DOUBLE VISION

The digital twin provides a new layer of engineering insight by replicating the performance of products in operation.

By **Eric Bantegnie**,
Vice President & General Manager
ANSYS Systems Business Unit, and
Sudhir Sharma,
Director High-Tech
Industry Marketing, ANSYS

Today, most product development teams rely on engineering simulation for innovation and to bring their solutions to market quickly and cost-effectively. By exposing their design to a range of virtual forces in a low-cost, risk-free digital world, engineers can optimize performance, launch products faster and minimize financial investments. Historically, the role of simulation has primarily been in this product development function. However, the digital twin promises to extend the value delivered by simulation beyond product development to the entire life cycle of a product — enabling it to be studied under its actual operating conditions in its unique working environment. By creating a replica of the actual product system in a digital environment, engineers can anticipate and address potential performance and maintenance issues before they occur. The real-time, real-world insights collected via these digital twins can also accelerate future design iterations, leading to continual product improvements.

WHAT IS A DIGITAL TWIN?

A digital twin is the combination of all the organization's digital information on a specific product with operating data streaming live from the product as it is being used in operation. Merging physics-based understanding with analytics delivers the insights that unlock the true value of the digital twin. Using these insights, engineers can understand the operational failure modes of the product, prevent unplanned downtime, improve product performance and seed the next product generation.

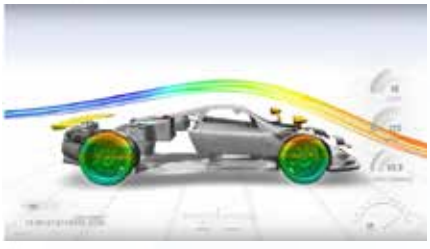
The digital twin is able to leverage multifidelity simulations from detailed 3-D physics to reduced-order models (ROMs) to compress simulation times and demonstrate key product performance aspects. For example, a digital twin of a gas turbine installed in a power plant might be designed to highlight energy efficiency, emissions, turbine blade wear or other factors of particular importance to the customer and thus the product development team.

By studying the digital twin, engineers can determine the root cause of any performance problems, improve output, schedule predictive maintenance, evaluate different control strategies and otherwise work to optimize product performance — and minimize operating expenses — in near real time. This is becoming increasingly important as customers shift from buying a product to buying an outcome, with the performance risk passed to the product developer.

"One of the most exciting aspects of digital twins is that we can now look at an individual product system — such as a wind turbine — and isolate just that one product," notes Marc-Thomas Schmidt, chief architect of the Predix® analytics platform for GE Digital. "We're not talking about a general class of turbines, but that one turbine. We can study the weather patterns that affect it, the angle of its blades, its energy output, and optimize that one piece of machinery. If we do this across all our product systems in the field, imagine the impact on overall product performance. This clearly represents a revolution in product engineering."

CAPITALIZING ON THE IOT

Digital twins have been made possible by a number of technology developments, including improvements in simulation software, hardware and processing speeds. The most important enabler has been the emergence of the Internet of Things (IoT). The implications of the IoT for our everyday lives have been well documented, and the growth of consumer devices is not slowing down. In fact, by 2025 sales of connected devices are expected to reach $11 trillion per year.



However, the industrial sector has been slower to capitalize on the IoT. While early applications have been fairly straightforward — such as turning a piece of equipment on and off — today the business world is beginning to recognize the enormous potential of IoT devices to capture real-time data that has great strategic potential.

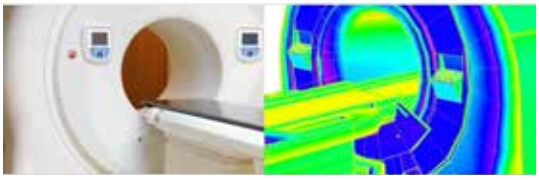
By placing small, relatively low-cost sensors on products as they're operating in the field, engineers gather a wealth of daily performance data. By combining this new information with the power of physics-based simulation, the engineering team can examine and address any performance issues, foresee the need for product maintenance or repair, and ensure that future versions of the product are optimized for day-to-day operating conditions.

"Engineers can understand the operational failure modes of the product, prevent unplanned downtime, *improve product performance* and seed the next product generation."

"What ANSYS brings to the table is exciting: the ability to simulate failure. Simulation is applied in both the upfront engineering — the digital twin might include information about the stress level before something broke, or how thin a wall can be —and during operation in the field," notes Andrew Timm, chief technology officer for PTC. "If something breaks you can test potential solutions in the simulated model and feed that information back to resolve the problem."

MAKING THE VISION A REALITY

While digital twins are primarily being used by large industrial manufacturers with complex product systems, continuing technology advances are making this best practice accessible to more businesses, with a broader range of product applications.



At ANSYS, we're committed to partnering with the leaders of the digital twin revolution to bring this capability to every product development team. For example, we've worked closely with GE to integrate our industry-leading simulation software with Predix, GE's proprietary cloud-based platform for industrial data and analytics. This collaboration matches day-to-day operational data with powerful analytics, ensuring that strategic insights are generated. These insights are made visual and actionable via engineering simulation.

ANSYS also collaborates closely with PTC, developer of ThingWorx® — an IoT platform that forms a gateway between remote sensors and simulation software. Via machine learning and augmented reality, PTC displays the important insights gathered from the IoT and connects that data to ANSYS software.

And because our simulation platform is highly customizable, it can be adapted to integrate with other IoT platforms and those that have yet to emerge on the market.

As ANSYS releases future versions of our simulation software, we will continue to focus on enhancements that allow seamless integration with other core technologies — making digital twins more affordable, more accessible and easier to master for product development teams. There's no doubt that digital twins hold enormous potential, and we believe our job is to give every ANSYS customer the opportunity to capitalize on that potential.

Digital Twin Web Page
ansys.com/digital-twin