Forum TERATEC 24

Unlock the future

AI, Gen AI and the Metaverse: A New Era of Possibilities and Challenges.

Valerio Rizzo, PhD | Lenovo EMEA Head of AI & Metaverse SME

Lenovo | NVIDIA

About Me

Valerio Rizzo, PhD

| EMEA HEAD of AI & Metaverse SME
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Technology

- Machine Learning/Deep Learning Hardware and Software Infrastructure
- Digital Twin / Metaverse Hardware and Software
- AI Vertical and Horizontal use case applications

Location

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Professional and Educational Background

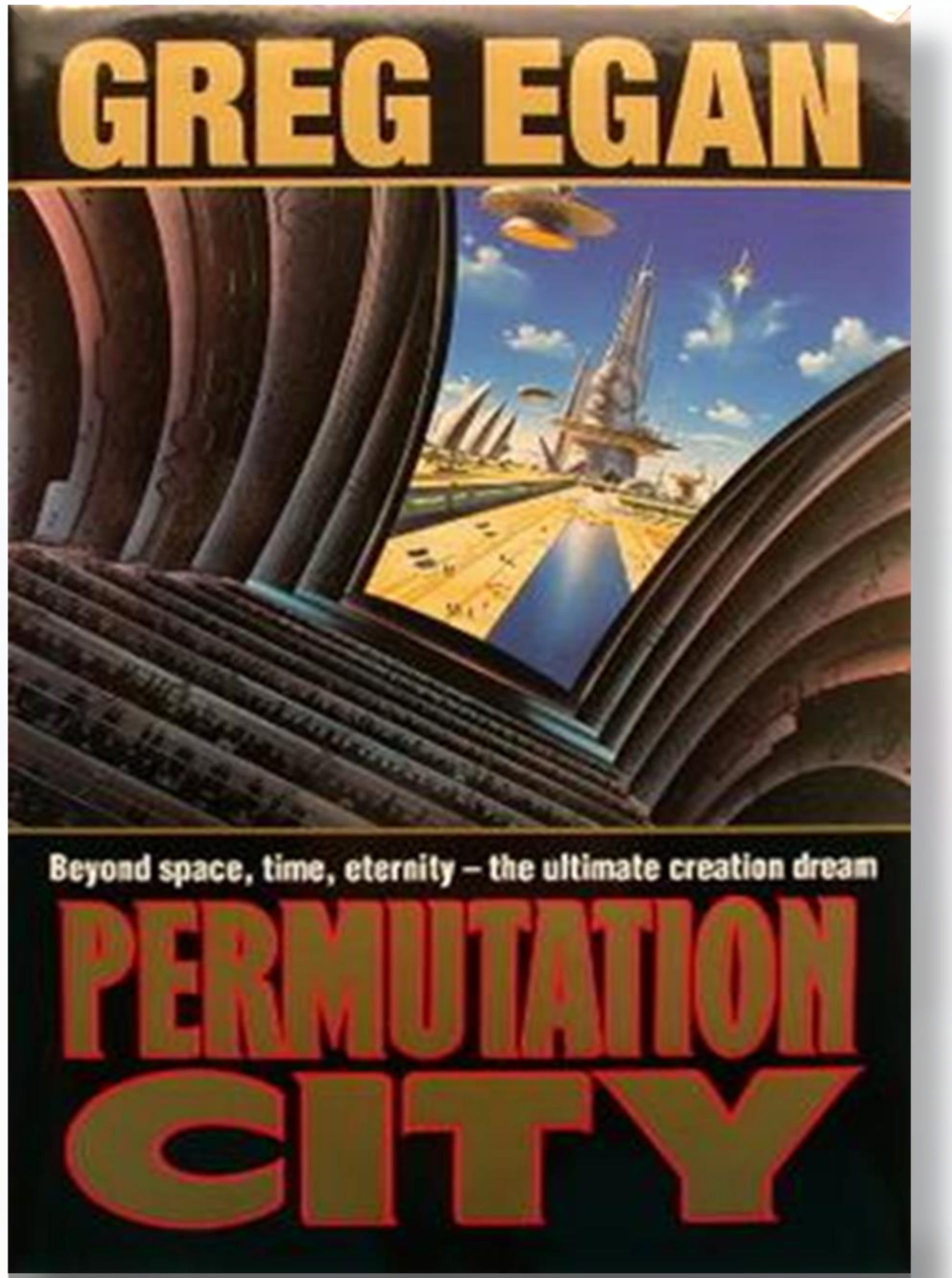
- PhD in Neuroscience and Neurophysiology
- Researcher, Lecturer, Reviewer and Associate Editor in neuroscience and neurophysiology
- Extensive professional experience in Immersive technology applied to pre-clinical research and M&E

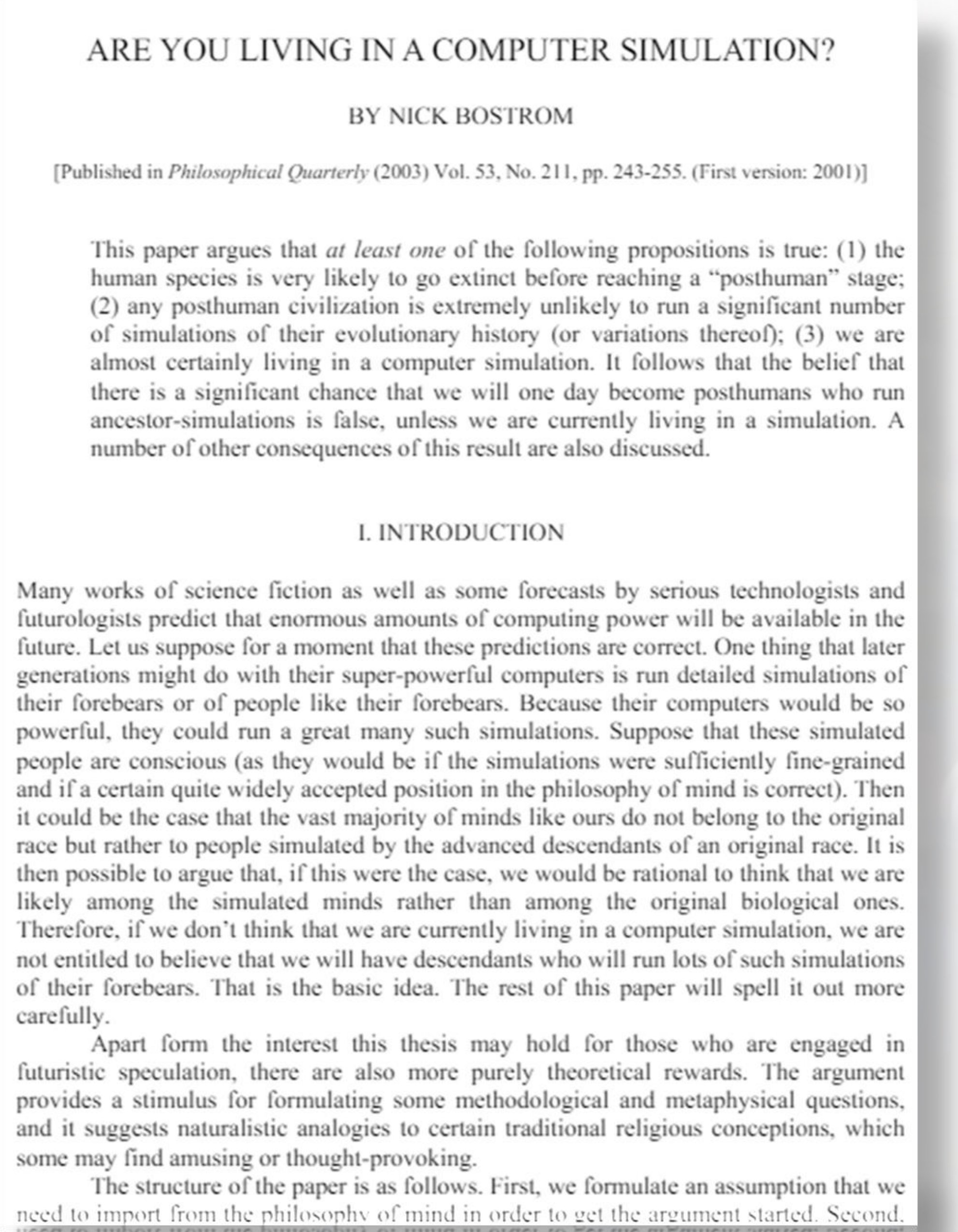
Passion

- Climbing, Boxing, Trekking, Yoga Nidra
- Avid Book Reader and Movie Watcher
- Photogrammetry, VR Game Dev, Coding
- VR Game Player

Unlock the future

From Fiction to Science





ARE YOU LIVING IN A COMPUTER SIMULATION?

BY NICK BOSTROM

[Published in *Philosophical Quarterly* (2003) Vol. 53, No. 211, pp. 243-255. (First version: 2001)]

This paper argues that *at least one* of the following propositions is true: (1) the human species is very likely to go extinct before reaching a "posthuman" stage; (2) any posthuman civilization is extremely unlikely to run a significant number of simulations of their evolutionary history (or variations thereof); (3) we are almost certainly living in a computer simulation. It follows that the belief that there is a significant chance that we will one day become posthumans who run ancestor-simulations is false, unless we are currently living in a simulation. A number of other consequences of this result are also discussed.

I. INTRODUCTION

Many works of science fiction as well as some forecasts by serious technologists and futurologists predict that enormous amounts of computing power will be available in the future. Let us suppose for a moment that these predictions are correct. One thing that later generations might do with their super-powerful computers is run detailed simulations of their forebears or of people like their forebears. Because their computers would be so powerful, they could run a great many such simulations. Suppose that these simulated people are conscious (as they would be if the simulations were sufficiently fine-grained and if a certain quite widely accepted position in the philosophy of mind is correct). Then it could be the case that the vast majority of minds like ours do not belong to the original race but rather to people simulated by the advanced descendants of an original race. It is then possible to argue that, if this were the case, we would be rational to think that we are likely among the simulated minds rather than among the original biological ones. Therefore, if we don't think that we are currently living in a computer simulation, we are not entitled to believe that we will have descendants who will run lots of such simulations of their forebears. That is the basic idea. The rest of this paper will spell it out more carefully.

