

DigitalTwinSphere:

Advancing AI-Driven Digital Twins for Resilience Across Sectors

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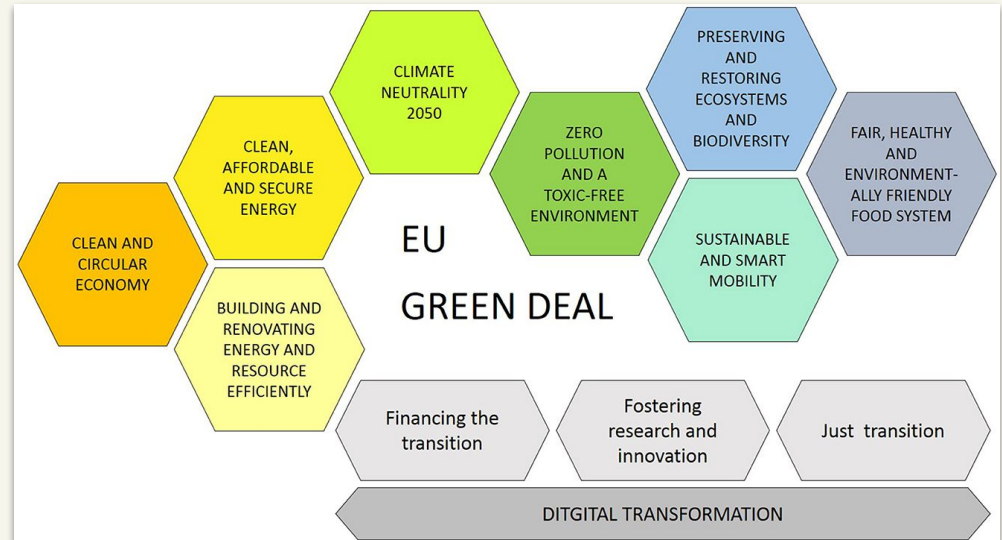


DSAI
DATA SCIENCE
ARTIFICIAL INTELLIGENCE

Successful R & I in Europe 2025
12th European Networking Event
06-07/03/2025
Düsseldorf

EU Green Deal and the role of Digital Twins

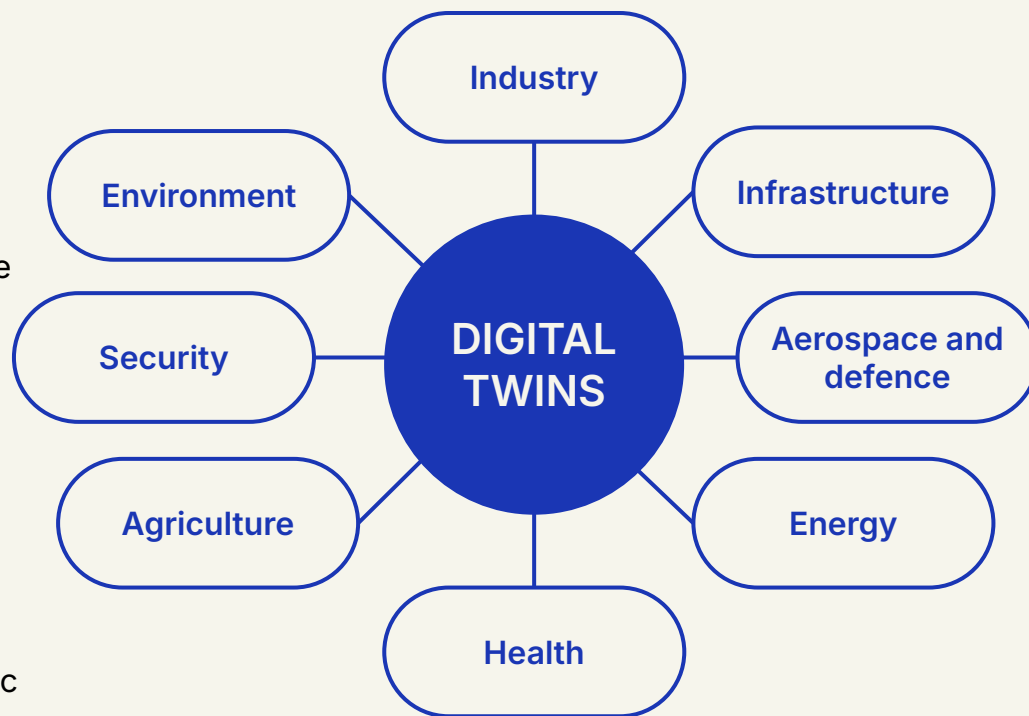
- ❑ **The crucial element:** openly accessible and interoperable European dataspace as a central hub for informed decision-making on sustainability issues.
- ❑ The **digital transformation** is an important building block of achieving the goals of the Green Deal.
- ❑ Advances in **HPC, big data analytics, AI** and **ML** as well as progress in Earth system observation and prediction have enabled increasing precision in **digitally representing physical systems**.
- ❑ **Dynamic, real-time, virtual replicas** of physical and biological entities are called **digital twins**.



The **key objectives** of the European Green Deal.

