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Is the SARS-CoV-2 Pandemic Disrupting Your Product Development Timeline?

Computational Modeling Can Help Keep Product Testing on Track

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Currently, product development in industries ranging from medical devices to consumer electronics is based largely on the tried-and-true methodology of extensive physical testing. A battery of physical tests is aimed at optimizing performance, product safety, reliability, and other design factors. This effort is labor intensive and time consuming. Unfortunately, business disruptions, such as those caused by SARS-CoV-2, can limit a manufacturer's ability to execute the traditional product testing scope.

A potential solution: augment physical testing with a computationally driven approach. Computational modeling, or *in silico* testing, provides a virtual representation of a product's response to simulated use and abuse. Leveraging a computationally focused design approach allows for a faster feedback loop between iterations, optimization of primary design factors, and a means to better target and select the suite of physical tests for ultimate product validation.

Virtually Advancing Product Development

Advances in computational power open the door to virtual product assessment throughout the development cycle, allowing analysis of a large variety of designs and conditions. Product developers across the board—not just those with dedicated in-house resources—can leverage computational modeling to virtually assess product risks and continue to drive product development timelines even during periods of business disruption. The current socio-economic conditions offer a unique opportunity for companies to address their product development strategies and re-tool with advanced simulation approaches.

Shifting to *in silico* testing to drive product development can help manufacturers assess performance metrics and advance prototypes when physical testing is infeasible. The power of physical testing will never be replaced, but virtual simulations allow for a more efficient assessment of design factors. This can be especially valuable for highly regulated products whose timelines hinge on completing key milestones. For example, a medical device manufacturer cannot begin a new clinical trial without demonstrating safety and efficacy data on its product; *in silico* test results can help support this requirement. The U.S. Food and Drug Administration (FDA) is currently introducing new programs (ASME V&V 40-2018 Assessing Credibility of Computational Modeling Through Verification and Validation: Application to Medical Devices) designed to test medical devices in simulations before engaging in clinical trials. The goal is to minimize the time and expense associated with product testing, while exposing fewer patients to clinical risk. The spirit of this approach can be replicated across a wide range of industries.

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Improving Product Design

By incorporating computational modeling into the product development program, manufacturers will gain access to new analysis techniques and metrics that not only make efforts more efficient but can lead to improved product designs. The ability to rapidly analyze a design allows for sensitivity studies or a complex virtual-test matrix to be developed to better characterize multiple features and variations that impact product performance. These factors might include geometry, material selection, and assembly processes. Additionally, computational modeling approaches introduce more informative metrics that are difficult or impractical to measure experimentally, such as stress concentrations, plastic strain, thermal distributions, and more.

Finally, by shifting to a more computationally focused approach, product developers can take advantage of probabilistic and uncertainty quantification tools to better understand risk and reliability. Other concepts that can be investigated from a computational perspective include damage and durability, tolerance stack up, multi-physics interactions, virtual data generation for artificial intelligence and machine-learning applications, experimental design to optimize critical data collection, and incorporation of emerging fabrication processes (e.g., additive manufacturing).

How Exponent Can Help

Exponent can help manufacturers develop, perform, and evaluate *in silico* testing for continued product development during periods of business disruption and beyond. Our team at Exponent frequently partners with organizations to develop and execute complex *in silico* testing and analyze, synthesize, and interpret the results in a way that is meaningful to both engineering and business decision-makers. Exponent can integrate with your teams, either in conjunction with or in lieu of in-house computational experts. Because our team includes polymer scientists, thermal scientists, biomedical experts, and electrical engineers, in addition to mechanics experts, our computational simulations are grounded in real-world, multi-disciplinary insights and can directly inform product development decisions.

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