Apart form the interest this thesis may hold for those who are engaged in futuristic speculation, there are also more purely theoretical rewards. The argument provides a stimulus for formulating some methodological and metaphysical questions, and it suggests naturalistic analogies to certain traditional religious conceptions, which some may find amusing or thought-provoking.

The structure of the paper is as follows. First, we formulate an assumption that we need to import from the philosophy of mind in order to get the argument started. Second,

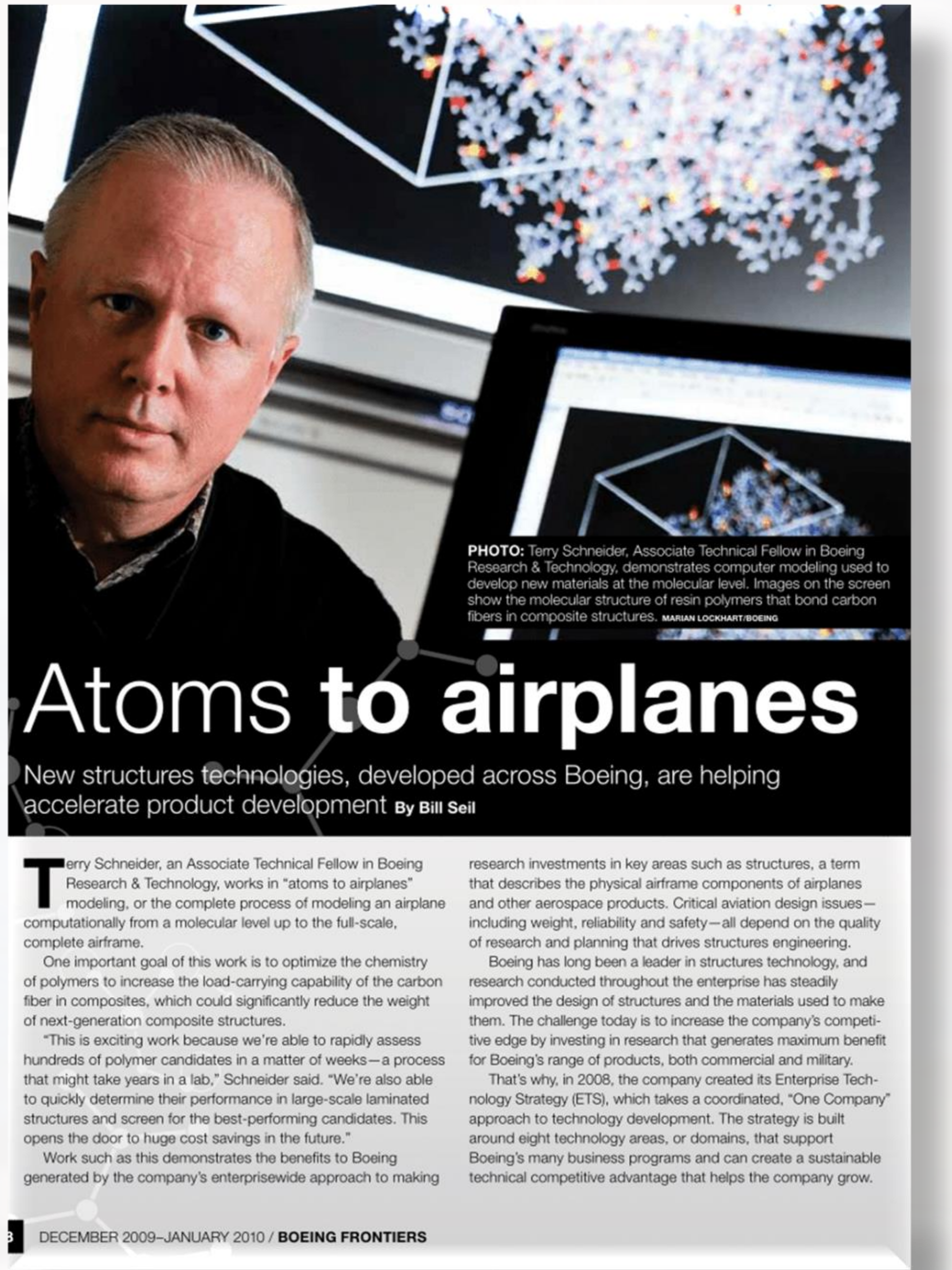


PHOTO: Terry Schneider, Associate Technical Fellow in Boeing Research & Technology, demonstrates computer modeling used to develop new materials at the molecular level. Images on the screen show the molecular structure of resin polymers that bond carbon fibers in composite structures. MARIAN LOCKHART/BOEING

Atoms **to airplanes**

New structures technologies, developed across Boeing, are helping accelerate product development **By Bill Seil**

Terry Schneider, an Associate Technical Fellow in Boeing Research & Technology, works in "atoms to airplanes" modeling, or the complete process of modeling an airplane computationally from a molecular level up to the full-scale, complete airframe.

One important goal of this work is to optimize the chemistry of polymers to increase the load-carrying capability of the carbon fiber in composites, which could significantly reduce the weight of next-generation composite structures.

"This is exciting work because we're able to rapidly assess hundreds of polymer candidates in a matter of weeks—a process that might take years in a lab," Schneider said. "We're also able to quickly determine their performance in large-scale laminated structures and screen for the best-performing candidates. This opens the door to huge cost savings in the future."

Work such as this demonstrates the benefits to Boeing generated by the company's enterprisewide approach to making research investments in key areas such as structures, a term that describes the physical airframe components of airplanes and other aerospace products. Critical aviation design issues—including weight, reliability and safety—all depend on the quality of research and planning that drives structures engineering.

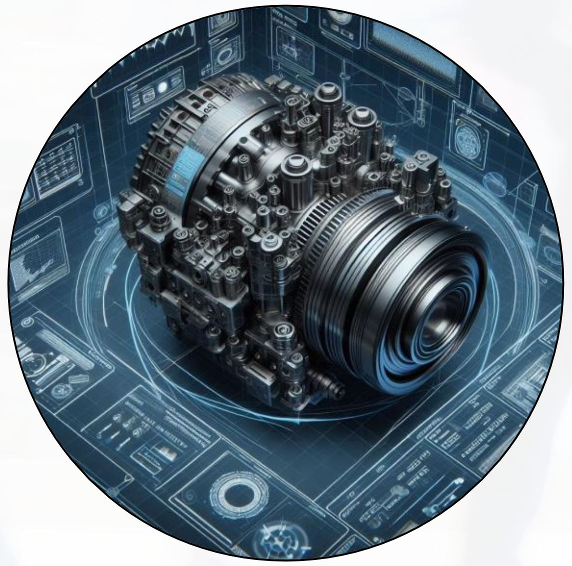
Boeing has long been a leader in structures technology, and research conducted throughout the enterprise has steadily improved the design of structures and the materials used to make them. The challenge today is to increase the company's competitive edge by investing in research that generates maximum benefit for Boeing's range of products, both commercial and military.

That's why, in 2008, the company created its Enterprise Technology Strategy (ETS), which takes a coordinated, "One Company" approach to technology development. The strategy is built around eight technology areas, or domains, that support Boeing's many business programs and can create a sustainable technical competitive advantage that helps the company grow.

8 DECEMBER 2009–JANUARY 2010 / **BOEING FRONTIERS**

From Digital Twin to Industrial Metaverse

Digital Twin



Immersive DT

Whole-System DT

Industrial Metaverse

> ***Connected whole-system digital twin with functionalities to interact with the real system in its environment, allowing decision makers to better understand the past and forecast the future.”***
>
> *Arthur D. Little*

SIEMENS

A virtual world in which we can **interact in real time with photorealistic, physics-based digital twins** of our real world. We believe **digital twins** are **the building blocks for the Metaverse.**

NVIDIA

Industrial Metaverse enables industrial companies of all sizes to create **closed-loop digital twins with real-time performance data, ideal for running simulations** and AI-accelerated processes for advanced applications such as **autonomous factories that rely on intelligent sensors and connected devices.**

IndustrialMetaverse.org

A real-time, persistent simulation space that is the **sum of all virtual worlds, digital twins, and augmented reality** that **connects digital economic assets and infrastructure** on a global scale in the **industrial and commercial setting.**

Microsoft

Industrial Metaverse enables **humans and AI to work together to design, build, operate, and optimize physical systems** using digital technologies.

sme

A **systematic discipline that combines hardware** [...] **data conversions** through analytics/machine learning, **time histories** through cyber-infrastructure, **cognition** through human-machine interface**, and configuration** through the Metaverse.

