2026 10th International Conference on RELIABILITY ENGINEERING

Hangzhou, China July 19-21, 2026

ICRE RELIABILITY ENGINEERING

Special Session 5

Multimodal Foundation Models for Digital Twin–Integrated Prognostics and Health Management of Complex Engineering Systems

Goal

As complex engineering systems in aerospace, energy/transportation, and intelligent manufacturing evolve toward multi-scale, multi-domain coupling and high uncertainty, Prognostics and Health Management (PHM) is shifting from isolated condition monitoring to system-level, virtual–physical integrated reasoning. Purely data-driven approaches struggle with rare faults, cross-level physics coupling, and policy changes, while purely physics-based simulation faces high modeling cost, parameter identifiability issues, and online synchronization challenges. Digital twins provide an executable "world model" for PHM: at the PHM-relevant granularity, composable multi-domain models (structure/thermal/flow/electrical/control/mission and maintenance processes) capture the evolution of degradation–fault–repair–reconfiguration and enable closed-loop verification for diagnosis, RUL prediction, risk assessment, and decision optimization. However, building and maintaining a complex-system twin is inherently a multi-scale, multi-domain fusion and continual calibration problem. Multimodal foundation models—leveraging sensor time series, event logs, maintenance work orders, natural-language technical documents, and graph/configuration/structural data—open a new pathway for PHM-oriented twin engineering. They can align heterogeneous evidence in a unified semantic space, extract actionable knowledge, auto-generate or complete executable twin elements (structures, parameters, constraints, failure modes, and maintenance actions), and support online data assimilation with uncertainty quantification. Scenario-based simulation in the twin then yields auditable diagnostic explanations, prognostic estimates, and maintenance/scheduling recommendations. This Special Session aims to bring together cutting-edge methods and industrial practices at the intersection of PHM, digital twins, and multimodal foundation models, advancing health management from algorithms to verifiable, deployable system capabilities.

Topics

Topics of interest include, but are not limited to:

- PHM-oriented digital twin modeling: multi-scale/multi-domain reduction, composable modeling, FMI/Modelica/SysML integration
- Virtual–physical synchronization & data assimilation: state estimation, online parameter identification, drift detection, adaptive calibrationReliability Robust Design and Multi-objective Optimization
- Multimodal foundation models for twin engineering: cross-modal alignment, knowledge extraction, auto-generation and consistency checking of twin artifacts
- Integrated diagnosis–prognosis–decision: explainable diagnosis, RUL/risk prediction, uncertainty quantification, maintenance & scheduling optimization
- Twin-based verification and evaluation: scenario libraries, fault injection, auditable benchmarks and engineering KPIs
- Industrial applications: aero-engines/fleets, rail, power & renewables, process industry, intelligent manufacturing
- ….

Chairs

Yang Hu, Beihang University, China

Wei Wang,
City University of Hong Kong, China

Zhiguo Zeng, Université Paris-Saclay, France

Publication

We provide a good opportunity by presenting your updated research knowledge and also by publishing it in the conference proceedings. submitted paper will be peer reviewed by conference committees, and accepted papers will be included into conference proceedings which will be indexed by SCOPUS and Ei compendex.

Submission

1. Full paper (presentation and publication)
- The paper must be written in English.
- All submissions will undergo a peer-review process by the conference committee.
- The paper should be at least FIVE pages including all figures, tables, and references.
- The paper should be submitted as a PDF document in .pdf format.
- submitted paper must be unpublished.
- Accepted papers will be invited for oral presentation or poster presentation and will be included in the conference proceedings.

2. Abstract (presentation only)
- Abstracts will be considered for presentation (oral/poster) only without publication.
- The abstract must be written in English.
- Abstracts should be no more than 300 words and clearly outline the title, purpose, methods, and outcomes of the research or practice being described.
- All submissions will undergo a peer-review process by the conference committee.

* Welcome to submit the paper or abstract by Electronic submission system: https://www.zmeeting.org/submission/icre2026
More details about submission, please visit at: https://www.icre.org/sub.html

Conference Program

July 19, 2026 I CONFERENCE + SHORT COURSE
July 20, 2026 I TECHNICAL EXCELLENCE & TRIBUTE
July 21, 2026 I INNOVATION & FUTURE OUTLOOK
July 17-22, 2026 I PHD SCHOOL PROGRAM

Conference Venue

Conference Venue:
Hangzhou International Innovation Institute of Beihang University
Address:
No. 166, Shuanghongqiao Street, Pingyao Town, Yuhang District, Hangzhou City

Hangzhou, China

Hangzhou, a renowned Jiangnan city blending millennia of heritage and poetic scenery, boasts three world cultural heritage sites. west Lake ripples with romance; Liangzhu Ruins hold ancient wisdom; the Grand canal carries folk vibes. Timeless song Dynasty elegance meets trendy fun, and delicious local cuisine delights the taste buds. A perfect mix of classic and modern, it awaits visitors from all over the world.

