Informatics in the Era of AI

Xin Lu[1,*] **and Wenjian Qin**[2,*]

[1]College of Systems Engineering, National University of Defense Technology, Changsha 410073, China

[2]Institute of Biomedical and Health Engineering, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China

*Correspondence: xin.lu.lab@outlook.com (X.L.); wj.qin@siat.ac.cn (W.Q.)

Received: October 30, 2025; Accepted: November 7, 2025; Published Online: November 8, 2025; https://doi.org/10.59717/j.xinn-inform.2025.100002

Citation: Lu X. and Qin W. (2025). Informatics in the Era of AI. *The Innovation Informatics* 1:100002.

CHALLENGES AND OPPORTUNITIES OF AI FOR INFORMATICS

In every aspect of human production and daily life, information has been continuously generated, from oracle bone script in ancient China and cuneiform in Mesopotamia, to modern broadcast news and online media content, from the earliest oral communication and gestural cues, to the emergence of AI-generated videos and voices. Although the carriers of information are constantly evolving, information itself has always been inextricably intertwined with the development of human society, inseparable from it. With the explosive growth of information, we now have unprecedented opportunities to perceive, analyze, and utilize the insights deeply embedded within big information.

Informatics is the systematic science of collection, storage, processing, and exploiting data to produce actionable knowledge and inform decision-making for study across diverse fields, thereby underpinning scientific research of information. As an interdisciplinary field, Informatics supplies rich nourishment for the advancement of AI technologies, while AI, in turn, generates exponentially growing data along with AI-based informatics methods, bring fundamental revolution in the entire landscape of informatics (Figure 1).

AI for Informatics is reshaping the frontiers of multiple disciplines. In AI4Science, the integration of data-driven models with scientific theory has transformed traditional research paradigms, enabling automated discovery and simulation; however, it also raises challenges related to interpretability, reproducibility, and the integration of human intuition into machine-assisted reasoning.

In electronic informatics, advances in AI-driven design and signal processing have enhanced computational efficiency and system reliability, yet they demand new standards for energy consumption, security, and interoperability. In computer science, the rise of large-scale AI systems introduces opportunities for new algorithmic theories and computing architectures, while challenging existing theories of complexity, scalability, and ethics. Besides, automation and control systems are evolving toward adaptive, self-organizing mechanisms guided by real-time data and learning algorithms, yet must contend with issues of safety, robustness, and human–machine coordination. In the domain of semiconductors and information devices, AI accelerates material discovery and chip design, but the physical limits of miniaturization and sustainability remain significant bottlenecks. Optical and optoelectronic information technologies benefit from AI-enhanced imaging, sensing, and communication, paving the way for ultrafast and intelligent information networks, though challenges persist in data volume management and noise reduction. Biomedical informatics has witnessed unprecedented opportunities for precision medicine, multi-omics integration, and healthcare decision support, yet it faces ethical dilemmas surrounding data privacy, fairness, and clinical validation. Lastly, computational social science leverages AI to decode human mobility, social networks, and collective behavior, offering new insights into complex societal systems, while simultaneously confronting issues of bias, transparency, and governance. Collectively, while there are still some issues that needed to be addressed, these developments mark a paradigm shift toward data-driven, intelligent, and interconnected modes of scientific inquiry and technological innovation.

Figure 1. The interdisciplinary landscape and applications of informatics in the AI era.

EDITOR'S HIGHLIGHTS

We are excited to announce the first issue of The Innovation Informatics. The works featured in this issue showcase the pivotal role of AI-driven informatics methods in advancing biomedicine, embodied intelligence, materials science, chemistry, soft robotics, and medicine. Together, these contributions exemplify the intrinsically interdisciplinary nature of informatics and highlight the journal's broad scope in exploring how intelligent computation drives innovation across scientific domains.