COSMOTECH

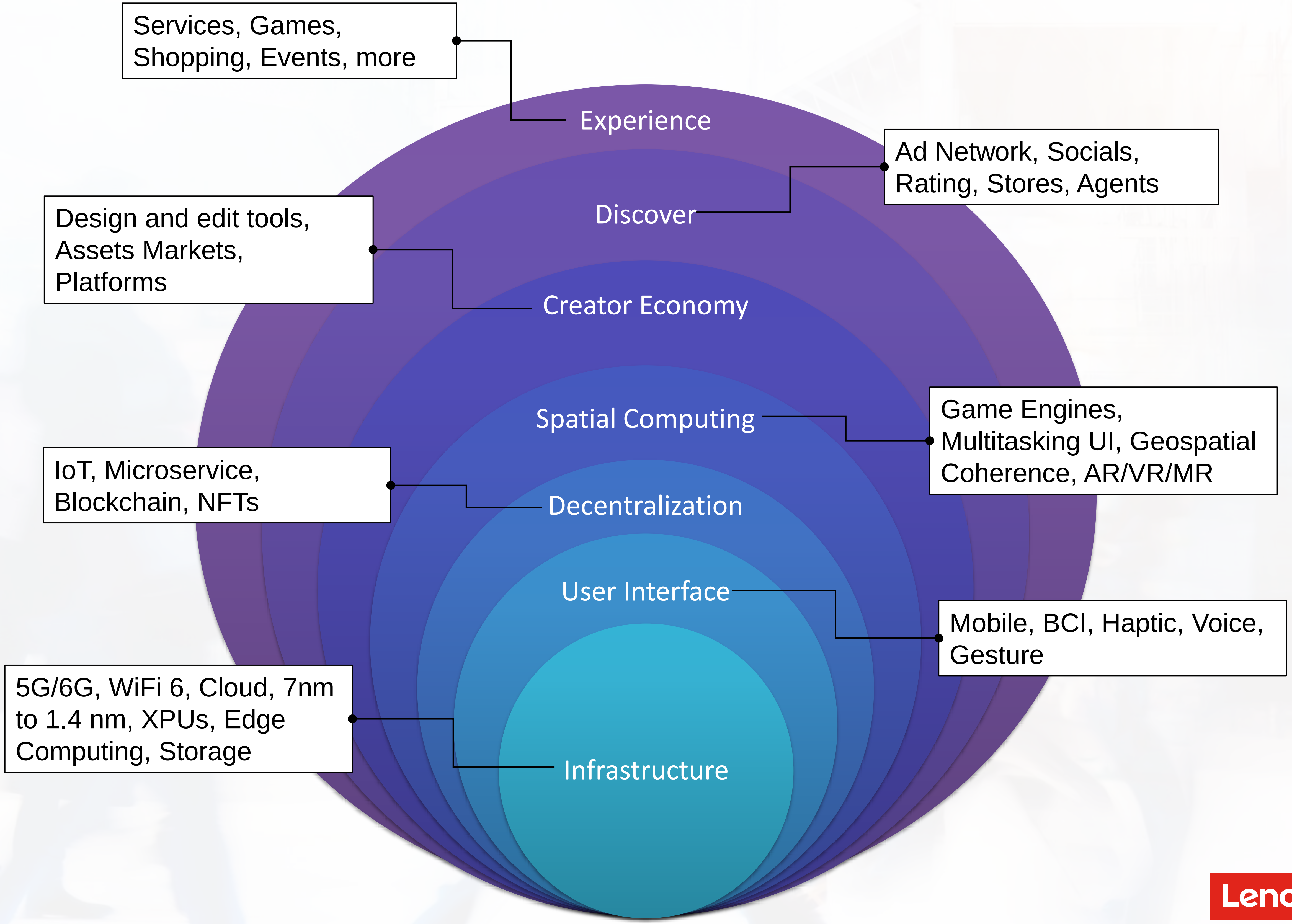
The Industrial Metaverse enables the creation of **digital twins of places, processes, real-world objects, and the humans** who interact with them.

Source: Arthur D. Little

> ***“A massively scaled and interoperable network of real-time rendered 3d virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence and with continuity of data, such as identity, history, entitlements, objects , communications and payments ”***

Matthew Ball, The Metaverse

Anatomy of the Metaverse



Services, Games, Shopping, Events, more

Experience

Ad Network, Socials, Rating, Stores, Agents

Discover

Design and edit tools, Assets Markets, Platforms

Creator Economy

Spatial Computing

Game Engines, Multitasking UI, Geospatial Coherence, AR/VR/MR

IoT, Microservice, Blockchain, NFTs

Decentralization

User Interface

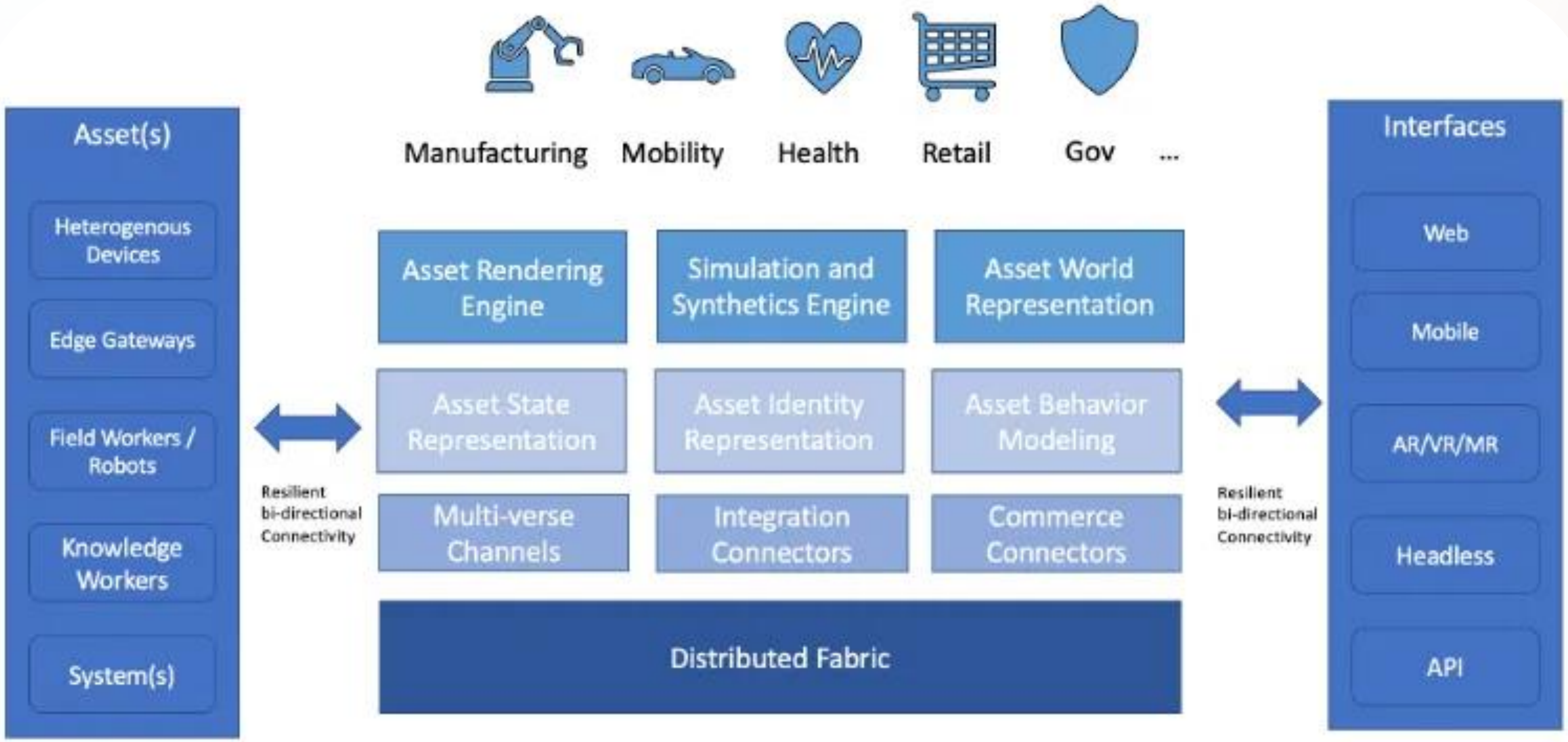
Mobile, BCI, Haptic, Voice, Gesture

5G/6G, WiFi 6, Cloud, 7nm to 1.4 nm, XPUs, Edge Computing, Storage

Infrastructure

Thien Huynh-The et al. "Artificial Intelligence for the Metaverse: A Survey" arXiv:2202.10336v1 [cs.CY] 15 Feb 2022

Metaverse System Model



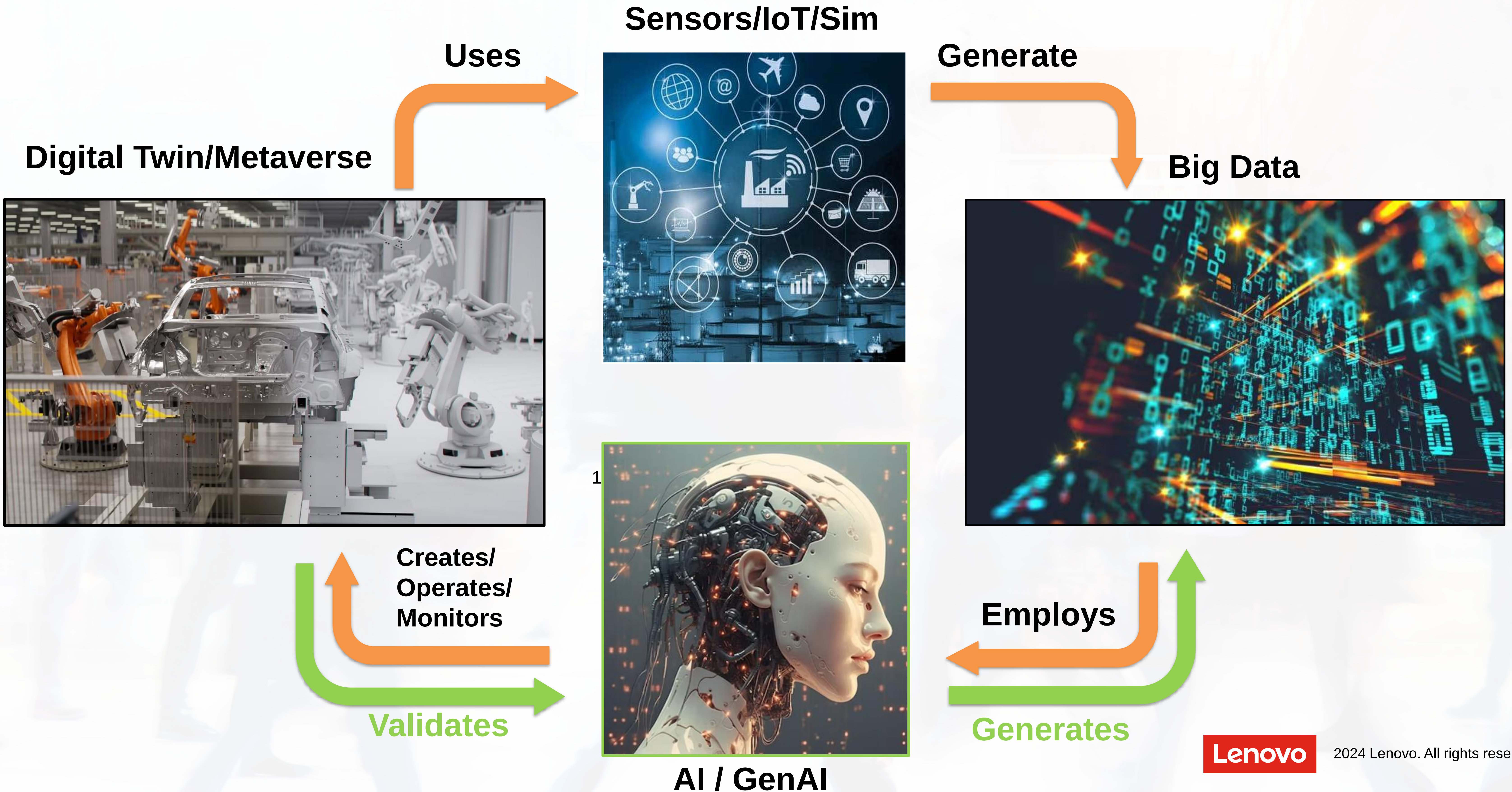
Forum TERATEC

> *The natural habitat of AI is in the virtual world.”*

Dr. Michael Grieves

- Intelligent digital twins and the development and management of complex systems -

