Simulation, Modeling and (Generative) AI as Tools to Support Creative Industries Applications

Tomasz Bednarz | Director of Strategic Researcher Engagement

“

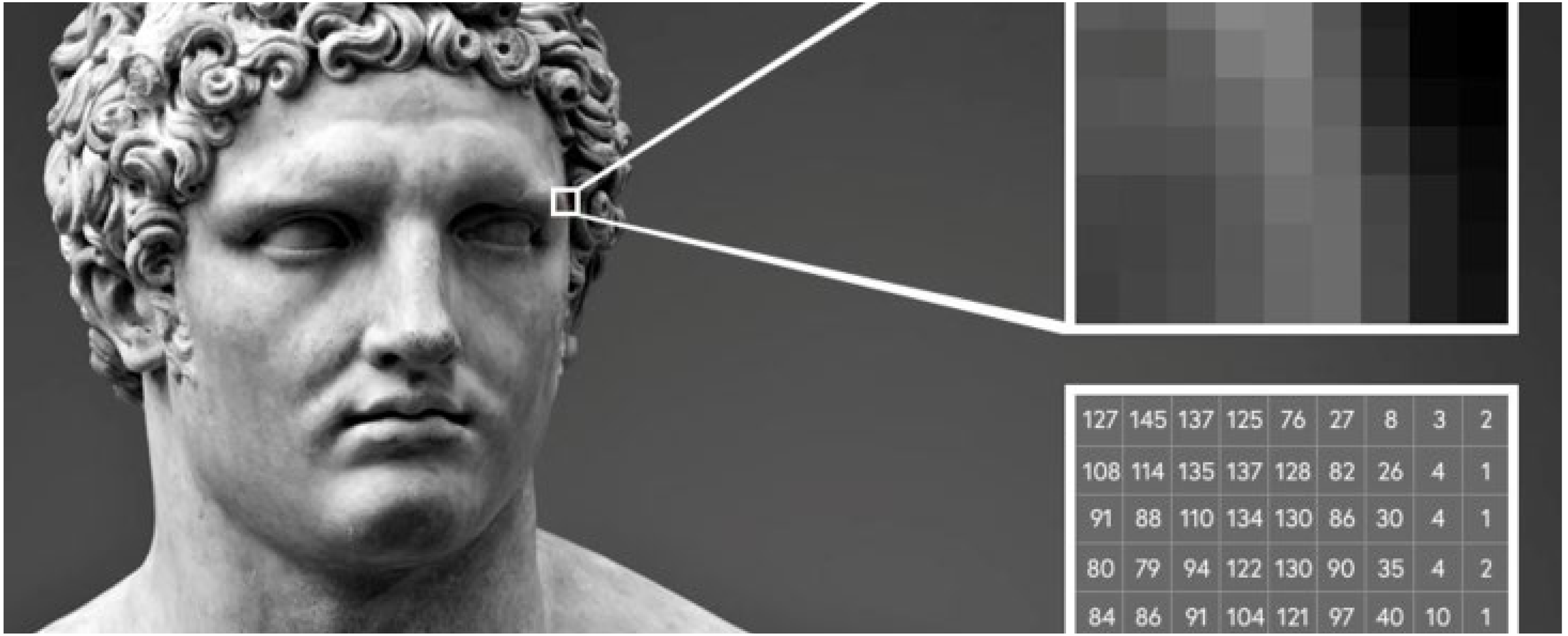
This presentation include content developed in a research project for curated exhibition at the Powerhouse Museum (MAAS) called **INVISIBLE REVEALED**. Project was curated by Dr. Deborah Lewler-Dormer with science lead Dr. Joseph Bevitt and engineering lead Dr. Tomasz Bednarz

ACKNOWLEGEMENT

”

Everything starts with a pixel

… if you can draw a pixel, you can do anything …



MiKroma II

Sub-miniature camera for 16mm film in cassettes. This camera was made in Prague in 1957.

Pocket Watch

Made in France around 1815-1820 (worked upon acquisition 1983)

“

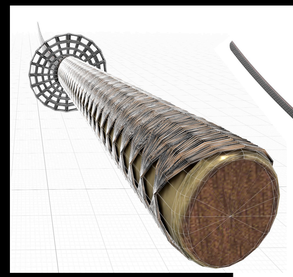
Using a combination of 9 different nuclear reactor, synchrotron and particle accelerator-based technologies, ANSTO’s imaging and analytical capabilities show how culturally significant artefacts were manufactured, and how they might be better conserved for decades and centuries to come.

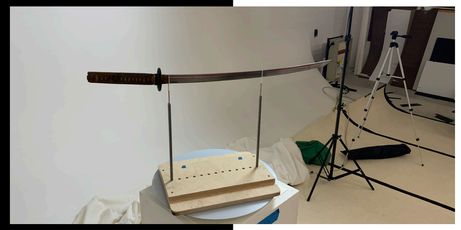
- Joseph Bevitt

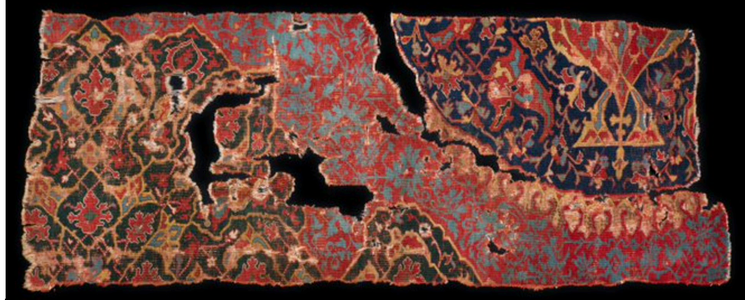
”

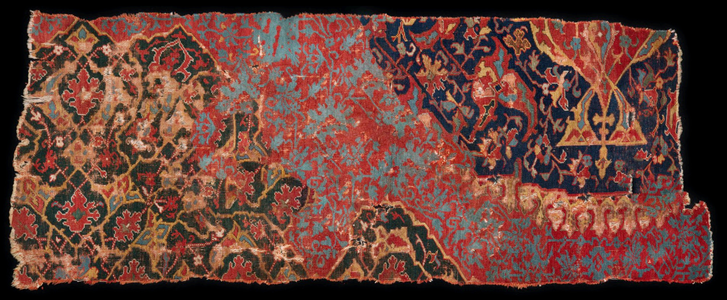
Tomb Guardian 2

AR









THE INVISIBLE REVEALED

INVISIBLE REVEALED project curated by Deborah Lewler-Dormer, science and engineering leads: Joseph Bevitt and Tomasz Bednarz

What is Photogrammetry?

