The Shape of Things to Come

From its beginnings more than 30 years ago, additive manufacturing has come a long way, capturing the public's imagination and gaining growing interest from manufacturers. However, this technology still holds enormous unrealized potential — and simulation will play a critical role in delivering on that potential.

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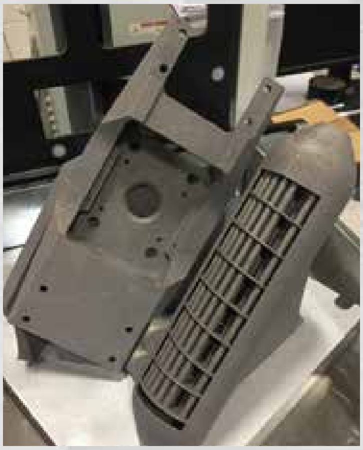

Photo courtesy Dr. Albert To, University of Pittsburgh

Twenty-five years ago, I was a Ph.D. student working on materials and production concepts for an emerging idea called additive manufacturing, or AM. Not one of my friends or family members understood what I was doing. Today, the term "3D printing" has entered our collective consciousness, and I no longer have to explain my job to anyone. Sales of metal 3D printers grew by 80 percent in 2017. The excitement around additive manufacturing is palpable.

But, while a few pioneering companies are leveraging the power of AM to mass-produce parts, for the most part, the potential of additive manufacturing remains unrealized.

There are a number of practical reasons for this. The equipment and materials can be cost-prohibitive for many companies. It can be frustratingly difficult to design products and define machine parameters for those just investing in AM technologies, and there is a shortage of professionals with AM experience. Printing mistakes are expensive, time-consuming and all too commonplace as companies struggle to get up to speed.

SIMULATION: MAKING THE VISION ACHIEVABLE

I believe engineering simulation holds the key to making 3D printing feasible, attainable and affordable for more and more companies. That's why I joined ANSYS.

Simulation significantly reduces the costly trial-and-error process that characterizes AM for so many businesses today. Instead of risking expensive powders, precious machine capacity and costly development hours on trial runs, companies can predict the results of their printing runs before the AM machine is turned on. They can identify areas of thermal or structural stress in the virtual world, and modify their designs to eliminate real-world shape distortion during printing. This is a game changer.

Via simulation, materials scientists can test their compositions and fine-tune them for not only real-world product usage, but also for the physical environment of 3D printing. Analysts can similarly predict the performance of their products, including geometric deformations, when subjected to production stresses and real-world operating environments.

After the design is handed off for manufacturing, product designers and machine operators can apply simulation to make adjustments that maximize printing results. Production surprises are minimized and risks are reduced — making the benefits of additive manufacturing much easier to achieve, profitably and reliably.

A CASE IN POINT: PARTS CONSOLIDATION

What exactly can simulation help accomplish? Consider the promise of parts consolidation. Many of the headlines around 3D printing have focused on the technology's ability to create a single, consolidated part, instead of 12 separate parts that are manufactured individually, then mechanically joined together.

Perhaps the most talked-about example is GE's revolutionary single-part nozzle for its jet engines — but today many businesses are exploring the idea of making single, highly complex shapes via additive manufacturing. Not only can parts consolidation save millions of dollars in production and materials costs, but it can also drastically improve product performance by reducing overall weight, eliminating vulnerable physical joints and avoiding system integration issues.

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Yet, for engineers, parts consolidation is a risky proposition. Single-part geometries are necessarily complex, typically including complicated topologies, intricate lattices for internal support and new microstructures within their materials compositions. They typically require a custom-engineered framework (support structures) to provide structural integrity during the actual printing process.

Engineering these parts, building support structures, subjecting them to the rigors of AM, then — if all goes well — conducting physical testing is a process characterized by high complexity and a high risk of failure at every stage. With simulation, parts consolidation shifts from an unachievable vision to a practical reality — because all these activities take place in a risk-free, cost-effective virtual design space.

ANSYS: DEMOCRATIZING ADDITIVE MANUFACTURING

Armed with simulation capabilities, more and more companies will be able to capture the enormous potential of additive manufacturing, including parts consolidation, in the near future.

Today, metal 3D printing is seen as the domain of a few select businesses, and human expertise is in high demand as companies fight for skilled people to lead their additive manufacturing efforts. With a complete portfolio of simulation solutions for AM, ANSYS is equipping people across the company to become experts in 3D printing — making this technology accessible to more companies and even smaller businesses.

From materials scientists and physics analysts to shop-floor machine operators, ANSYS is committed to democratizing AM simulation and making 3D printing accessible to just about every business. It's a concept we're strongly committed to, because we believe simulation will cover the last mile in the continuing journey to make additive manufacturing commonplace across companies and industries. As director of additive manufacturing at ANSYS, I have had the opportunity to take 25 years of experience in AM and bring it to the world on a global scale. I hope to empower future generations of designers, engineers and creators to take AM to the next level using simulation.