The Intertwined Nature of Metaverse and AI



Sensors/IoT/Sim

Uses

Generate

Digital Twin/Metaverse

Big Data

Creates/
Operates/
Monitors

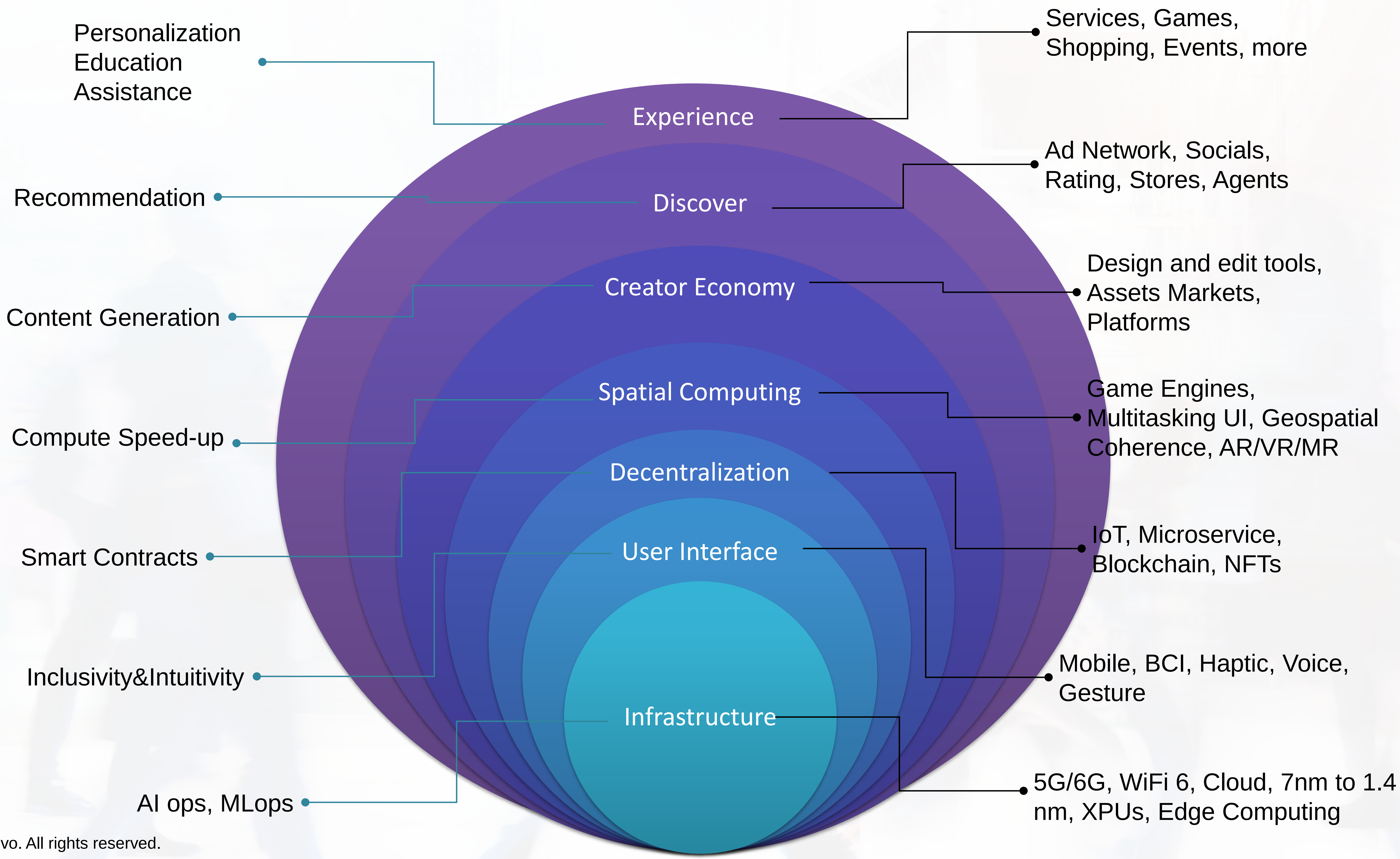
Employs

Validates

Generates

AI / GenAI

AI value for the Metaverse



Personalization Education Assistance	Experience	Services, Games, Shopping, Events, more
Recommendation	Discover	Ad Network, Socials, Rating, Stores, Agents
Content Generation	Creator Economy	Design and edit tools, Assets Markets, Platforms
Compute Speed-up	Spatial Computing	Game Engines, Multitasking UI, Geospatial Coherence, AR/VR/MR
Smart Contracts	Decentralization	IoT, Microservice, Blockchain, NFTs
Inclusivity&Intuitivity	User Interface	Mobile, BCI, Haptic, Voice, Gesture
AI ops, MLops	Infrastructure	5G/6G, WiFi 6, Cloud, 7nm to 1.4 nm, XPUs, Edge Computing

Thien Huynh-The et al. “Artificial Intelligence for the Metaverse: A Survey” arXiv:2202.10336v1 [cs.CY] 15 Feb 2022