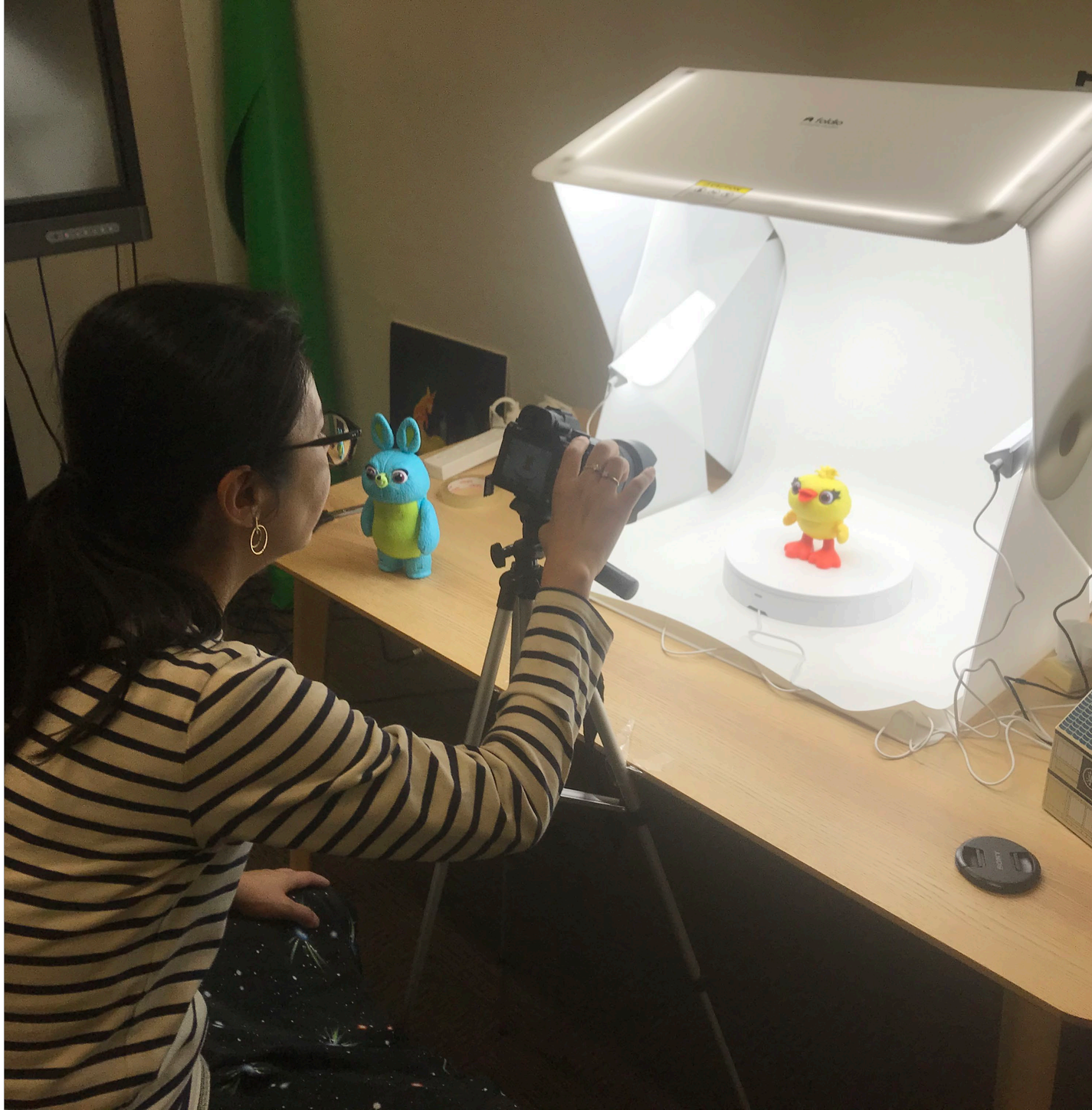
“photos” = light
“gramma” = to drawn
“metron” = to measure

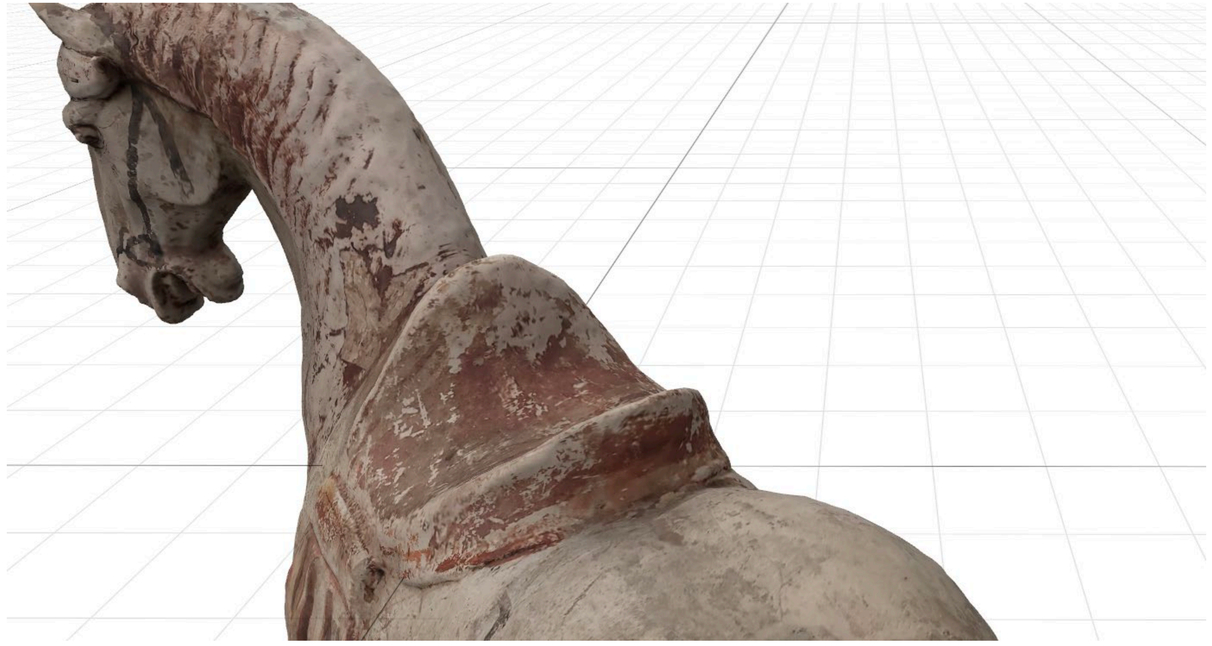
Photogrammetry = measuring with light (photographs)

