



Engineering Change Lab

Machine Learning, Artificial Intelligence, Generative Design
and the Impact on Engineering Practice

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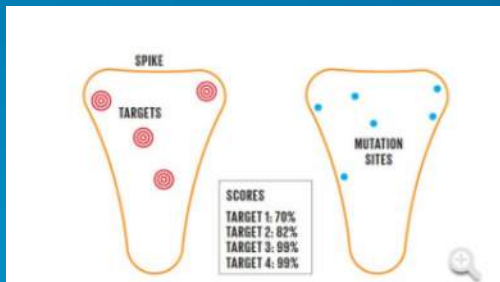
Distinguishing Terms

- Machine Learning
- Artificial Intelligence
- Generative Design

Possibly Surprising places ML/AI is used in engineering today

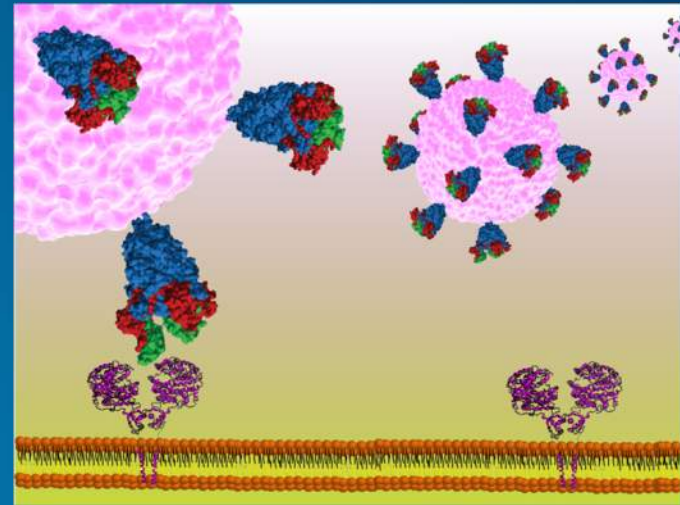
- **Civil—survey data collection, terrestrial scanning, aerial scanning, data extraction, construction process optimization**
- **Mechanical—CNC optimization, sustainable concrete manufacture, structure and support optimization and simulation**
- **Chemical—”generative” chemical design**

Vaccine Development and Analysis



AI Assistance

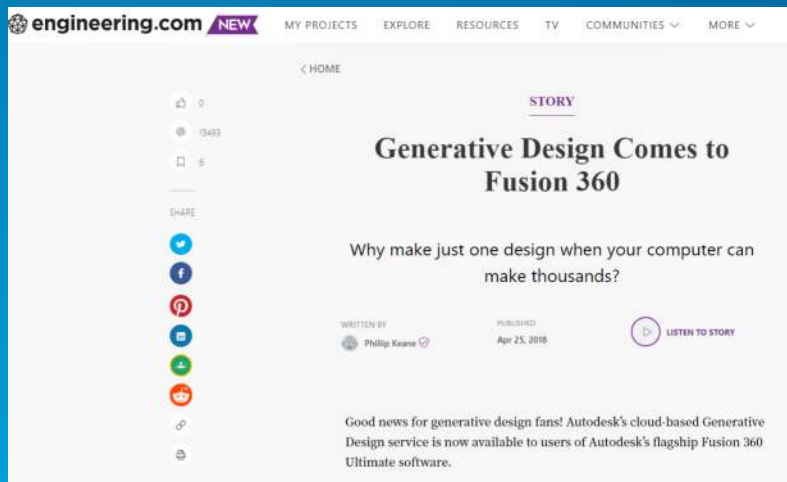
One role for AI in vaccine design is to study the proteins that make up the virus, which include the spike protein. By examining its complex structure, an AI system can sort through thousands of components to identify those that are most likely to trigger a robust immune response. What's more, viruses are always mutating. AI systems need to identify components that are unlikely to mutate, to ensure that a vaccine will remain effective over time.



“Simulations are especially important because to design a new drug, it’s crucial to have dynamic 3D visualizations of protein structures and behavior rather than a static picture.”