How Today’s AI is Shaping Tomorrow’s Possibilities

3D Modeling & Visualization

Decentralized Computing

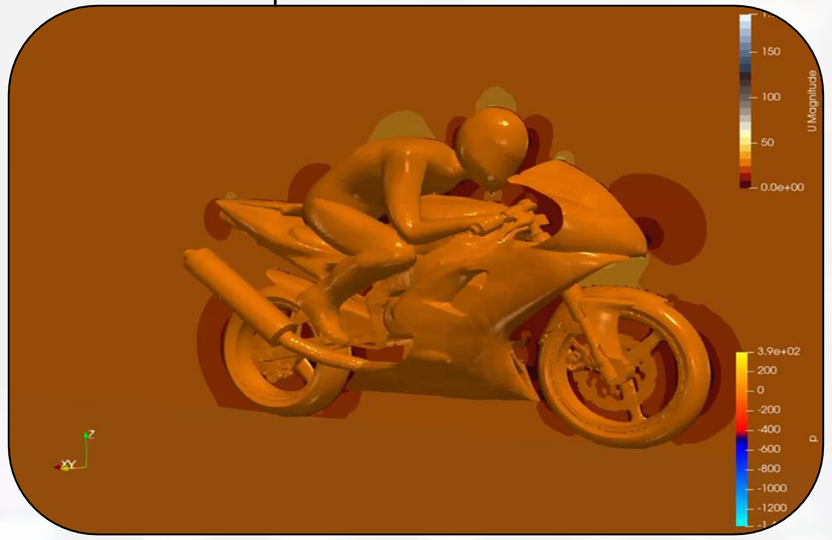
Network Optimization

Confidential AI Solutions

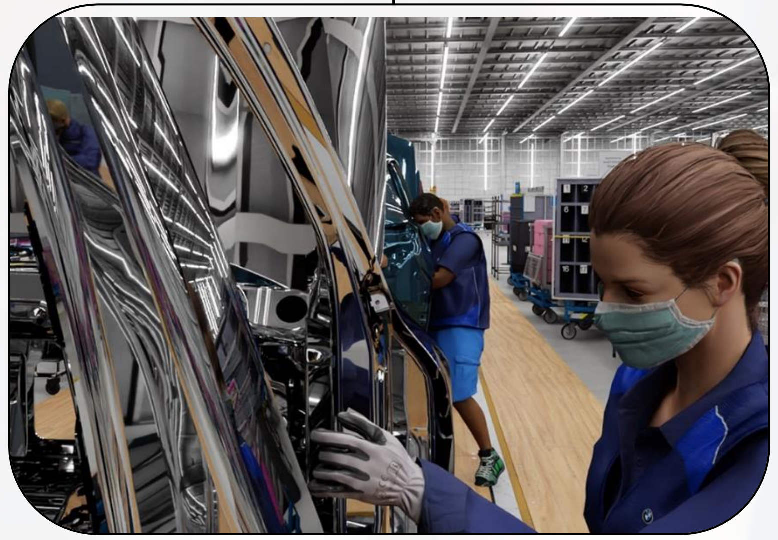
INDUSTRIAL METAVERSE

Spatial Computing

Human-Machine Interactivity



Physically Accurate Simulations



Realistic Interactive Virtual Entities

How Today’s AI is Shaping Tomorrow’s Possibilities

3D Modeling & Visualization

Decentralized Computing

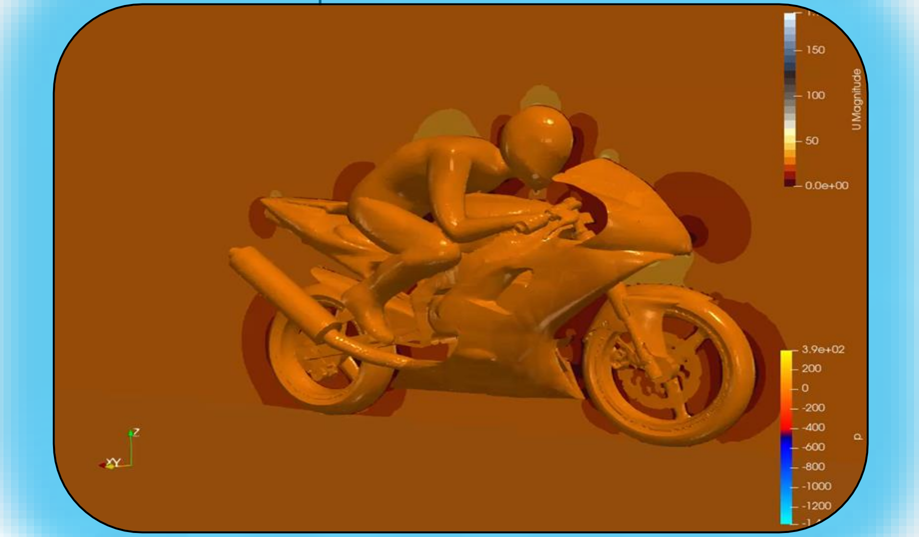
Network Optimization

Confidential AI Solutions

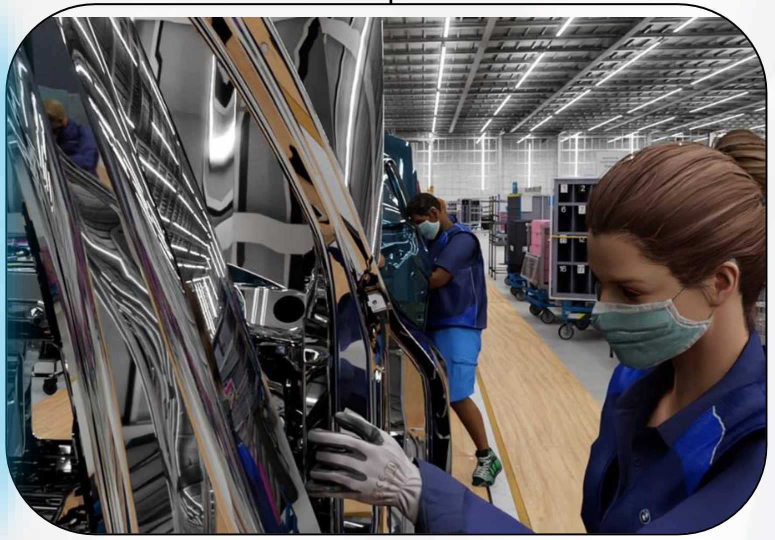
INDUSTRIAL METAVERSE

Spatial Computing

Human-Machine Interactivity



Physically Accurate Simulations



Realistic Interactive Virtual Entities

Advances in Neural Rendering and Mesh Generation

PixelNeRF
(2021)

arXiv:2012.02190v3 [cs.CV] 30 May 2021

pixelNeRF: Neural Radiance Fields from One or Few Images

Alex Yu Vickie Ye Matthew Tancik Angjoo Kanazawa
UC Berkeley

Figure 1: **NeRF from one or few images.** We present pixelNeRF, a learning framework that predicts a Neural Radiance Field (NeRF) representation from a single (top) or few posed images (bottom). PixelNeRF can be trained on a set of multi-view images, allowing it to generate plausible novel view synthesis from very few input images without test-time optimization (bottom left). In contrast, NeRF has no generalization capabilities and performs poorly when only three input views are available (bottom right).

Abstract

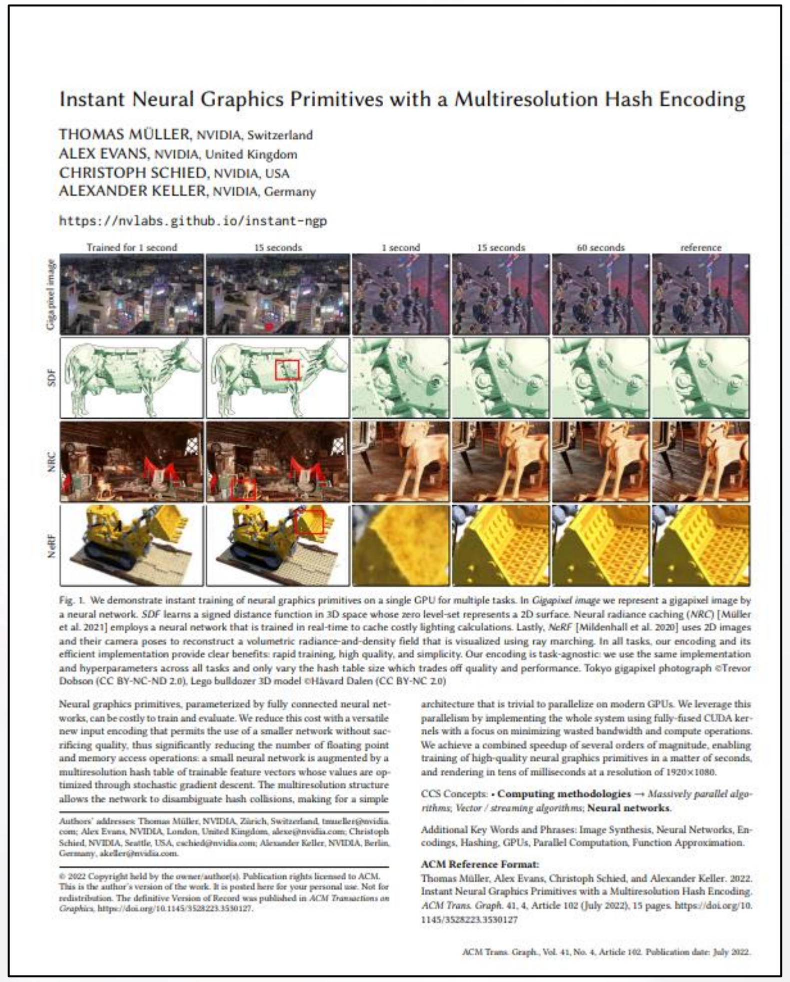
We propose pixelNeRF, a learning framework that predicts a continuous neural scene representation conditioned on one or few input images. The existing approach for constructing neural radiance fields [27] involves optimizing the representation to every scene independently, requiring many calibrated views and significant compute time. We take a step towards resolving these shortcomings by introducing an architecture that conditions a NeRF on image inputs in a fully convolutional manner. This allows the network to be trained across multiple scenes to learn a scene prior, enabling it to perform novel view synthesis in a feed-forward manner from a sparse set of views (as few as one). Leveraging the volume rendering approach of NeRF, our model can be trained directly from images with no explicit 3D supervision. We conduct extensive experiments on ShapeNet benchmarks for single image novel view synthesis tasks with held-out objects as well as entire unseen categories. We further demonstrate the flexibility of pixelNeRF by demonstrating it on multi-object ShapeNet scenes and real scenes from the DTU dataset. In all cases, pixelNeRF outperforms current state-of-the-art baselines for novel view synthesis and single image 3D reconstruction. For the video and code, please visit the project website: https://alexyu.net/pixelnerf.

1. Introduction

We study the problem of synthesizing novel views of a scene from a sparse set of input views. This long-standing problem has recently seen progress due to advances in differentiable neural rendering [27, 20, 24, 40]. Across these approaches, a 3D scene is represented with a neural network, which can then be rendered into 2D views. Notably, the recent method neural radiance fields (NeRF) [27] has shown impressive performance on novel view synthesis of a specific scene by implicitly encoding volumetric density and color through a neural network. While NeRF can render photorealistic novel views, it is often impractical as it requires a large number of posed images and a lengthy per-scene optimization.

In this paper, we address these shortcomings by proposing pixelNeRF, a learning framework that enables predicting NeRFs from one or several images in a feed-forward manner. Unlike the original NeRF network, which does not make use of any image features, pixelNeRF takes spatial image features aligned to each pixel as an input. This image conditioning allows the framework to be trained on a set of multi-view images, where it can learn scene priors to perform view synthesis from one or few input views. In contrast, NeRF is unable to generalize and performs poorly when few input images are available, as shown in Fig. 1.

Instant Ngp
(2022)



Instant Neural Graphics Primitives with a Multiresolution Hash Encoding

THOMAS MÜLLER, NVIDIA, Switzerland
ALEX EVANS, NVIDIA, United Kingdom
CHRISTOPH SCHIED, NVIDIA, USA
ALEXANDER KELLER, NVIDIA, Germany

https://nvlabs.github.io/instant-ngp

Fig. 1. We demonstrate instant training of neural graphics primitives on a single GPU for multiple tasks. In *Gigapixel image* we represent a gigapixel image by a neural network. *SDF* learns a signed distance function in 3D space whose zero level-set represents a 2D surface. Neural radiance caching (*NRC*) [Müller et al. 2021] employs a neural network that is trained in real-time to cache costly lighting calculations. Lastly, *NeRF* [Mildenhall et al. 2020] uses 2D images and their camera poses to reconstruct a volumetric radiance-and-density field that is visualized using ray marching. In all tasks, our encoding and its efficient implementation provide clear benefits: rapid training, high quality, and simplicity. Our encoding is task-agnostic: we use the same implementation and hyperparameters across all tasks and only vary the hash table size which trades off quality and performance. Tokyo gigapixel photograph ©Trevor Dobson (CC BY-NC-ND 2.0), Lego bulldozer 3D model ©Håvard Dalen (CC BY-NC 2.0)

Neural graphics primitives, parameterized by fully connected neural networks, can be costly to train and evaluate. We reduce this cost with a versatile new input encoding that permits the use of a smaller network without sacrificing quality, thus significantly reducing the number of floating point and memory access operations: a small neural network is augmented by a multiresolution hash table of trainable feature vectors whose values are optimized through stochastic gradient descent. The multiresolution structure allows the network to disambiguate hash collisions, making for a simple architecture that is trivial to parallelize on modern GPUs. We leverage this parallelism by implementing the whole system using fully-fused CUDA kernels with a focus on minimizing wasted bandwidth and compute operations. We achieve a combined speedup of several orders of magnitude, enabling training of high-quality neural graphics primitives in a matter of seconds, and rendering in tens of milliseconds at a resolution of 1920×1080.