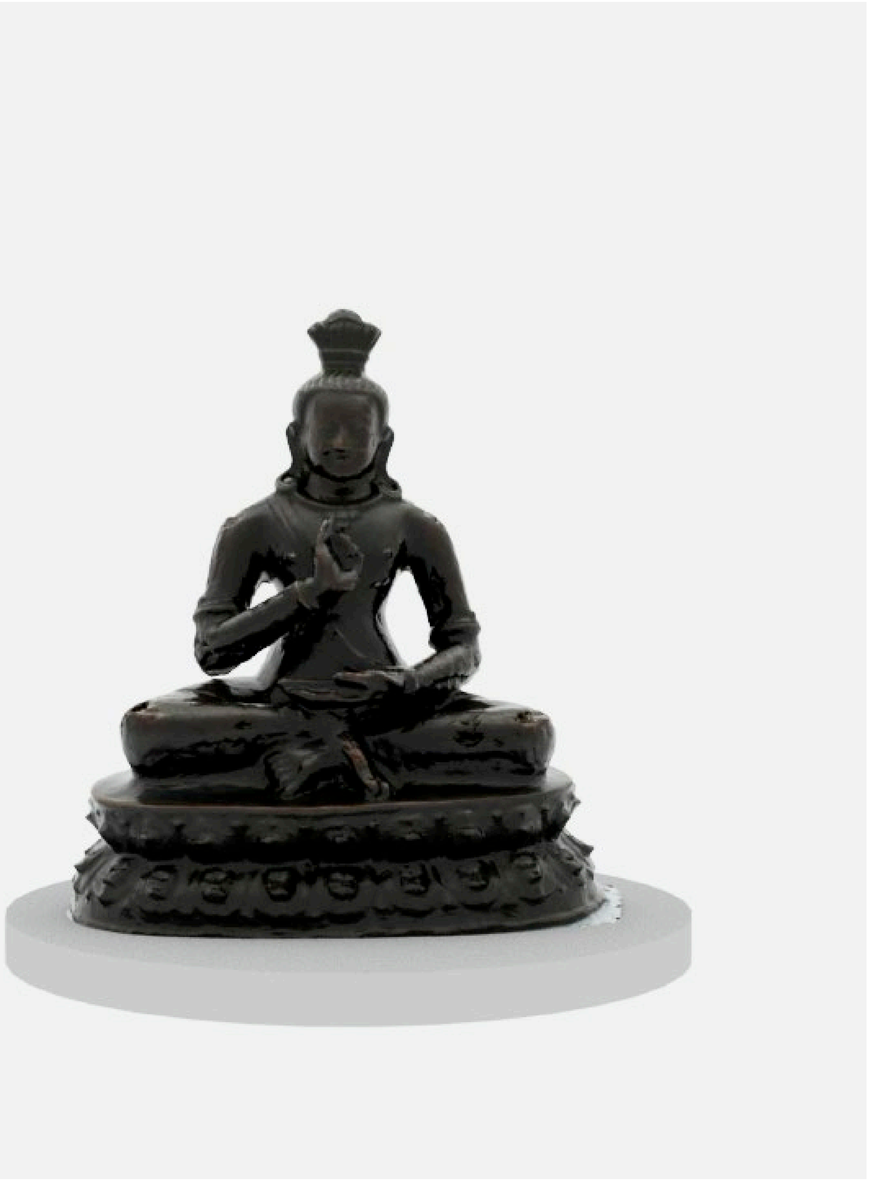
Estimation of the geometric and semantic properties of objects based on images or observations from similar sensors.

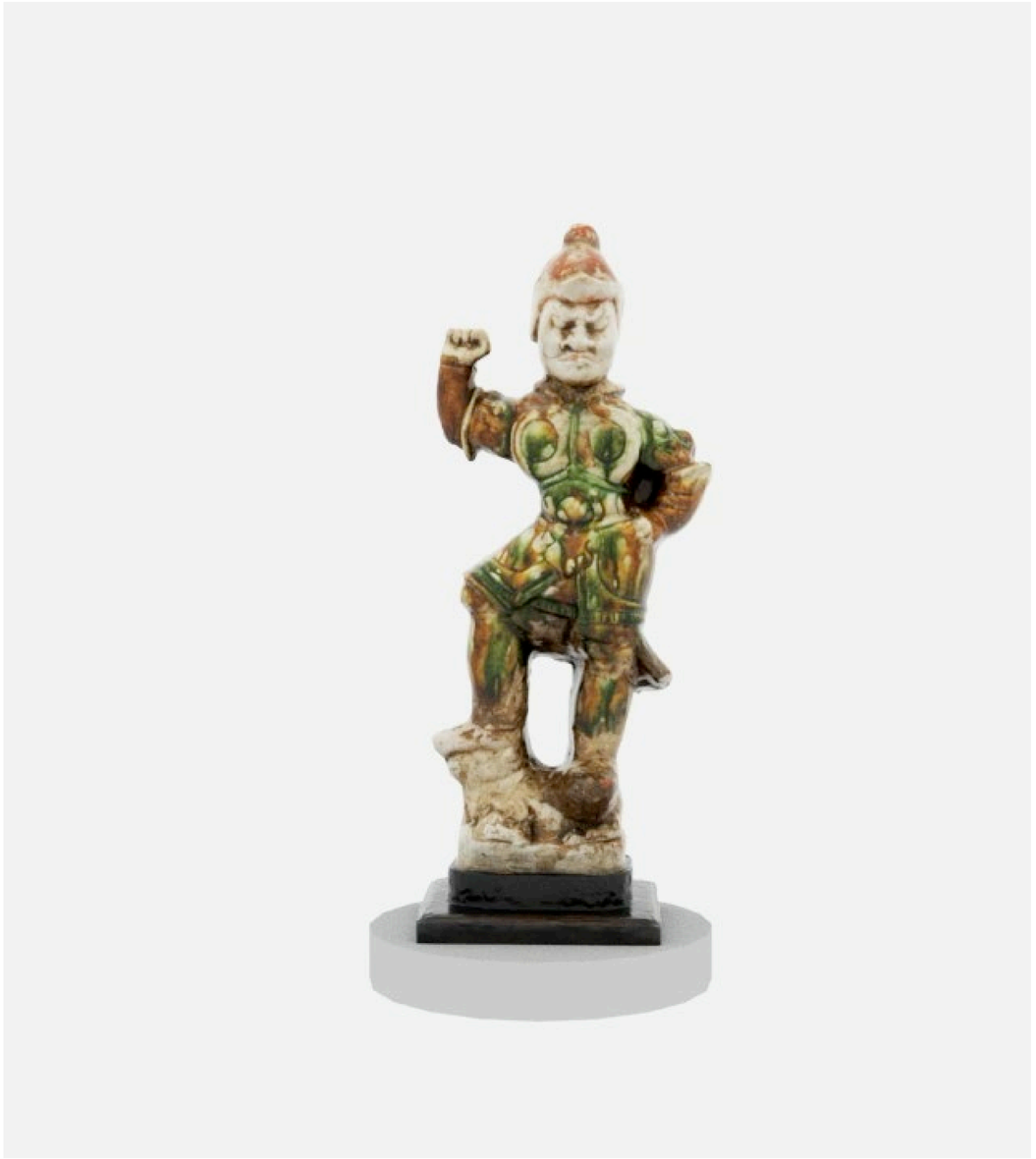
What can it measure?