Li et al.'s perspective on Biomedical AI charts the evolution of technology from digital models trained on vast biomedical datasets, to physically intelligent systems such as surgical robots that interact with and learn from their environments, and further toward biological intelligence that enables direct communication between human brains and AI.[1]

In the article "Interpretable and robust multimodal data integration for precise treatment response and survival prediction in gastric cancer", Zhou et al. proposes an interpretable and robust multimodal data integration framework (iMD4GC) for gastric cancer analysis, effectively combining heterogeneous data sources to predict treatment response and survival outcomes while enhancing clinical interpretability, reliability, and decision-making support.[2]

Tang et al. introduce PsyRTDevice, an open-source toolkit that enables sub-millisecond evaluation of reaction time (RT) device accuracy using sound-wave technology.[3] The toolkit allows researchers to rapidly quantify latency and variability across wired and wireless devices. By providing a practical and accessible validation framework, *PsyRTDevice* enhances experimental rigor and reproducibility in cognitive and behavioral research.

An et al. summarized recent progress of embodied intelligence along three constitutive elements—intelligence, embodiment, and environment—as well as three core capabilities: perception, decision-making, and action, highlighting current advances and challenges, and conclude with perspectives on future directions toward adaptive, multimodal, and collaborative embodied systems.[4]

Ma et al. reviews how active learning is used in accelerating material discovery and introduces a framework that categorizes active learning in both experimental and computational settings, highlighting the importance of integrating domain knowledge and addresses interpretability challenges.[5]

NEWS & COMMENTS

A number of insightful pieces exploring the frontiers of informatics, AI, and interdisciplinary innovation are presented in this issue. Optical computing is reviewed as an energy-efficient, high-speed alternative for AI inference, overcoming the limitations of traditional electronic platforms in large-scale generative models. Challenges in defining and quantifying "understanding" in large language models are discussed, emphasizing the need for unified, reproducible evaluation standards. In bioelectronics, the NeuroWorm soft fiber electrode enables real-time, dynamic, long-term bioelectrical monitoring, representing a breakthrough. Machine learning's integration into large scientific facilities is examined, with a focus on maintaining scientific principles while enhancing operational efficiency. Geospatial foundation models are explored as tools to support the development of digital ecological civilization and sustainability initiatives. Trustworthy AI is shown to enhance safety and resilience in low-altitude system-of-systems operations through reliability, explainability, robustness, and human-AI collaboration. Finally, interface engineering in perovskite solar cells is highlighted for improving photostability and photovoltaic performance, pointing toward future applications and research directions.

REFERENCES

1. Li Z.-C., Qin W., Liang D., et al. (2025). Biomedical AI: Evolving from digital to physical and biological intelligence. *Innov. Inform.* **1**:100010. DOI:10.59717/j.xinn-inform.2025.100010
2. Zhou F., Xu Y., Cui Y., et al. (2025). Interpretable and robust multimodal data integration for precise treatment response and survival prediction in gastric cancer. *Innov. Inform.* **1**:100011. DOI:10.59717/j.xinn-inform.2025.100011
3. Tang N., Li A., Chen Bo., et al. (2025). PsyRTDevice: Open-source toolkit for sub-millisecond evaluation of reaction time device accuracy. *Innov. Inform.* **1**:100017. DOI:10.59717/j.xinn-inform.2025.100017
4. An Z., Yu X., Wang C., et al. (2025). Embodied Intelligence: Recent advances and future perspectives. *Innov. Inform.* **1**:100008. DOI:10.59717/j.xinn-inform.2025.100008
5. Ma Y., Gao Y., Wang L., et al. (2025). Accelerating materials discovery through active learning: Methods, challenges and opportunities. *Innov. Inform.* **1**:100013. DOI:10.59717/j.xinn-inform.2025.100013

AUTHOR CONTRIBUTIONS

All authors contributed to the manuscript and approved the final version.

DECLARATION OF INTERESTS

Xin Lu and Wenjian Qin are Executive Editors of The Innovation Informatics and were recused from reviewing or making final decisions on this manuscript. The peer-review process was handled independently of these members and their research groups.