CCS Concepts: • **Computing methodologies** → *Massively parallel algorithms; Vector / streaming algorithms;* **Neural networks**.

Additional Key Words and Phrases: Image Synthesis, Neural Networks, Encodings, Hashing, GPUs, Parallel Computation, Function Approximation.

ACM Reference Format:
Thomas Müller, Alex Evans, Christoph Schied, and Alexander Keller. 2022. Instant Neural Graphics Primitives with a Multiresolution Hash Encoding. *ACM Trans. Graph.* 41, 4, Article 102 (July 2022), 15 pages. https://doi.org/10.1145/3528223.3530127

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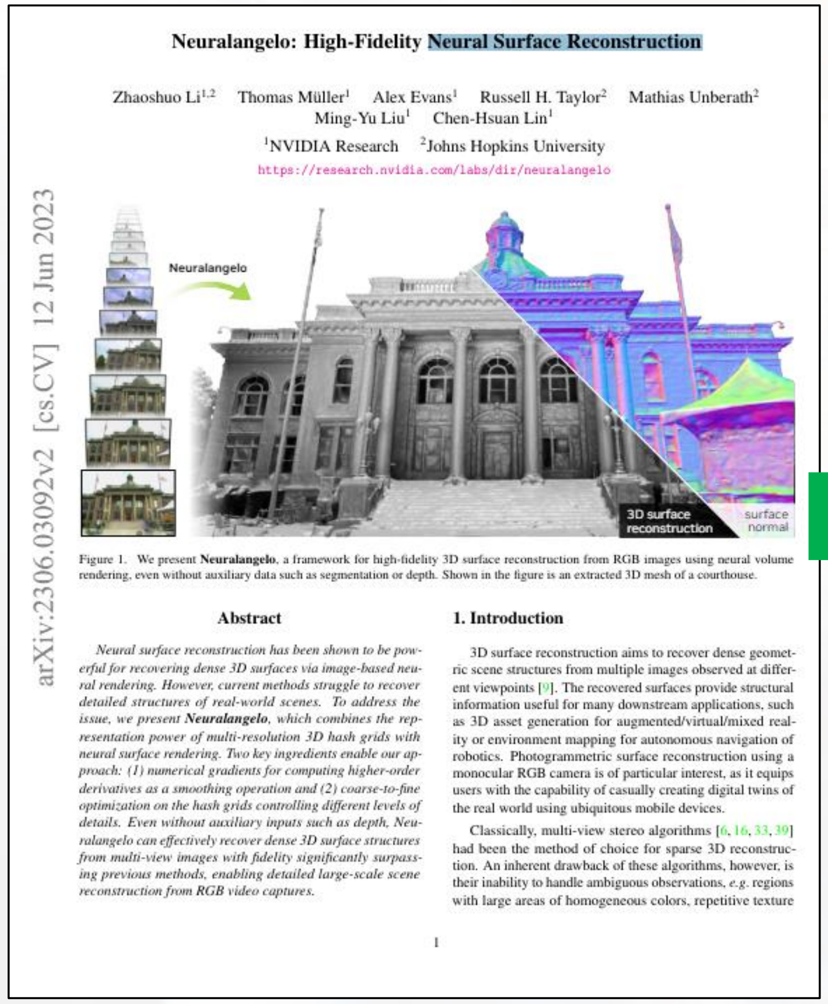
ACM Trans. Graph., Vol. 41, No. 4, Article 102. Publication date: July 2022.

Neuralangelo
(2023)



arXiv:2306.03092v2 [cs.CV] 12 Jun 2023

Neuralangelo: High-Fidelity Neural Surface Reconstruction

Zhaoshuo Li[1,2] Thomas Müller[1] Alex Evans[1] Russell H. Taylor[2] Mathias Unberath[2]
Ming-Yu Liu[1] Chen-Hsuan Lin[1]
[1]NVIDIA Research [2]Johns Hopkins University
https://research.nvidia.com/labs/dir/neuralangelo

Figure 1. We present **Neuralangelo**, a framework for high-fidelity 3D surface reconstruction from RGB images using neural volume rendering, even without auxiliary data such as segmentation or depth. Shown in the figure is an extracted 3D mesh of a courthouse.

Abstract

Neural surface reconstruction has been shown to be powerful for recovering dense 3D surfaces via image-based neural rendering. However, current methods struggle to recover detailed structures of real-world scenes. To address the issue, we present **Neuralangelo**, *which combines the representation power of multi-resolution 3D hash grids with neural surface rendering. Two key ingredients enable our approach: (1) numerical gradients for computing higher-order derivatives as a smoothing operation and (2) coarse-to-fine optimization on the hash grids controlling different levels of details. Even without auxiliary inputs such as depth, Neuralangelo can effectively recover dense 3D surface structures from multi-view images with fidelity significantly surpassing previous methods, enabling detailed large-scale scene reconstruction from RGB video captures.*

1. Introduction

3D surface reconstruction aims to recover dense geometric scene structures from multiple images observed at different viewpoints [9]. The recovered surfaces provide structural information useful for many downstream applications, such as 3D asset generation for augmented/virtual/mixed reality or environment mapping for autonomous navigation of robotics. Photogrammetric surface reconstruction using a monocular RGB camera is of particular interest, as it equips users with the capability of casually creating digital twins of the real world using ubiquitous mobile devices.

Classically, multi-view stereo algorithms [6, 16, 33, 39] had been the method of choice for sparse 3D reconstruction. An inherent drawback of these algorithms, however, is their inability to handle ambiguous observations, *e.g.* regions with large areas of homogeneous colors, repetitive texture

1

Magic3D
(2023)

Magic3D: High-Resolution Text-to-3D Content Creation

Chen-Hsuan Lin* Jun Gao* Luming Tang* Towaki Takikawa* Xiaohui Zeng*
Xun Huang Karsten Kreis Sanja Fidler† Ming-Yu Liu† Tsung-Yi Lin
NVIDIA Corporation
https://research.nvidia.com/labs/dir/magic3d

Abstract

DreamFusion [33] has recently demonstrated the utility of a pre-trained text-to-image diffusion model to optimize Neural Radiance Fields (NeRF) [25], achieving remarkable text-to-3D synthesis results. However, the method has two inherent limitations: (a) extremely slow optimization of NeRF and (b) low-resolution image space supervision on NeRF, leading to low-quality 3D models with a long processing time. In this paper, we address these limitations by utilizing a two-stage optimization framework. First, we obtain a coarse model using a low-resolution diffusion prior and accelerate with a sparse 3D hash grid structure. Using the coarse representation as the initialization, we further optimize a textured 3D mesh model with an efficient differentiable renderer interacting with a high-resolution latent diffusion model. Our method, dubbed Magic3D, can create high quality 3D mesh models in 40 minutes, which is 2× faster than DreamFusion (reportedly taking 1.5 hours on average), while also achieving higher resolution. User studies show 61.7% raters to prefer our approach over DreamFusion. Together with the image-conditioned generation capabilities, we provide users with new ways to control 3D synthesis, opening up new avenues to various creative applications.

1. Introduction

3D digital content has been in high demand for a variety of applications, including gaming, entertainment, architecture, and robotics simulation. It is slowly finding its way into virtually every possible domain: retail, online conferencing, virtual social presence, education, *etc.* However, creating professional 3D content is not for anyone — it requires immense artistic and aesthetic training with 3D modeling expertise. Developing these skill sets takes a significant amount of time and effort. Augmenting 3D content creation with natural language could considerably help democratize 3D content creation for novices and turbocharge expert artists.

Image content creation from text prompts [2, 30, 35, 38] has seen significant progress with the advances of diffusion models [13, 43, 44] for generative modeling of images. The key enablers are large-scale datasets comprising billions of samples (images with text) scrapped from the Internet and massive amounts of compute. In contrast, 3D content generation has progressed at a much slower pace. Existing 3D object generation models [4, 9, 49] are mostly categorical. A trained model can only be used to synthesize objects for a single class, with early signs of scaling to multiple classes shown recently by Zeng *et al.* [49]. Therefore, what a user can do with these models is extremely limited and not yet ready for artistic creation. This limitation is largely due to the lack of diverse large-scale 3D datasets — compared to image and video content, 3D content is much less accessible on the Internet. This naturally raises the question of whether 3D generation capability can be achieved by leveraging powerful text-to-image generative models.

Recently, DreamFusion [33] demonstrated its remarkable ability for text-conditioned 3D content generation by utilizing a pre-trained text-to-image diffusion model [38] that generates images as a strong image prior. The diffusion model acts as a critic to optimize the underlying 3D representation. The optimization process ensures that rendered images from a 3D model, represented by Neural Radiance Fields (NeRF) [25], match the distribution of photorealistic images across different viewpoints, given the input text prompt. Since the supervision signal in DreamFusion operates on very low-resolution images (64 × 64), DreamFusion cannot synthesize high-frequency 3D geometric and texture details. Due to the use of inefficient MLP architectures for the NeRF representation, practical high-resolution synthesis may not even be possible as the required memory footprint and the computation budget grows quickly with the resolution. Even at a resolution of 64 × 64, optimization times are in hours (1.5 hours per prompt on average using TPUv4).

