ASME IDETC-CIE 2026
INTERNATIONAL DESIGN ENGINEERING TECHNICAL CONFERENCES & COMPUTERS AND INFORMATION IN ENGINEERING CONFERENCE

DAC Signature Event

Panel: AI-Empowered Digital Twins for Engineering Design and Manufacturing

Moderator: Zhen Hu

Tuesday, August 25, 4:20 PM-6:00 PM, Room: Ballroom of the Americas F
ASME IDETC-CIE 2026
Houston, TX, USA

Our Panelists

Austin Downey
Associate Professor
University of South Carolina

Structural Health Monitoring, Digital Twins, Real-time Systems, Controls.

Chenhui Shao
Associate Professor
University of Michigan

Smart Manufacturing, Machine Learning, Statistics; Big Data Analytics, Process Control.

Elizabeth Qian
Assistant Professor
Georgia Institute of Technology

Scientific Machine Learning, Model Reduction, Multi-fidelity Methods, Uncertainty Quantification.

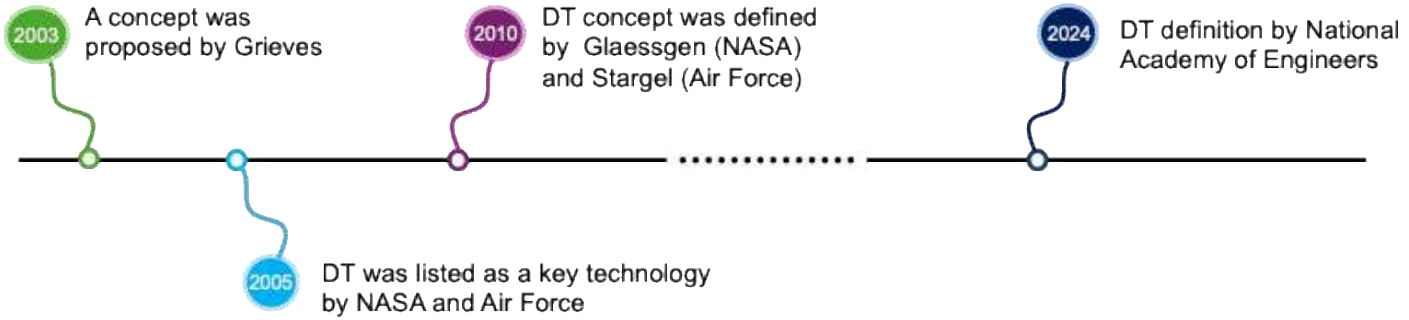
Ramin Bostanabad
Associate Professor
University of California, Irvine

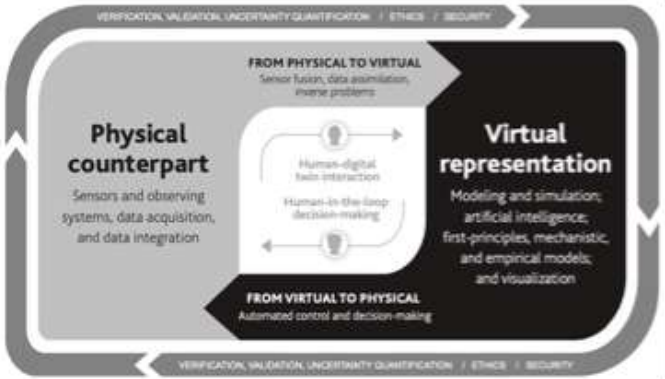
Design Under Uncertainty, Computational Mechanics, Uncertainty Quantification.

Agenda

- **Lightning presentations**: Short perspective talk by each panelist, sharing their insights into the theme of the panel.
- **Questions from moderator**
- **Q&A from the audience**
- **Closing remarks**