Camera localization
Determine the location of objects
3D reconstruction
Similarities & data association
Object detection
Semantic interpretation



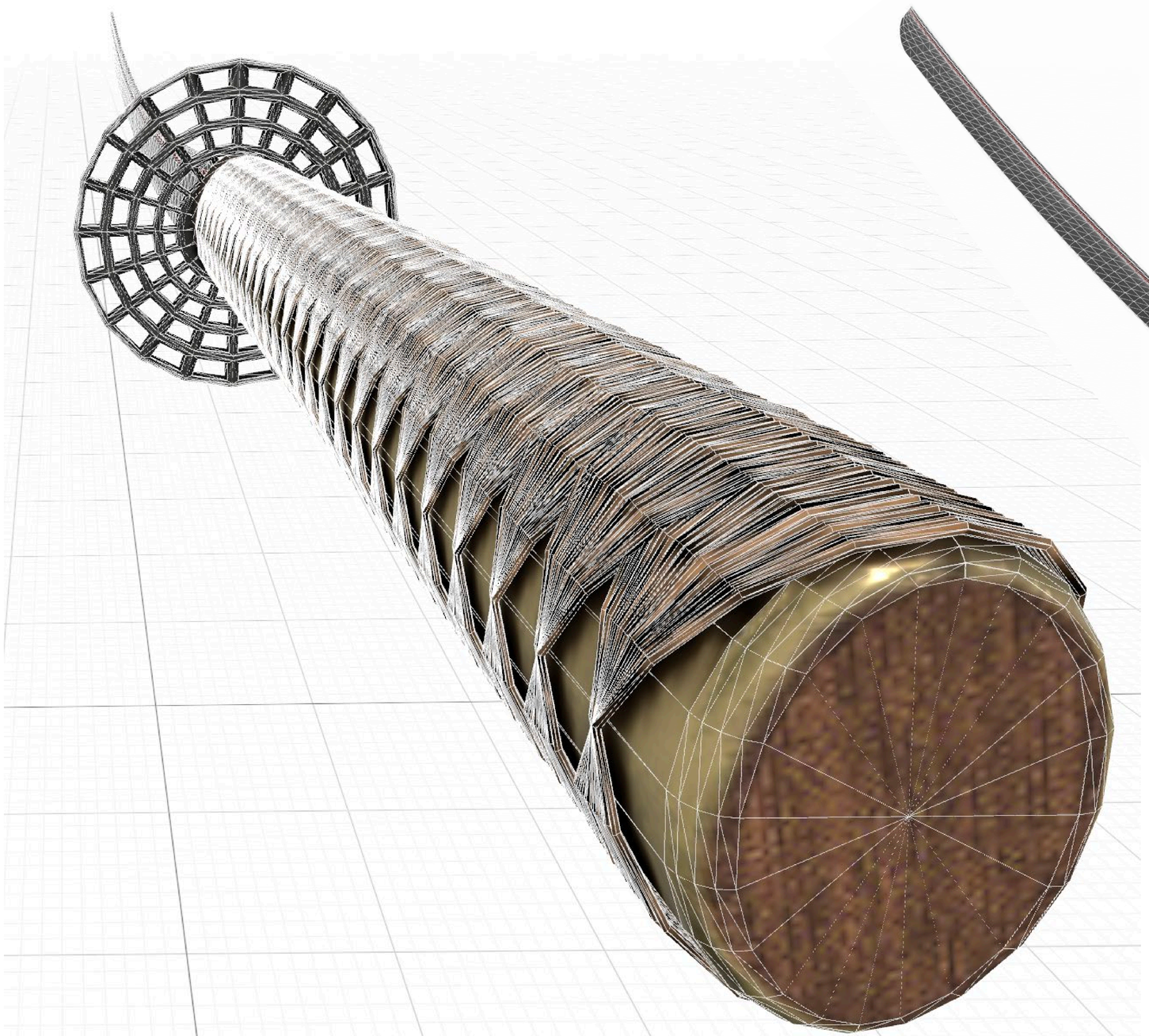






NVIDIA.

700x450x450



Zur Beachtung!
Klappe
schließen

This horse comes from a Chinese Tang dynasty (618–907 CE) tomb.
Figures of animals and people were often placed in tombs during this period, as gifts to accompany the dead to the next world.
Neutron tomography has given us a picture of the many repairs this fragile ceramic object has undergone over the centuries.
The legs have had to be glued back together, and parts of the tail and a whole ear were replaced with new materials.
SWITCH
ANSTO

...