Important Dates

Submission Deadline: April 10, 2026
Notification Deadline: May 5, 2026
Camera-ready Date: May 20, 2026

Sponsors LASAR³ Co-sponsors

杭州市北京航空航天大学国际创新研究院（北京航空航天大学国际创新学院）
哈爾濱工業大學 HARBIN INSTITUTE OF TECHNOLOGY

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特别专题 5

多模态大模型驱动的数字孪生与故障预测健康管理：复杂工程系统的虚实融合智能运维

专题目标

随着航空航天、能源交通、智能制造等高端工程系统进入“多尺度—多域耦合—高不确定性”的复杂系统时代，PHM（故障预测与健康管理）正在从“单点状态监测”向“系统级虚实融合推演”演进。仅依赖数据驱动模型难以覆盖稀有故障、跨层级机理耦合与运行策略变化；仅依赖机理仿真又面临建模成本高、参数难标定、在线同步难等问题。

数字孪生为PHM提供了可推演的系统运行“世界模型”：在PHM关注的颗粒度上，通过可组合的多域模型（结构/热/流体/电/控制/任务与保障过程）表征退化—故障—维修—再配置的演化机理，支持诊断、寿命预测、风险评估与决策优化的闭环验证。然而复杂系统数字孪生建模天然是一个多尺度、多域融合与持续校准的问题。

近年来，多模态大模型（传感器时序、事件日志、维修工卡与自然语言技术资料、图谱/配置/结构数据等）为“面向PHM服务的孪生建模”带来新路径：可在统一语义空间中完成跨模态对齐与知识抽取，自动生成/补全可执行的孪生模型要素（结构、参数、约束、故障模式与维修动作），并实现在线同化与不确定性量化；在孪生环境中开展场景化推演，形成可审计的诊断解释、寿命预测与维护/调度策略建议。

本专题旨在汇聚“PHM × 数字孪生 × 多模态大模型”交叉领域的最新方法与工程实践，推动复杂工程系统健康管理从算法走向体系化、可验证、可部署的系统能力。

专题主题

征稿主题包括但不限于：

- 面向PHM的数字孪生建模方法：多尺度/多域降阶、可组合建模、FMI/Modelica/SysML等集成不确定性来源表征、传播分析与灵敏度研究
- 虚实同步与数据同化：状态估计、参数在线辨识、漂移检测与模型自适应校准
- 多模态大模型赋能的孪生工程：跨模态对齐、知识抽取、孪生要素自动生成与一致性校验
- 诊断—预测—决策一体化：可解释诊断、RUL/风险预测、不确定性量化、维护与调度优化
- 基于孪生推演的验证评估：场景库构建、故障注入、可审计评测基准与工程指标体系
- 典型行业应用：航空发动机/机队、轨道交通、电力与新能源、流程工业、智能制造等
- ...

专题主席

胡杨，北京航天航空大学，中国

王伟，香港城市大学，中国

曾志国，巴黎萨克雷大学，法国

会议出版

会议收录的文章将出版在会议论文集中出版，并提交EI Compendex, Scopus等其他检索机构审核检索。

投稿方式

1). 上传文章到电子投稿系统：https://www.zmeeting.org/submission/icre2026
2). 或发送文章至会议邮箱：icre_conf@outlook.com
提示：
1. 全文投稿（含报告与出版）
- 稿件须以英文撰写。
- 所有投稿均由会议委员会进行同行评审。
- 稿件篇幅不少于 5 页，包含所有图表及参考文献。
- 稿件须以 PDF 格式提交。
- 投稿稿件须为未发表的原创成果。
- 录用稿件将受邀进行口头报告或海报展示，并收录至会议论文集。
2. 摘要投稿（仅作报告）
- 摘要仅用于申请报告资格（口头报告 / 海报展示），不纳入出版范围。
- 摘要须以英文撰写。
- 摘要字数不超过 300 词，须清晰阐明所涉研究或实践的标题、研究目的、研究方法及研究成果。
- 所有投稿均由会议委员会进行同行评审。
• 详细信息请见----https://icre.org/sub.html

会议日程

2026年7月19日- 签到注册
2026年7月20日- 开幕式+主旨报告+作者报告
2026年7月21日- 开幕式+主旨报告+作者报告
2026年7月19-21日- 博士研究生项目

会议地址

杭州市北京航空航天大学国际创新研究院（北京航空航天大学国际创新学院）

地址：杭州市余杭区瓶窑镇双红桥街166号

中国杭州

杭州，一座融千年文脉与诗画风光的江南名城，三大世界文化遗产勾勒其独特魅力。西湖碧波漾诗意，良渚遗址藏远古智慧，大运河流淌南北烟火。宋韵风雅浸润红墙古社，新潮玩法解锁别样体验，鲜醇杭帮菜抚慰味蕾。古典与现代交织，漫步街巷皆是惊喜，正静待八方游客前来探寻。

重要日期

投稿截止日期：2026年4月10日
审稿通知日期：2026年5月05日
注册截止日期：2026年5月20日

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