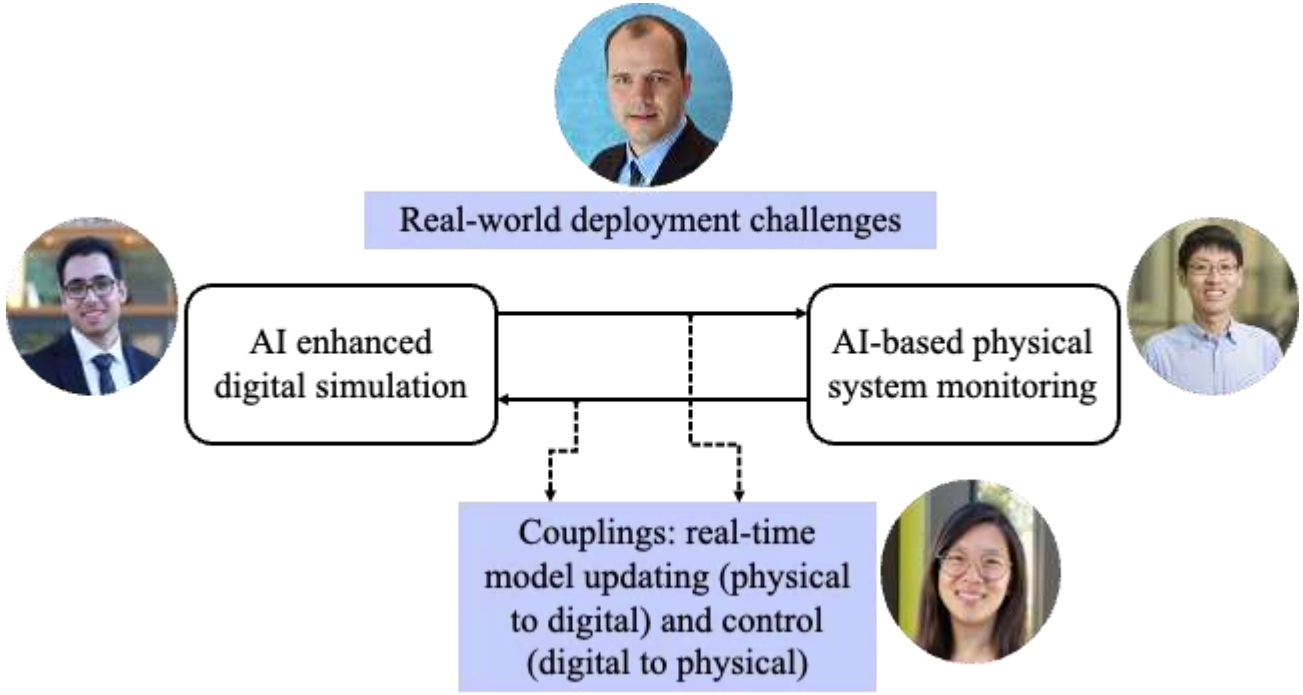
Digital Twins and AI





(NAE report 2024)

Lightning talks

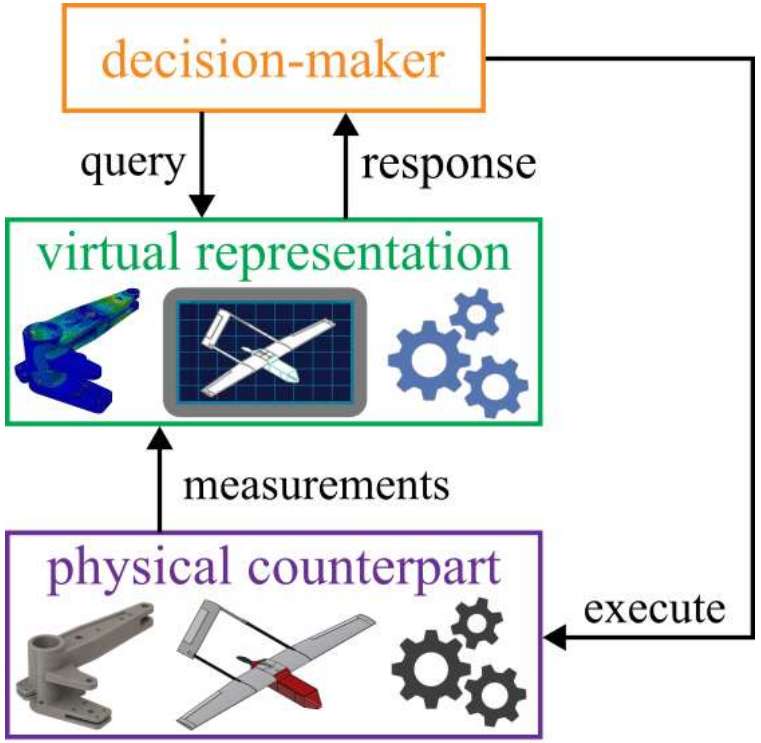


Austin Downey
Associate Professor

Mechanical Engineering, Aerospace Engineering, Civil Engineering
Molinaroli College of Engineering and Computing
University of South Carolina