In this paper, we present a method that can synthesize highly detailed 3D models from text prompts within a reduced computation time. Specifically, we propose a coarse-

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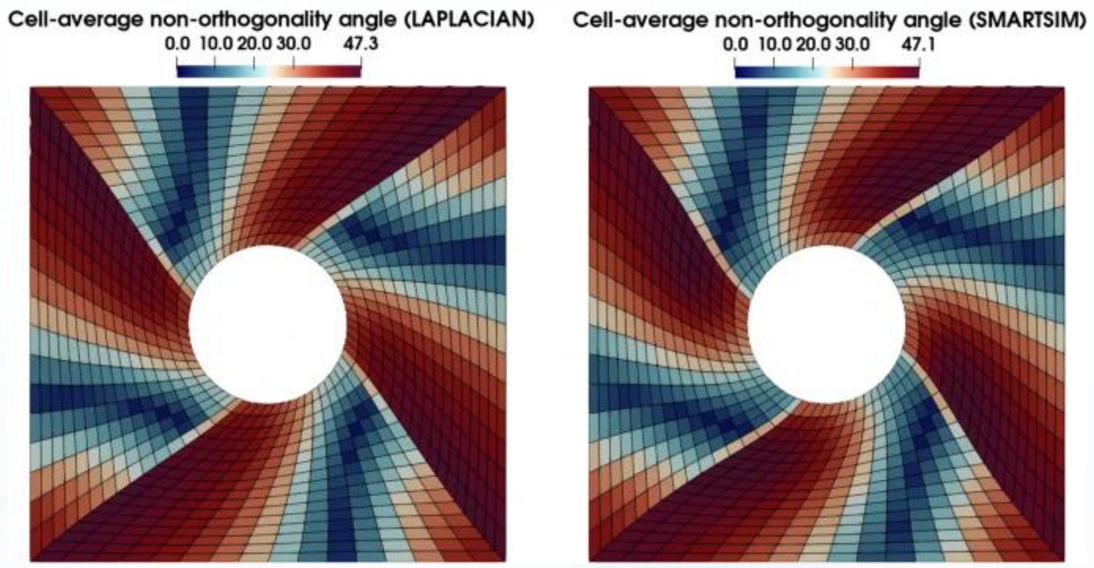
*†: equal contribution.

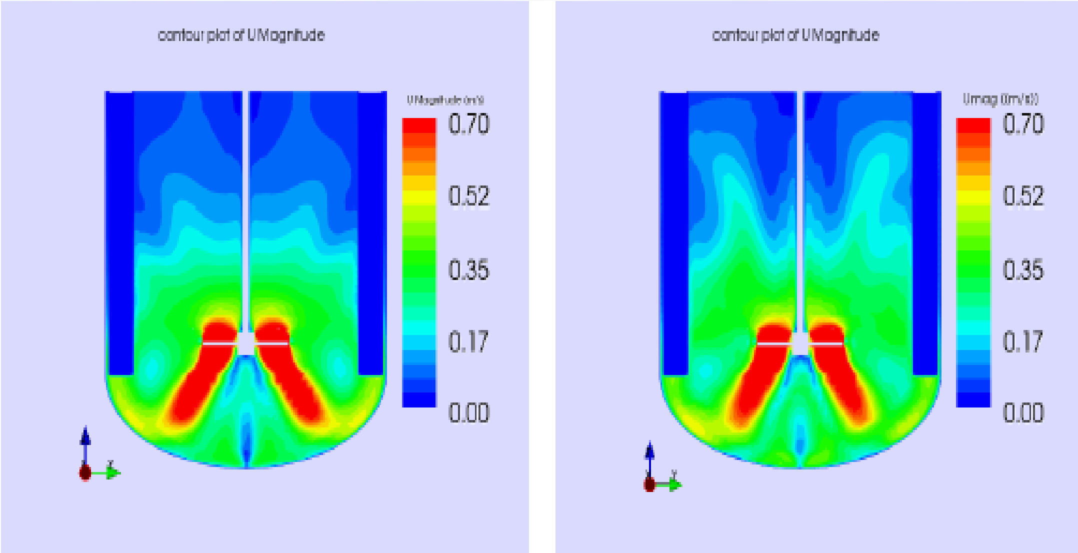
Metric	PixelNeRF	Instant NGP	Neuralangelo
Rendering Time (ms)	10-30 per pixel	<1 per pixel	~100-500 per pixel
Scene Complexity	High	Medium-High	Very High
Photorealism	No/ Limited	Yes	Yes
Real-time Capability	No	Yes	No

A. Yu, V. Ye, M. Tancik and A. Kanazawa, "pixelNeRF: Neural Radiance Fields from One or Few Images," 2021 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), Nashville, TN, USA, 2021, pp. 4576-4585, doi: 10.1109/CVPR46437.2021.00455. keywords: {Convolutional codes;Solid modeling;Computer vision;Three-dimensional displays;Image resolution;Computer architecture;Benchmark testing},
"Instant Neural Graphics Primitives with a Multiresolution Hash Encoding" Thomas Müller et al. ACM Transactions on Graphics (SIGGRAPH), July 2022a
Li, Zhaoshuo & Müller, Thomas & Evans, Alex & Taylor, Russell & Unberath, Mathias & Liu, Ming-Yu & Lin, Chen-Hsuan. (2023). Neuralangelo: High-Fidelity Neural Surface Reconstruction.
Lin, Chen-Hsuan & Gao, Jun & Tang, Luming & Takikawa, Towaki & Zeng, Xiaohui & Huang, Xun & Kreis, Karsten & Fidler, Sanja & Liu, Ming-Yu & Lin, Tsung-Yi. (2022). Magic3D: High-Resolution Text-to-3D Content Creation. 10.48550/arXiv.2211.10440.

Towards Real-Time Physically Accurate Simulations



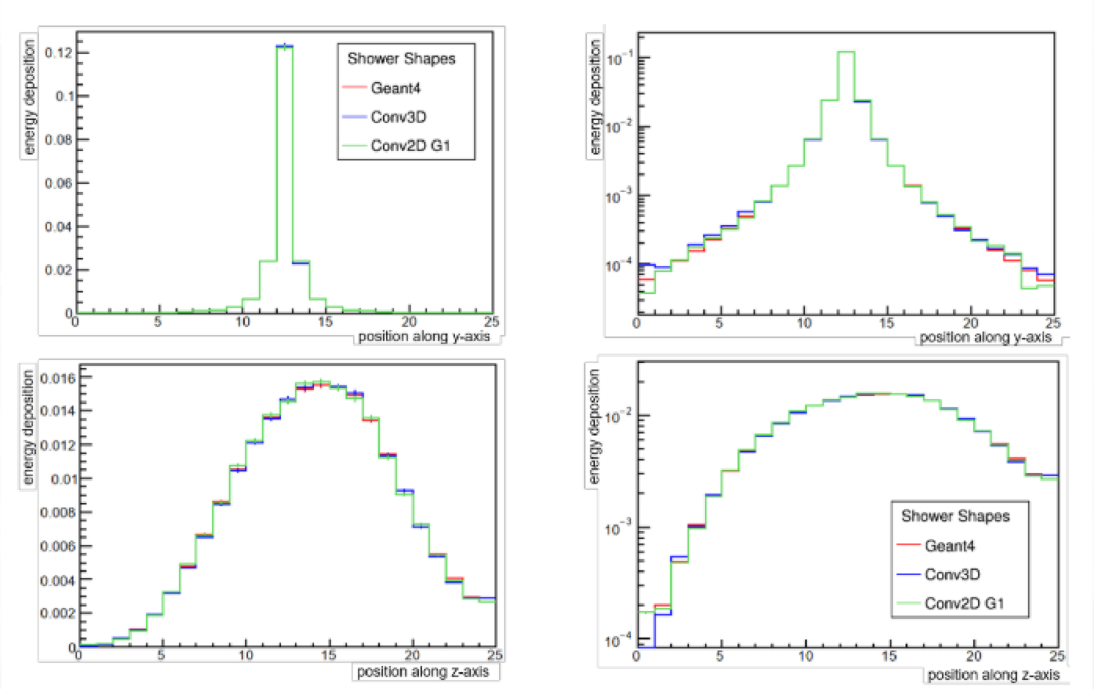
Approximating mesh-motion Laplacian mesh motion solver in OpenFOAM with MLP



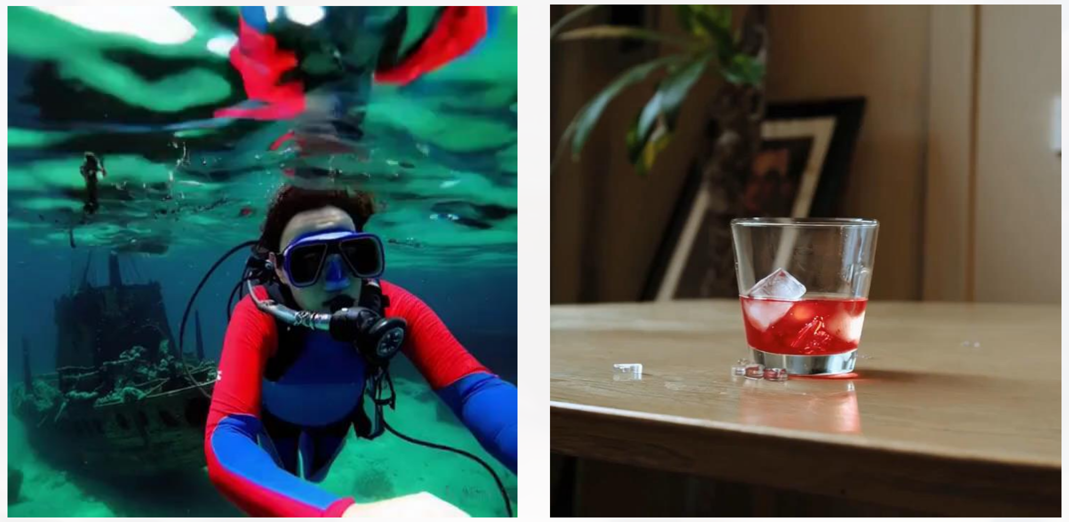
Using CNN to Solve Euler-Lagrange, Momentum Transfer, and Incompressible RANS Equations

Gen AI

AI / ML



Simulating high energy physics calorimeter detector outputs with 2D GAN



Video generation models as general purpose simulators of the physical world?