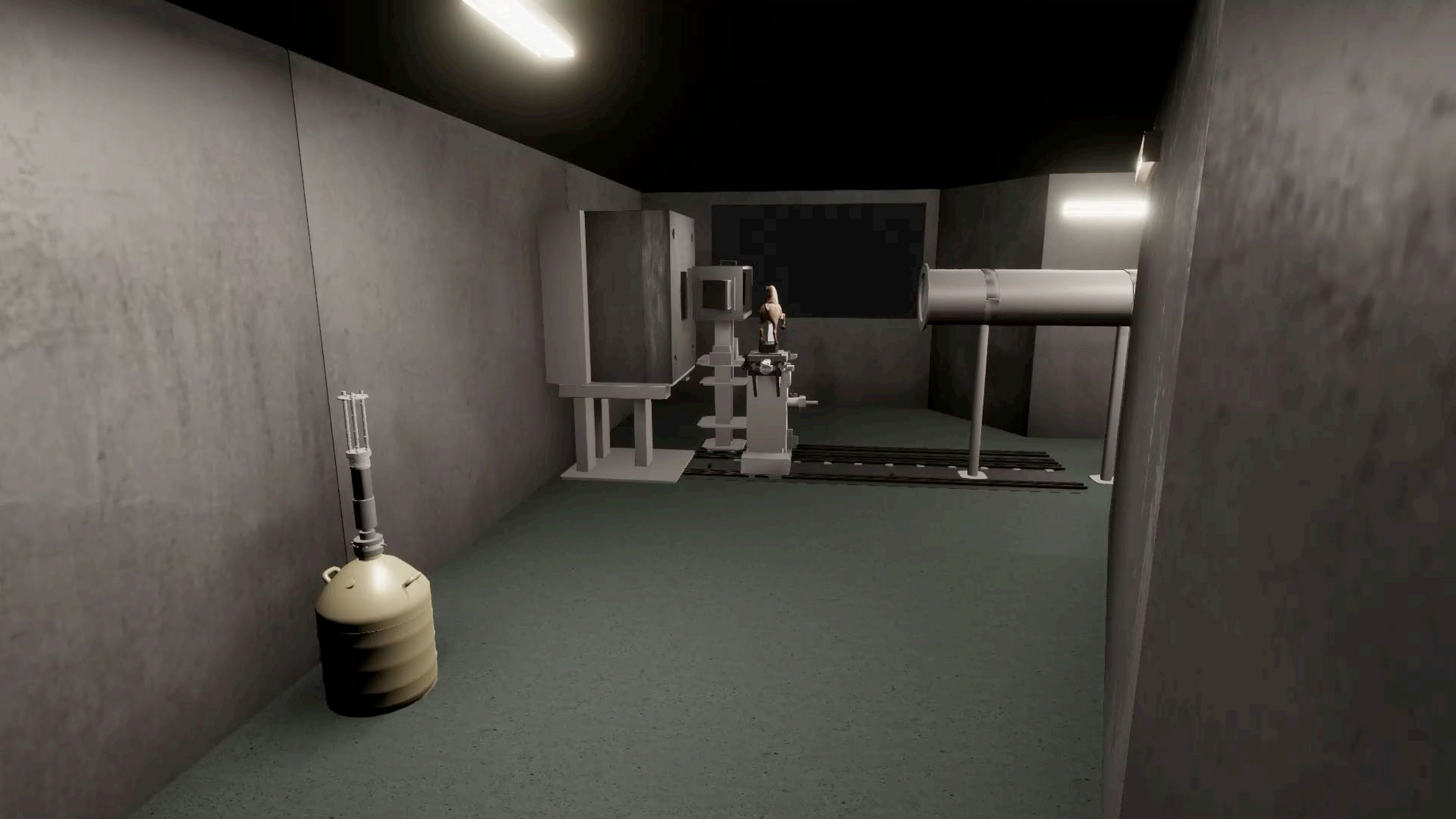
Shutter open to allow neutrons generated by the nuclear reactor to pass through the pinhole, slits and flight tube and strike the scintillation screen.

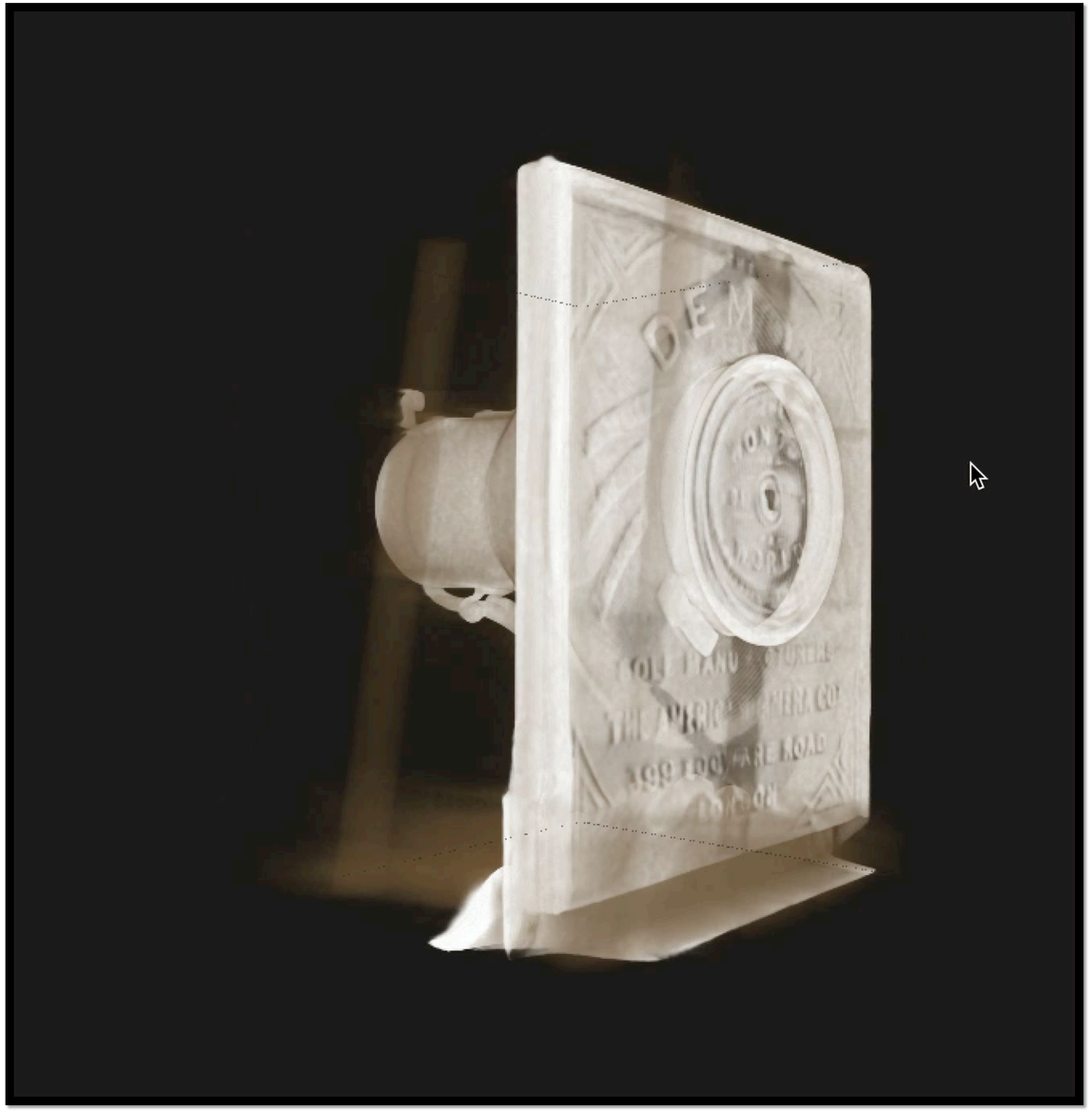
Neutrons are neutral, subatomic particles that cannot be detected directly by electronics, and rapidly degrade electronic equipment.

To make them visible to the camera, which is placed away from the neutron beam, a scintillation screen is coated in a special paint that emits photons (light) when it is irradiated with neutrons.

The green light that is emitted bounces off a mirror angled at 45 degrees, directing it toward a scientific camera which captures a photograph of the neutron shadow – a two-dimensional neutron radiograph.