<https://spectrum.ieee.org/artificial-intelligence/medical-ai/what-ai-can-and-cant-do-in-the-race-for-a-coronavirus-vaccine>
<https://covid19-hpc-consortium.org/blog/sars-coronavirus-one-and-two-s-resemblance-conceals-very-different-behavioral-patterns>

Autodesk Fusion 360 Examples



Autodesk Within Medical allows variable porosity and fine lattices to be generated based on the designer's requirements. This skull implant is optimized for weight and for compatibility with existing bone structure. (Image courtesy of Autodesk.)

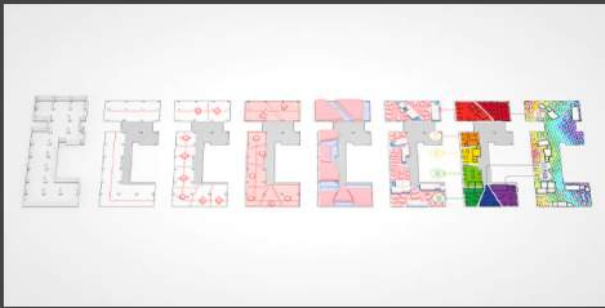
Images courtesy of Autodesk, engineering.com

Impact on Manufacturing and Construction

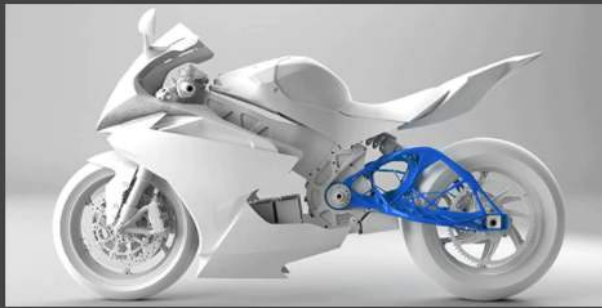


<https://www.fastcompany.com/3047350/this-robot-can-3-d-print-a-steel-bridge-in-mid-air#1>

Possibilities



Explore a wider range of design options



Make impossible designs possible
Generative design lets you create optimized

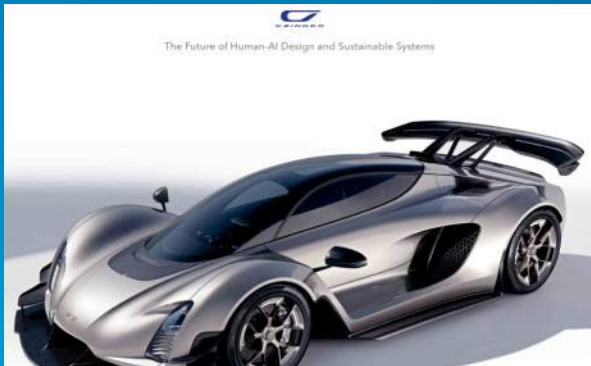


Optimize for materials and manufacturing methods

Generative Design



Automotive



“Price parity of printed vs cast aluminum”

Goodbye, Henry Ford ...

<https://www.youtube.com/watch?v=OCto6qSjIXw>

ML/AI/GD Value Chain for Engineering

Inexpensive
Cloud Storage

Massively Parallel
Cloud Computation

ML/AI Modeling
Services

Cloud-Hosted Apps

“Multi-Cloud”



Your Branded Service?



Your engineers



Your customers?

This is an industrial revolution with significant economic and social consequences

<https://blogs.oracle.com/cloud-infrastructure/living-with-multicloud-a-foundation-architecture-framework>
engineer icons png from pngtree.com

What Does ML/AI/GD Mean for Engineering?

Yesterday and Today



A team of engineers and contractors works with a customer to design and build a bridge with the help of computers

Near Future



A team of engineers, cloud services, “intelligent machines”, and contractors works with a customer to design and build a bridge

Assertions and Questions

- This changes but does not eliminate the role of the engineer
 - Who will consult, define, and *test* the results
- Engineers will increasingly be attracted to and required to learn these techniques
- How will fundamental engineering processes adapt?
 - Liability, certification, licensing, billing, ...
 - Are cloud computation cost expensed or built into rates?
 - Do customers subscribe to them?
- What will be your unique approach to this?
- How will you compete with offshore ML/AI labs?
- There are ethical and economic policy concerns here
 - What's the future of labor in manufacturing and construction?
 - What are the opportunities for sustainability?



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THE
SCIENCE
OF
WHERE