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Launching *Journal of Mechanoinformatics*

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INAUGURAL EDITORIAL

Welcome to the inaugural issue of *Journal of Mechanoinformatics* (*JMechI*), a peer-reviewed open-access international journal dedicated to the fast-growing interdisciplinary frontier unifying mechanics, data science, artificial intelligence (AI), computer simulation, and autonomous experimentation.

Mechanics has advanced for more than three centuries through three intertwined traditions - theory, experiment, and computation - each yielding achievements of remarkable depth: universal conservation laws, full-field measurement techniques of extraordinary resolution, and numerical methods capable of resolving boundary-value problems from the atomic to the planetary scale. Yet the questions that now define the frontier - predicting behavior across length and time scales, coupling mechanics with chemistry, biology and electromagnetism, and discovering governing laws from vast streams of multimodal data - can no longer be answered within any single tradition. They call for a synthesis in which data, algorithms, and physical principles become constitutive elements of inquiry, rather than auxiliary tools.

This synthesis is advancing rapidly across several complementary fronts. Data-driven computational mechanics bypasses constitutive modeling by solving directly from empirical material data, while curated repositories and full-field measurements make mechanics data a first-class research object. Neural operators learn solution mappings between function spaces, achieving orders-of-magnitude speedup and mesh-independent generalization; machine-learned interatomic potentials with equivariant graph architectures approach ab initio accuracy at far lower cost, powering 100-million-atom simulations. Physics-informed deep learning has matured from soft enforcement - embedding governing equations as loss penalties - to hard architectural constraints guaranteeing symmetry, energy conservation, and thermodynamic consistency. Learned world models predict the spatiotemporal evolution of mechanical systems under embedded differential-equation constraints, enabling real-time digital twins. Most ambitiously, AI-driven law discovery platforms combining symbolic regression, language-model-driven hypothesis generation,

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self-corrective reflection, and adversarial multi-agent debate are beginning to propose, test, and evolve candidate governing equations, operationalizing falsification at scale. Parallel to these computational advances, autonomous laboratories - closed-loop systems coupling robotics, active-learning algorithms and real-time computation - are designing, executing and interpreting experiments, achieving order-of-magnitude accelerations in synthesis and characterization.

Yet formidable challenges accompany these advances. Mechanics data remain fragmented; the Findable, Accessible, Interoperable, Reusable (FAIR) principles are only partially adopted, and heterogeneous multi-scale data lack unified standards, provenance tracking and rigorous uncertainty quantification. Physics-informed networks still struggle with stiff gradients, multi-scale coupling and extrapolation beyond training regimes. Learned world models face long-horizon instability and distribution shift. Autonomous experimentation has yet to reach mechanical testing - no self-driving laboratories exist for fracture, fatigue, or constitutive calibration. Recent benchmarks reveal that naive self-refinement can inflate false-discovery rates, cautioning that genuine falsification must be engineered, not assumed from self-correction.

These open problems precisely define the frontier where the most exciting breakthroughs will occur. Their resolution promises transferable constitutive models, real-time predictive twins, autonomous characterization, and accelerated law discovery - above all, a renewed mechanics theory for the AI era, in which variational principles, conservation laws, and constitutive frameworks are discovered and refined through data-driven inquiry without sacrificing rigor: prospects of extraordinary breadth and depth for the entire mechanics community.

Against this transformative backdrop, we proudly launch *JMechI* as a global communication hub rooted in rigorous mechanical principles and cutting-edge data methodologies. The journal advances three foundational missions:

First, publish original, technically sound research spanning data-driven mechanics, multi-scale simulation, neural-operator solvers, physics-informed and structure-preserving networks, learned world models, AI-assisted law discovery, autonomous experimentation, and engineering applications.

Second, to feature authoritative reviews, forward-looking perspectives, special issues, and concise technical communications that map the mechanoinformatics roadmap and propose innovations that bridge atomistic and continuum scales.

Third, to break disciplinary silos and build an inclusive global community uniting mechanical engineers, materials scientists, AI researchers, and industrial practitioners, sharing benchmarks and solutions for advanced manufacturing, aerospace, energy materials, and biomedical devices, and mentoring the next generation of mechanoinformatics researchers.

We firmly believe that manuscripts in the inaugural volume will set the journal's academic tone and lay the foundation for lasting influence. Its vitality stems from high-quality contributions from founding editors, board members, and pioneering authors who define the field's early academic landscape.

We invite mechanoinformatics scholars to submit breakthroughs - original research articles, comprehensive reviews, insightful perspectives, and concise technical communications. We also welcome nominations of outstanding work. Our editorial team will uphold rigorous, impartial peer review, ensuring that every accepted work delivers solid, innovative insights.

Working with our global editorial board, expert reviewers, and contributing authors, we strive to grow *JMechI* into an authoritative platform where mechanical principles and data-driven methods jointly redefine what is predictable, discoverable, and automatable in mechanics.

Thank you for your trust and support. We look forward to building, together with the community, an indispensable global hub for mechanoinformatics research.

DECLARATIONS

Authors' contributions

The author contributed solely to the article.

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Consent for publication

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