- Joseph Bevitt

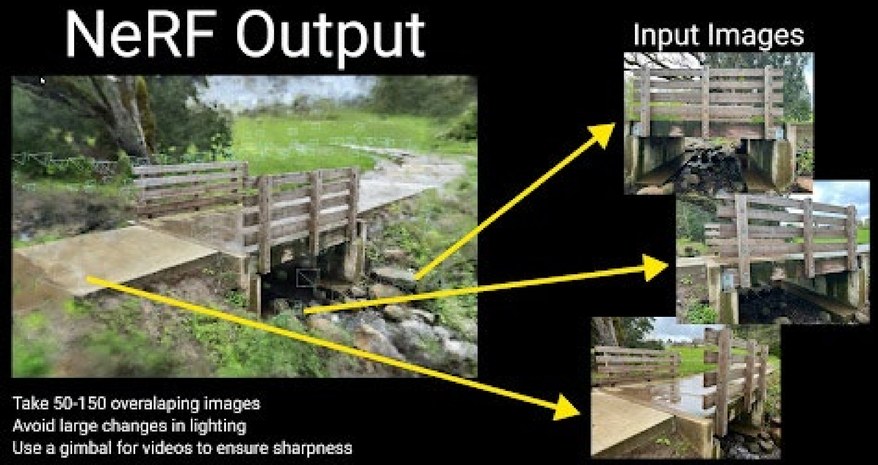


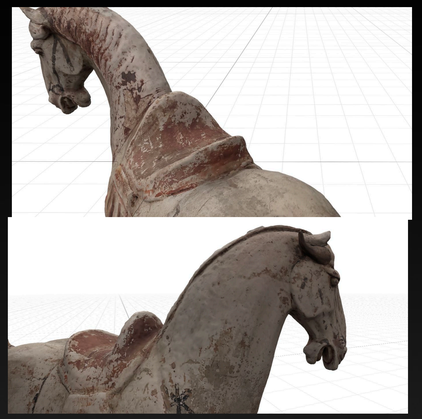


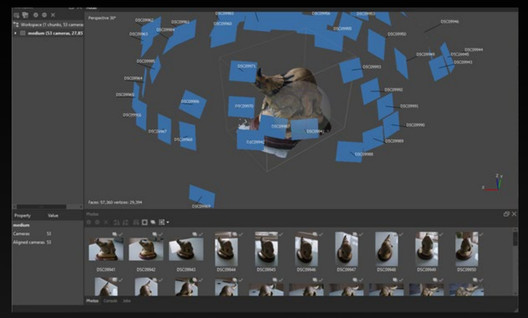
Instant Neural Radiance Fields

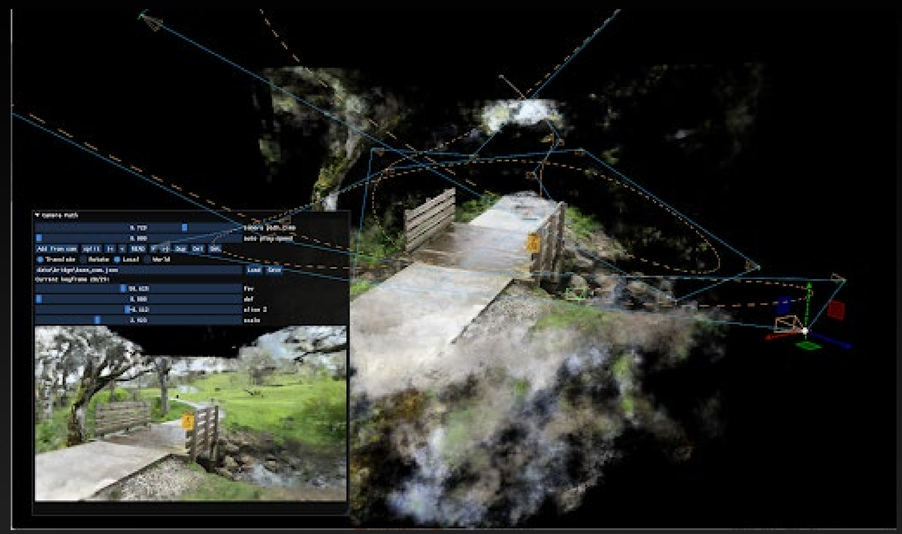
Fast 3D reconstrucion

- Neural Radiance Fields (NeRF) are neural networks capable of generating 3D images or scenes from a set of 2D images.
- Using spatial location and volumetric rendering, the model uses the camera pose from the images to render the 3D space of the scene.
- NeRF viewer allows to create keyframed camera fly through animations









https://developer.nvidia.com/blog/getting-started-with-nvidia-instant-nerfs/

INSTANT NERF (NEURAL RADIANCE FIELDS) - RAPID 3D RECONSTRUCTION

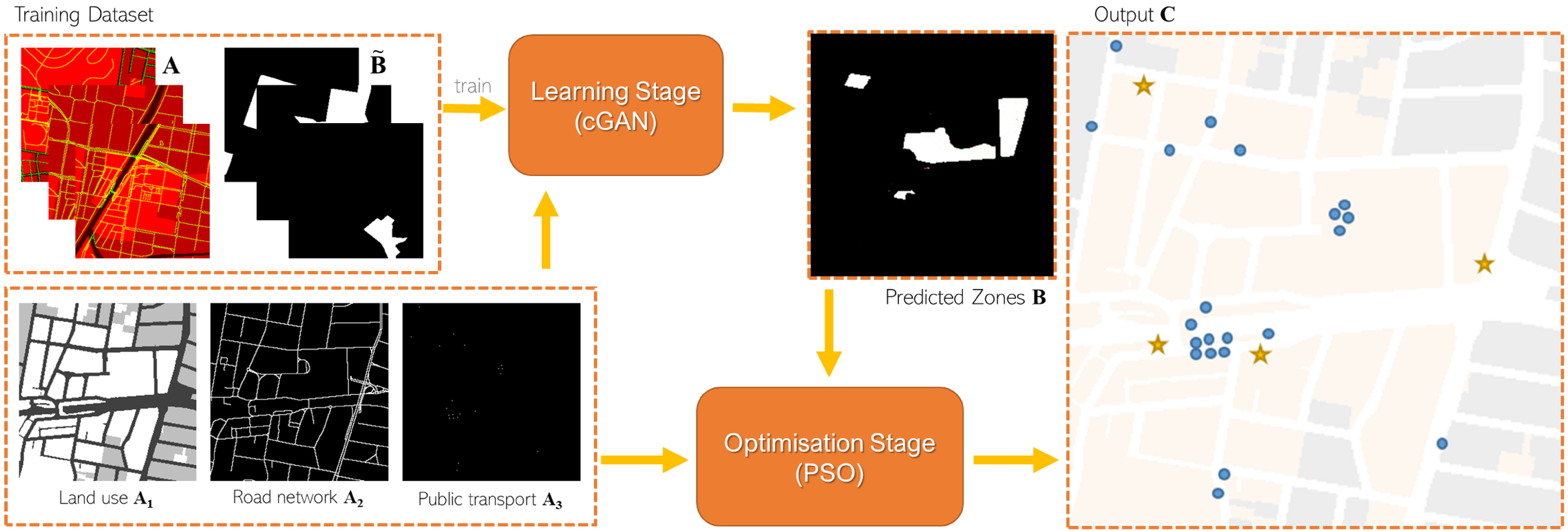
Usual photogrammetry reconstruction pipeline with ~150 photographs take about 2-3 days of compute on NVIDIA RTX 8000.