Digital Twins across Sectors

- ❑ Play a crucial role in advancing strategic priorities across multiple domains.
 - ❑ **Smart Grids and Renewable Energy:** Digital twins help optimize the generation, distribution, and consumption of energy, supporting the EU's transition to renewable sources.
 - ❑ **AI and Data Science Research:** They contribute to the development of new algorithms and decision-making models.
 - ❑ **Autonomous Vehicles and Rail Networks:** They support the development of self-driving cars, high-speed trains, and intelligent traffic systems.




System Modeling for Digital Twin Development


□ We designed a **novel Model Solver framework** to streamline the creation and development of Digital Twins across various domains.

□ **The key elements:**

- Model-Driven Development
- Dynamic and Nonlinear Modeling
- Realistic Simulations
- Configurable Data Generation
- Symbolically Assisted Numerical Methods

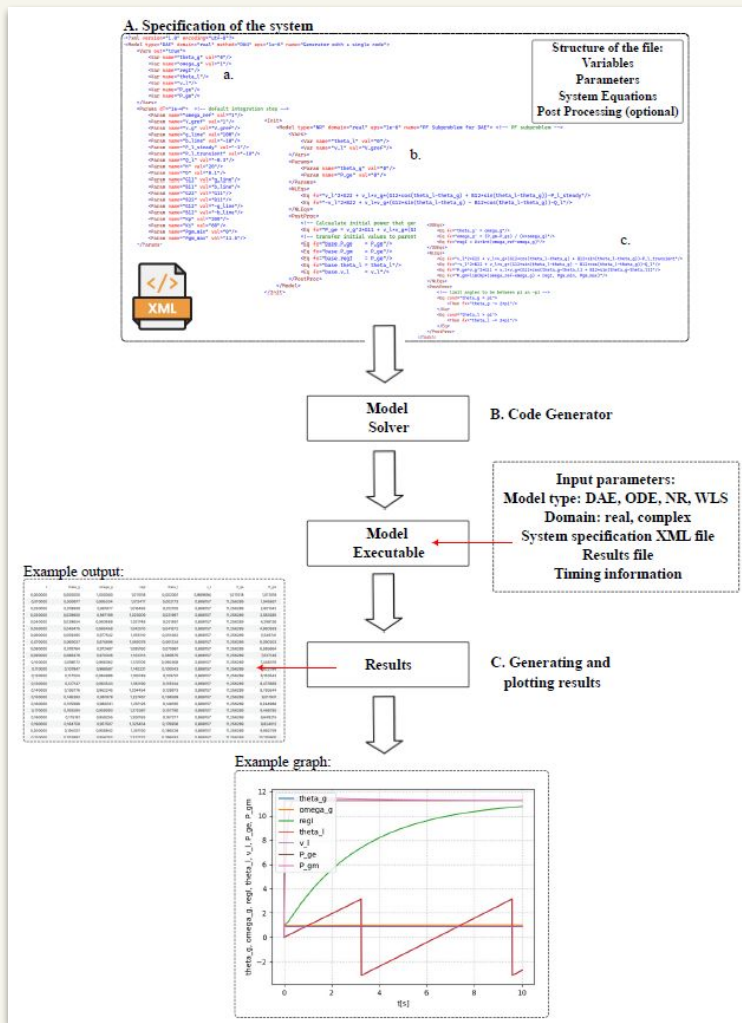


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Intelligence
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Enhancing smart grid resilience with deep learning anomaly detection prior to state estimation

Amila Akagic Izudin Dzafic



Next Steps

Topics to explore

Systems from various domains that have known mathematical formulations.

Types and roles of partners

- Industry partners seeking the development of **Digital Twins** (pilot projects or end-users) for **data generation** and the application of **AI/ML methods** across various tasks.
- Universities and research institutes eager to explore and advance **AI technologies** through diverse research initiatives.

Our expertise

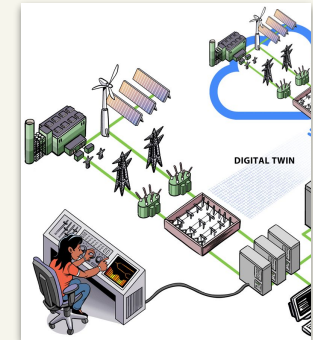
- Several international and national projects demonstrating capabilities of AI/ML on various Digital Twins.



DIGITAL TWINS IN
CONTROL
SYSTEMS



DIGITAL TWINS IN
ELECTRICAL
ENGINEERING



DIGITAL TWINS IN
SMART GRID



DIGITAL TWINS IN
ECONOMY



DIGITAL TWINS IN
MOLECULAR
CHEMISTRY

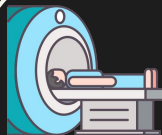


DIGITAL TWINS IN
BIOLOGY

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BIOMEDICAL IMAGING LAB

Computer Vision,
Semantic
Segmentation,
Object Detection,
Image Processing,
Digital Signal
Processing



NLP RESEARCH LAB

Language Models,
Large Language
Models, Sentiment
Analysis, Automatic
Report Generation,
Agentic Systems



ACCELERATED HARDWARE LAB

Speed up complex
computations,
simulations, and
AI-driven
experiments with
specialized
hardware