf-class Liquid Rocket Engine Using Hydrogen Peroxide and Ethanol." *International Conference on Astronautics and Space Exploration (iCASE)*, Hsinchu, Taiwan.

PRESENTATIONS

“An Adaptive Probabilistic Framework to Support Mission Success Assessment in Launch Vehicle Development”

Jul 12, 2026

NATPA 2026 Annual Conference, Young Scholar Program, San Diego, CA

HONORS AND AWARDS

- Young Scholar, North America Taiwanese Professors’ Association (2026)
- ONGLAISAT Mission Team, Small Satellite Mission of the Year Award, 40th Small Satellite Conference (2026)
- Government Scholarship to Study Abroad, Ministry of Education, Taiwan (2025)
- Ross Fellowship, Purdue University (2023)
- First Prize, Student Paper, International Conference on Astronautics and Space Exploration (2021)
- Best Creativity, NASA Space Apps Challenge Taipei (2018)

TECHNICAL SKILLS

Methods: Bayesian analysis, Monte Carlo simulation, engineering risk analysis, uncertainty quantification, FHA, PSSA, FTA, FMEA/FMECA, ZSA, STPA, ARP4754B/ARP4761A, requirements and verification

Programming and analysis: Python, MATLAB/Simulink, C++ , LabVIEW, ANSYS Fluent

Engineering tools: CATIA Magic, SysML, MBSE, SolidWorks, data acquisition and hot-fire testing