

Physics-Guided Validation to Support AI-Driven Paradigm

以物理基礎引導的驗證來支持人工智慧驅動模式

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Future society needs a sustainable energy supply to support economic growth. Artificial intelligence (AI)-aided, data-driven approaches are rapidly transforming the energy landscape. Sustaining this momentum requires solutions that are both cost effective and energy efficient. The current approach relies on heuristic methods and intensive data acquisition and computation. However, resource constraints make rapid deployment difficult. Quantifying returns on investment while accounting for uncertainty and risk adds another major challenge. A trustworthy framework is therefore vital and essential to guide this transformation—but how can such a framework be built?

Physics-informed framework has been often proposed as a safeguard for the data-driven paradigm. To make this paradigm trustworthy, however, its physics-informed foundation must be reinforced through fundamental science-based validation. This presentation will discuss how empirical reduction and induction can strengthen that foundation through quantification and verification. The goal is to ensure that regression-model predictions not only obey fundamental principles but are also quantitatively interpretable. This would connect controlled laboratory test data with real-world, live data streams for practical applications. Because limited data transferability has become a major bottleneck, a quantitative and verifiable physics-guided framework could help overcome the current challenge and accelerate a sustainable transformation that is both cost-effective and energy-efficient.