A Digital Twin Is a Decision-Making Framework

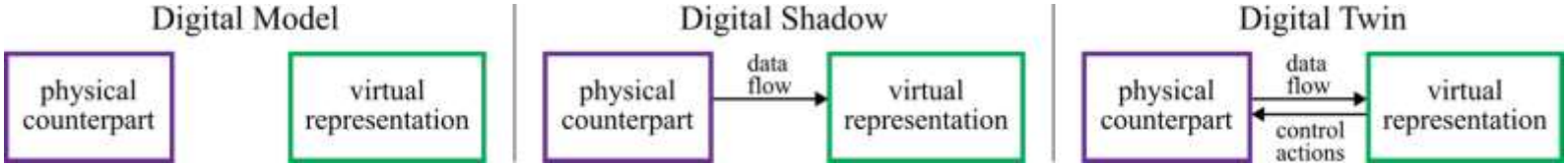
- Physical counterpart: the real system, asset, or process
- Virtual representation: models, data, and state estimates
- Decision maker: queries the virtual representation and acts on the physical system
- The value is not just “having a model” — it is using the model to support decision



Sado, Kerry, et al. "Query-and-response digital twin framework using a multidomain, multifunction image folio." *IEEE Transactions on Transportation Electrification* 10.4 (2024): 7873-7885.

Digital Model, Digital Shadow, or Digital Twin?

- Digital model: physical system and virtual model are disconnected
- Digital shadow: data flows from physical system to virtual representation
- Digital twin: information flows both ways
- Two-way coupling is what enables feedback, control, and lifecycle decision-making



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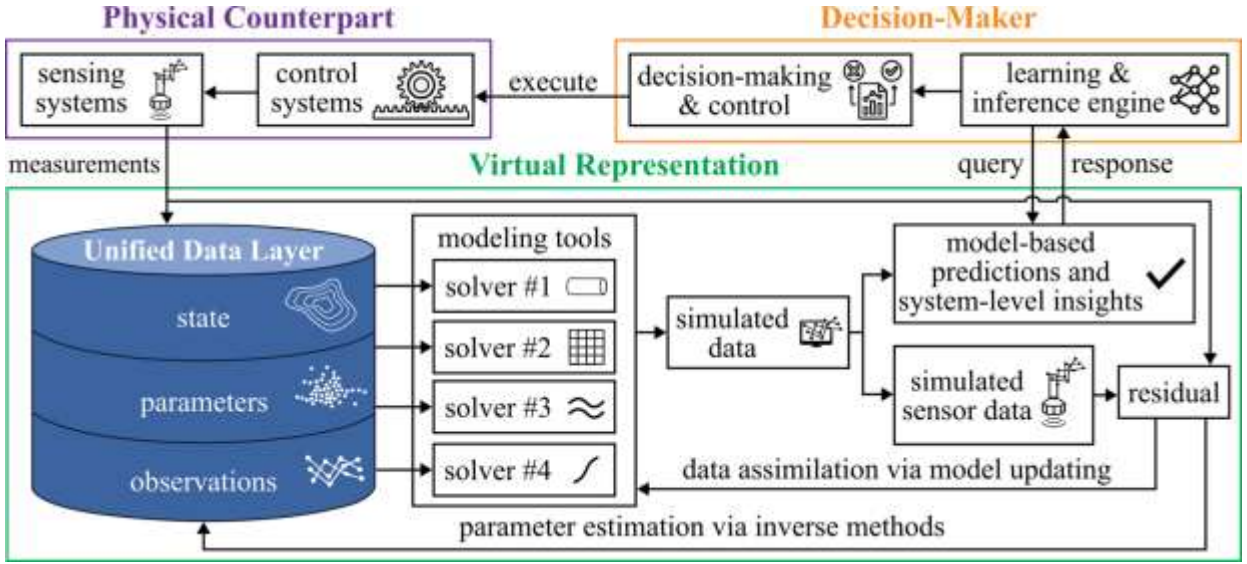
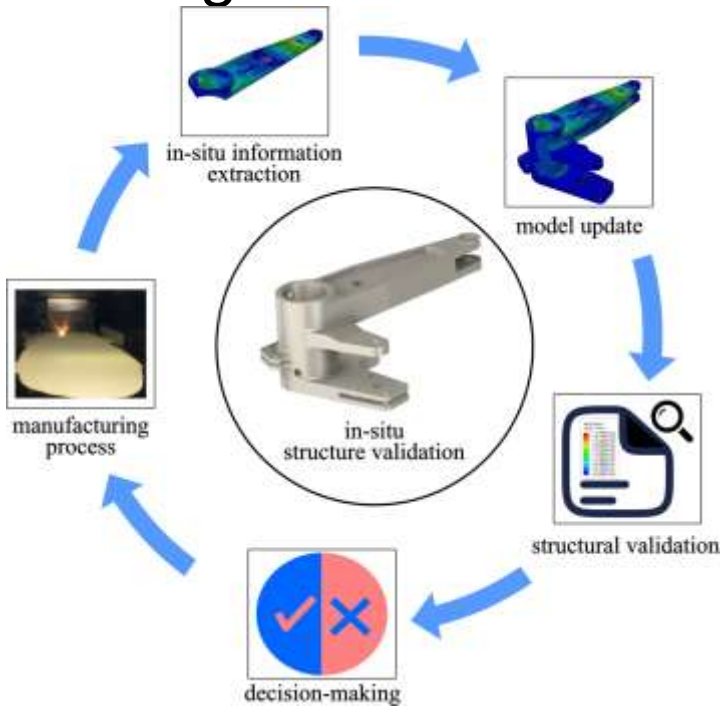
Shared Data Backbone Enable Many Models