With Instant-NeRF, full 3D reconstruction inference takes about ~2-3 minutes.

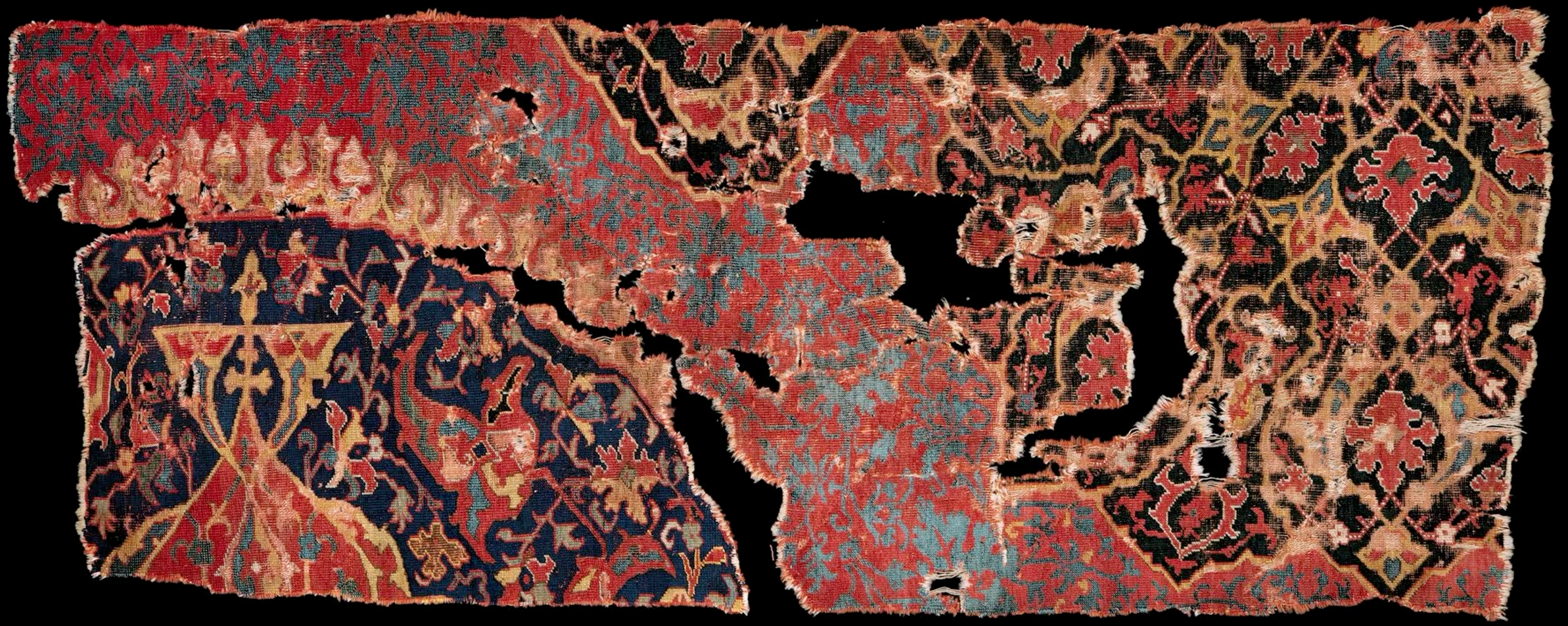
https://github.com/NVlabs/instant-ngp

Automatic Site Selection of Cultural Venues

A cGAN outputs zones from urban data as a constraint prior to a stochastic optimisation of site locations of cultural venues.



Source: https://dl.acm.org/doi/10.1145/3283254.3283257



Fragment, medallion carpet, knotted wool pile / felt.
Woven in Usher, Wester Turkey, c. 1600.

AI IS COMING OF AGE

Unlocking the Discrimination, Simulation, and Generation capabilities required for the Metaverse

DISCRIMINATIVE MODELS

Perceiving the World

Detection, classification, segmentation

SIMULATION MODELS

Simulating Real Life

Real time, photoreal, physically accurate

GENERATIVE MODELS

Creating New Things

Understanding structure

Generative AI will bring a revolution in productivity

10% of all data by 2025 vs <1% in 2022

- Gartner

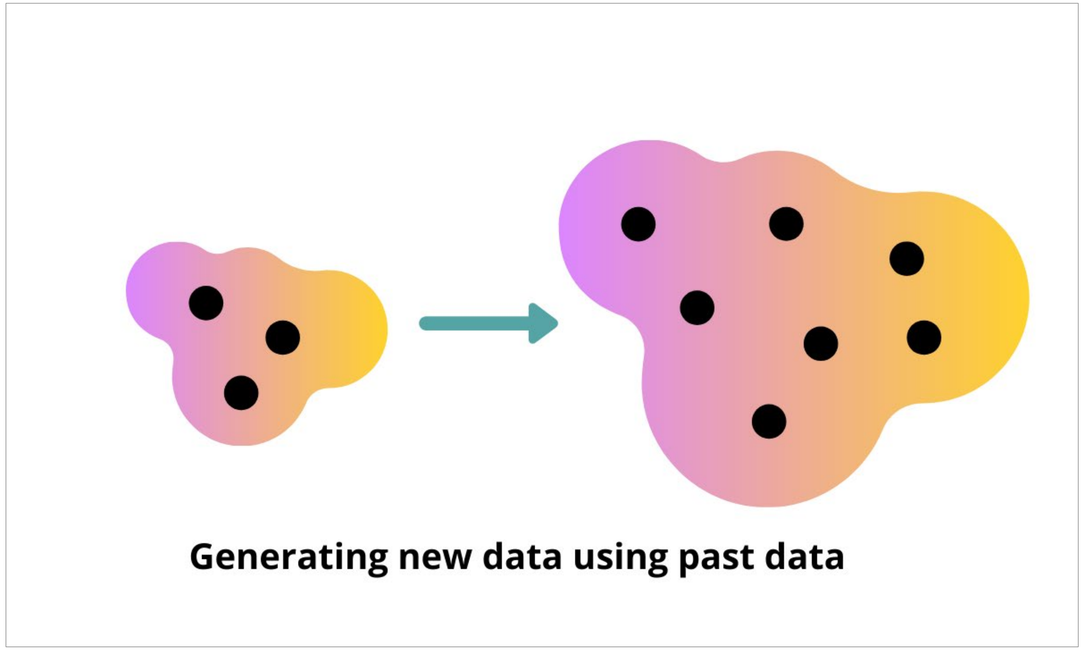
NVIDIA

What is Generative AI?

