Pillar 1: Manufacturing
Digital Twin for large electric motors

Dr. Stefan Boschert
Principal Key Expert
Siemens Technology

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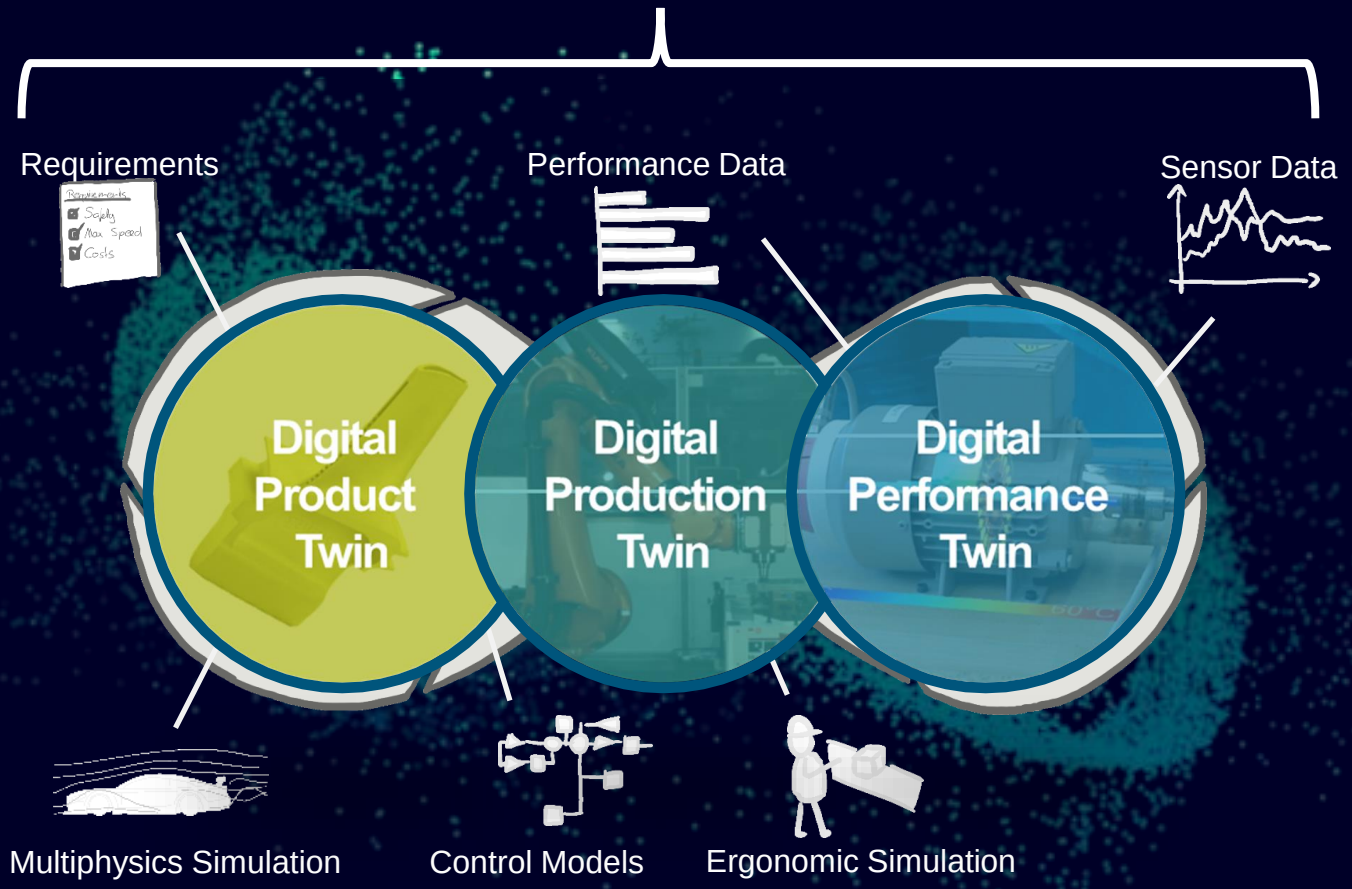
The comprehensive Digital Twin is key to combine the real and digital world

Digital world



Real world

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“Unlike any other company in the world, we are able to combine the real and the digital worlds.”

Dr. Roland Busch,
President and CEO of Siemens AG

Source: https://www.fnlondon.com/articles/siemens-ceo-roland-busch-on-combining-the-real-and-the-digital-worlds-20210727

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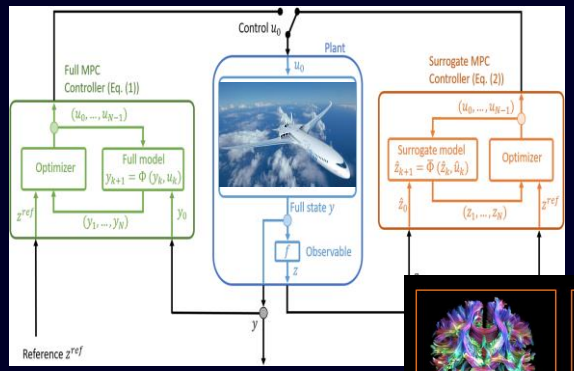
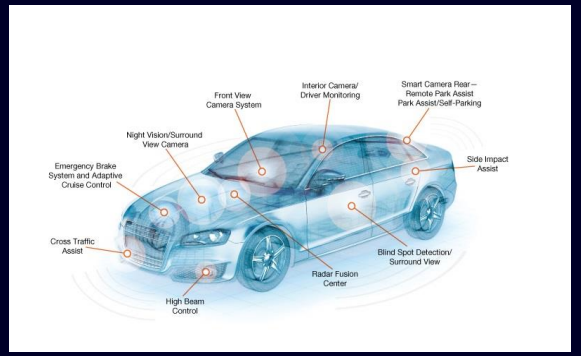
Siemens Use Cases