Maric, T., Fadeli, M.E., Rigazzi, A. et al. Combining machine learning with computational fluid dynamics using OpenFOAM and SmartSim. Meccanica (2024). https://doi.org/10.1007/s11012-024-01797-z
Rojek, K., Wyrzykowski, R., Gepner, P. (2021). AI-Accelerated CFD Simulation Based on OpenFOAM and CPU/GPU Computing. In: Paszynski, M., Kranzlmüller, D., Krzhizhanovskaya, V.V., Dongarra, J.J., Sloot, P.M.A. (eds) Computational Science – ICCS 2021. ICCS 2021. Lecture Notes in Computer Science(), vol 12743. Springer, Cham. https://doi.org/10.1007/978-3-030-77964-1_29
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Tensors Reshape Compute Architectures

HPC

Viz / Render

Edge/Client

AI-optimized Portfolio from Model Development to Inferencing

80+ new and enhanced Infrastructure platforms – Pocket to Cloud, Edge to Core

Data Management

Solutions
High Performance File System (w/WEKA)
Object Storage Solutions (w/Cloudian)
DSS-G / Spectrum Scale
BeeGFS

DM & DE
DM7100F
DM5100
DG7000

DE6600
DE6600

ML & Data Analytics

4-socket
SR850 V2
SR850 V3 Intel
SR860 V2
SR860 V3 Intel

2-Socket
SR650 V2
SR650 V3 Intel
SR655
SR655 V3 AMD
SR665
SR665 V3 AMD

ThinkSystem

Deep Learning Training HGX

ST650 V3 Intel
SR670/75 V3 4-8x PCIe
SR670/75 V3 4-GPU HGX

NEW SR680a V3 8-GPU HGX
NEW SR685 V3 8-GPU HGX

SD650-I V3
SD665-N V3

NEW SR780a 8-GPU HGX

Data Science Workstation

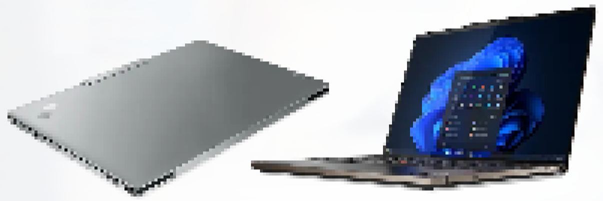
Edge
NEW P3 Ultra
NEW P3 Tiny
Desktop
NEW PX
NEW P7
P620
NEW P5
NEW P3 Tower

P1 Gen5
P1 Gen6

Lenovo ThinkStation

ThinkPad with Neural Processing Units

ThinkPad X13s Gen1 – 15 TOPS
ThinkPad Z13 Gen2 – 11 TOPS
ThinkPad Z16 Gen2 – 11 TOPS
ThinkPad T14s AMD Gen4 – 11 TOPS
ThinkPad T14 AMD Gen4 – 11 TOPS
ThinkPad T16 AMD Gen2 – 11 TOPS
ThinkPad X13 AMD Gen4 – 11 TOPS



Lenovo ThinkPad

Edge AI

Server
SE350
NEW SE350 V2
NEW SE360 V2
SE450
NEW SE455

SE70 AWS
Panorama

Clients
SE10, SE10-I
M90
SE30
SE50
SE70

AI Appliance

Lenovo ThinkEdge

Appliances

ThinkAgile MX Systems (Microsoft)
MX3330-F
MX3330-H
MX3331-F
MX3331-H
MX3530-F
MX3530-H
MX3531-F
MX3531-H

ThinkAgile HX Systems (Nutanix)
HX1330
HX1331
HX2330
HX2331
HX3330
HX3331
HX5530
HX5531

ThinkAgile VX Systems (VMware)
VX3331
VX3530-G
VX7531

ThinkAgile

Lenovo

Challenges ahead

Scalability
& Energy Efficiency

Security &
Privacy

Interoperability &
Standards

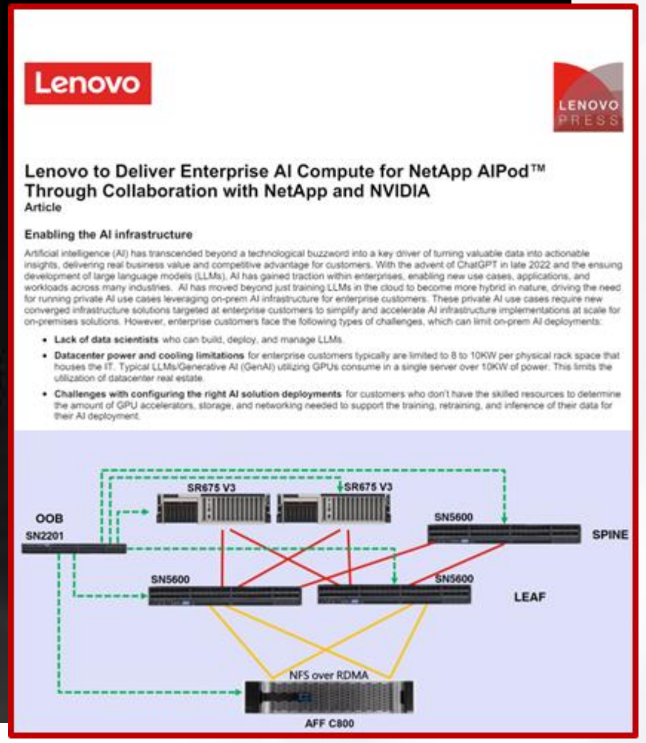
Compute & Storage
Optimization

Ethic & Regulations

Lenovo E2E – OVX Infrastructure Solutions

Through Collaboration with NetApp and NVIDIA

LENOVO - E2E – OVX INFRASTRUCTURE



Lenovo to Deliver Enterprise AI Compute for NetApp AIPod™ Through Collaboration with NetApp and NVIDIA

Article

Enabling the AI infrastructure

Artificial intelligence (AI) has transcended beyond a technological buzzword into a key driver of turning valuable data into actionable insights, delivering real business value and competitive advantage for customers. With the advent of ChatGPT in late 2022 and the ensuing development of large language models (LLMs), AI has gained traction within enterprises, enabling new use cases, applications, and workloads across many industries. AI has moved beyond just training LLMs in the cloud to become more hybrid in nature, driving the need for running private AI use cases leveraging on-prem AI infrastructure for enterprise customers. These private AI use cases require new converged infrastructure solutions targeted at enterprise customers to simplify and accelerate AI infrastructure implementations at scale for on-premises solutions. However, enterprise customers face the following types of challenges, which can limit on-prem AI deployments:

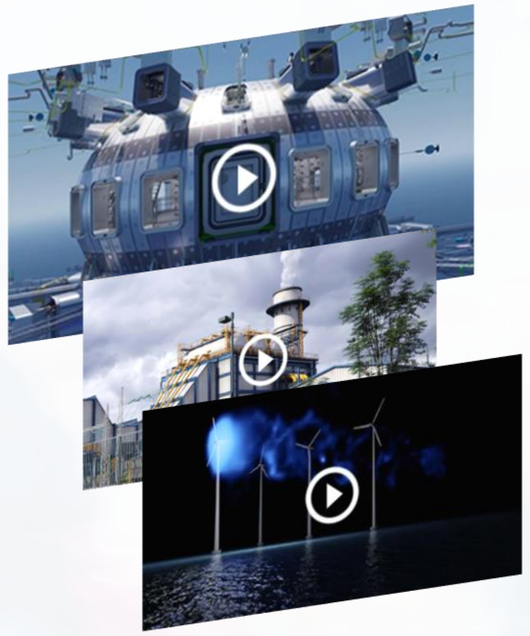
- **Lack of data scientists** who can build, deploy, and manage LLMs.
- **Datacenter power and cooling limitations** for enterprise customers typically are limited to 8 to 10KW per physical rack space that houses the IT. Typical LLMs/Generative AI (GenAI) utilizing GPUs consume in a single server over 10KW of power. This limits the utilization of datacenter real estate.
- **Challenges with configuring the right AI solution deployments** for customers who don't have the skilled resources to determine the amount of GPU accelerators, storage, and networking needed to support the training, retraining, and inference of their data for their AI deployment.

The benefits of MV tech application embrace all industries.

Automotive

- Fast-Track Industrial Factory Planning
- Developing Custom Applications for Factory Planners

Energy

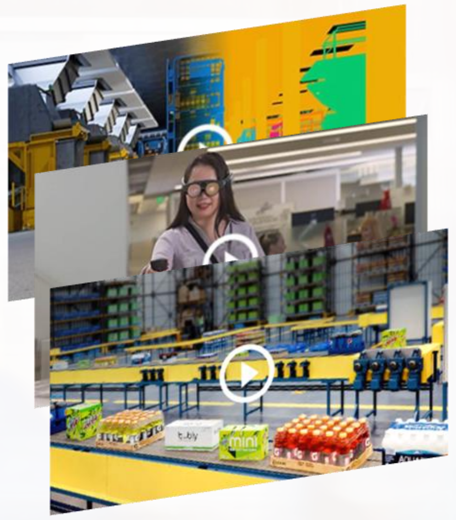


- Accelerating Fusion Reactor Design and Development
- Reducing Downtime and Unplanned Maintenance
- Optimizing Wind Farm Design and Electricity Generation

Infrastructure

- Transforming Telco Network Planning and Operations
- Simulating and Optimizing Autonomous Railway Networks
- Testing and Optimizing 5G Deployment

Retail



- Autonomous Warehouse Robots
- Retail Layout
- Optimizing Distribution Center Throughput

Science

- Accelerating Carbon Capture and Storage
- Visualizing High-Resolution, Global-Scale Climate Data
- Accelerating Climate Research
- Visualizing Molecular Dynamics
- Brain Digital Twin

Industrial Metaverse

Are we there yet?

Takeaways:

Evolving DT Concept	The extended and enhanced use of digital twins is at the core of the Industrial Metaverse. AI applications can speed up 3D asset creation and prototyping while providing more intelligent capabilities to DT
AI-Powered Metaverse	Integrating AI into the HPC framework for the Industrial Metaverse unlocks new capabilities, driving innovation and efficiency in high-fidelity rendering and physical simulations.
Metaverse-Ready Infrastructure	The key technologies for achieving extended whole-system digital twins are not yet mature, but advances in AI, edge computing, and cloud infrastructure are rapidly closing the gap.
Challenges	Key issues include security, scalability, latency, costs, skill gaps, and regulatory compliance (including AI and data governance)
Future Trends	Accelerators mem bw will keep increasing, AI eats HPC, Raytracing engine will be integrated into AI superchips (i.e.: NVIDIA DGX) or Viz card will start employing DGX-like architectures

Forum TERATEC 24

thanks.

Lenovo