- A common data layer stores states, parameters, and observations
- Multiple models can operate on the same data backbone



Manufacturing Is a Natural Place for Digital Twins

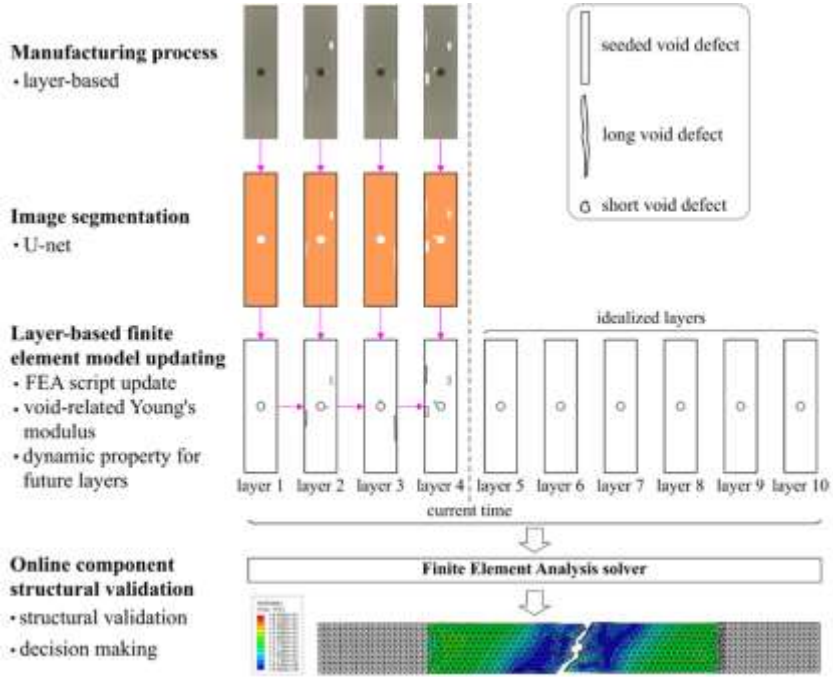
- Manufacturing provides frequent measurements and natural feedback loops
- In-process validation can shift inspection from after-the-fact to during production
- Parts may be accepted, rejected, repaired, or redirected based on predicted performance
- Additive manufacturing is a strong test case because the part is created layer by layer



Zolfagharian, Ali, et al. "Roadmap on Artificial Intelligence-Augmented Additive Manufacturing." *Advanced Intelligent Systems* (2026): e202500484.

Example: Building the Structural Twin During Printing

- Layer images identify defects as the part is manufactured
- Defect information updates a finite element model in real time
- The evolving model predicts structural performance before the part is complete
- The same model can become the starting point for lifecycle monitoring



Fu, Yanzhou, et al. "Simulation-in-the-loop additive manufacturing for real-time structural validation and digital twin development." *Additive Manufacturing* 98 (2025): 104631.

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Questions from Moderator

- **Four warm-up questions**
  - Real-world deployment challenge
  - Trustworthy
  - Engineering design and manufacturing
  - Scalability

Real-world deployment challenges

Can you describe a specific instance where you or your collaborators attempted to deploy an AI-driven digital twin in an actual engineering design or manufacturing context? What worked, what broke, and what surprised you?

Trustworthy

AI/ML is increasingly used to accelerate computational simulations in digital twins through surrogate models, neural operators, reduced-order modeling, and physics-informed machine learning.

What are the barriers that must be overcome for trusted real-world adoption of these techniques in digital twins? What future directions do you see for AI-accelerated digital simulation?

Engineering Design and Manufacturing

One of the persistent challenges in engineering is the gap between "design intent" and "as-manufactured" reality.

How can AI-empowered digital twins close this gap in real time, and can you share an example?

Scalability

Building one digital twin with a well-tuned ROM or AI model is possible. Scaling to a fleet of hundreds or thousands of twins, where each represent a nominally identical but physically unique asset is a different challenge.

How do ROM or AI strategies need to change when you move from a single digital twin to fleet-scale deployment?

Q&A