Turbomachinery

Multi-physics simulation for Hydraulic metal forming machines



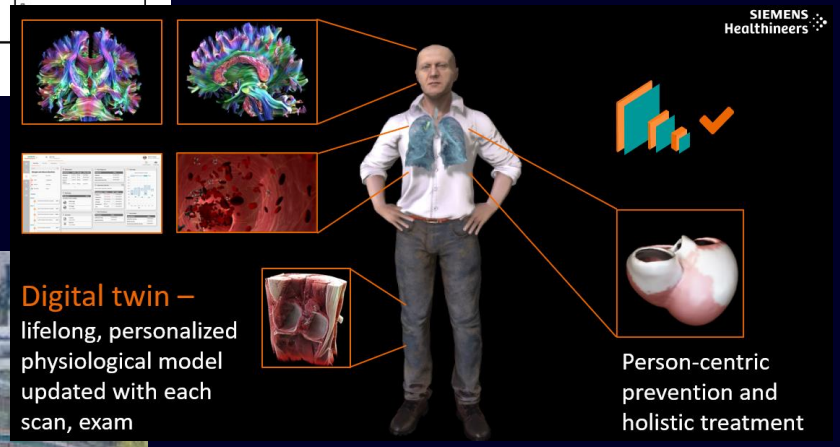
Flow Control



Automotive Design & Control

Grid Control

Positive Train Control



Personalized Healthcare

Source: Google Images

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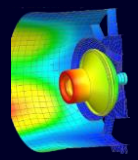
Digital Twin - A new age of computational paradigms

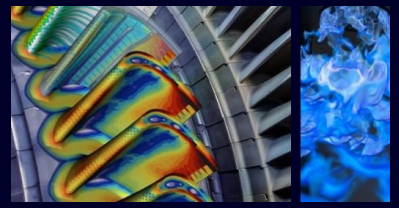
Model Pioneers



~1985

- Geometry
- Single-Physics

CAx Sunrise



~2000

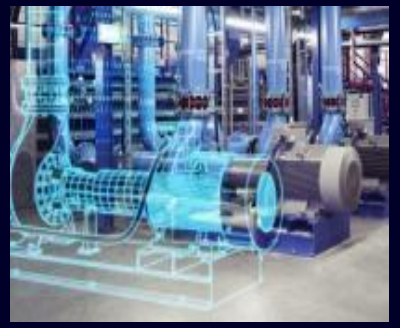
- Computer-Aided Tools in R&D
- Multi-Physics

PLM Pervasion

~2015

- Collaborative
- Model-based Engineering

Digital Twin Era



~2022

- Model-based operations
- X-as-a-service

Industrial Metaverse

- Democratization
- Realtime++ predictions

CAx: Computer Aided Design, Engineering, & Manufacturing | **PLM**: Product Lifecycle Management

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eFlows4HPC Use Case

Situation:

Electric motors are a central component of any manufacturing machine.

- Machine is not running permanently; Motor is started/stopped frequently.
- Motor produces heat due to electrical losses
- Cooling of motor is done through internal ventilation (coupled with motor rotation)
- Start & stop produces significantly higher losses than permanent operation
- **Electric windings in motor may not overheat**

Goal:

- Optimize operation of motor (minimize cool down times between separate operation phases) based on actual situation in real-time by using a Digital Twin

Approach:

- Build detailed model that can describe the heat-up and cool-down of motor based on known physics (assume electrical loads are known as time-dependent heat sources)
- Build up full FEM model (CFD, Heat transfer)
- Derive ROM that can estimate temperature of critical points based on operation in real time

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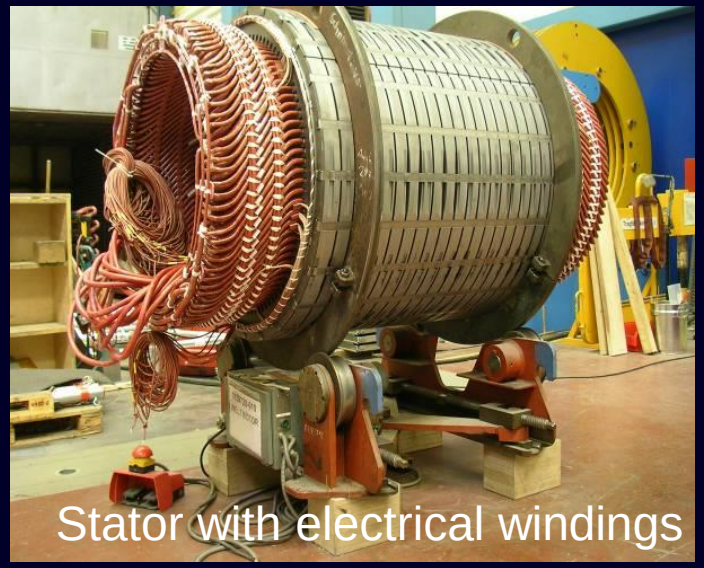
eFlows4HPC usecase

Rotor on test stand



Stator with electrical windings

Assembling of rotor and housing

eFlows4HPC SIEMENS