Tips to Get Started

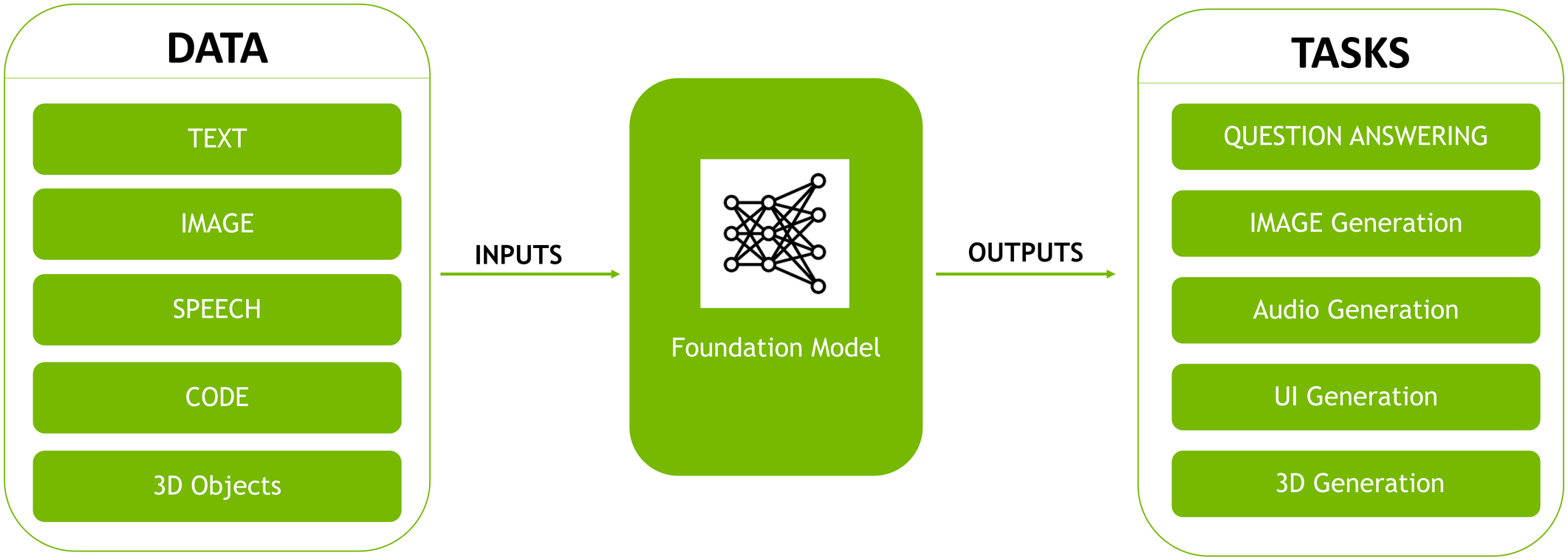
Generative AI refers to machine learning algorithms that enable computers to use existing or past content like text, audio and video files, images, and even code to generate new possible content.

The main idea is to generate completely original artifacts that would look like the real deal.



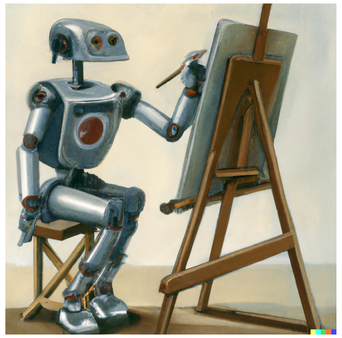
Generating new data using past data

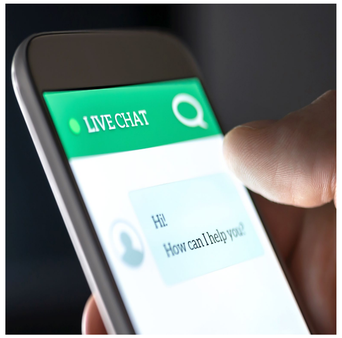
How Generative AI Works



NVIDIA.

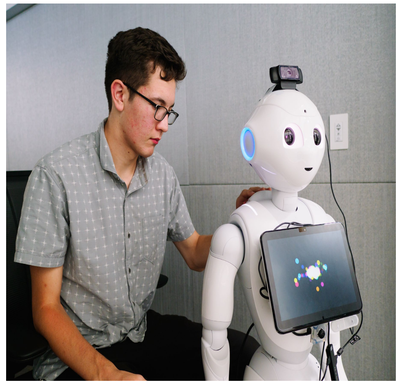
Content Generation
Marketing Copy, Blog Generator, Code Generator





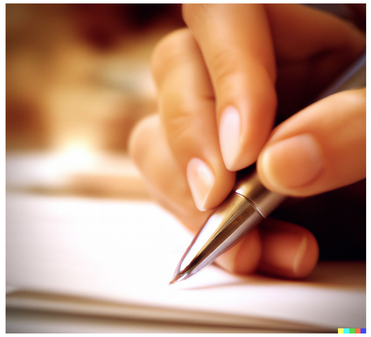
Chatbots
Question & Answering, Dialogue Generation

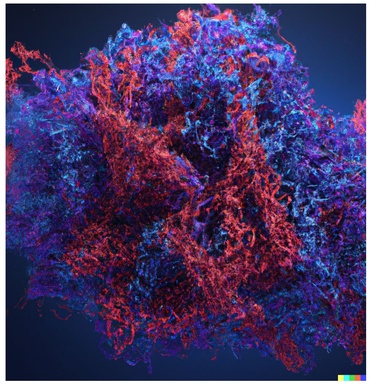
Summarization
Catchy headlines, Article Summarization



Virtual Avatars
Sentiment Analysis, Intelligent Responses

Translation
Human language to code, Language to Language Translation





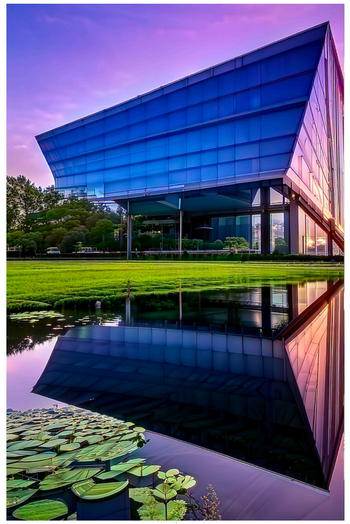
Healthcare
Protein Structure Prediction, Protein Discovery, Drug Discovery

LLMs Unlock New Opportunities
LLMs transcend language and pattern matching

Generative AI is Transforming Every Industry

3D VFX & Game Design

Generate assets and textures

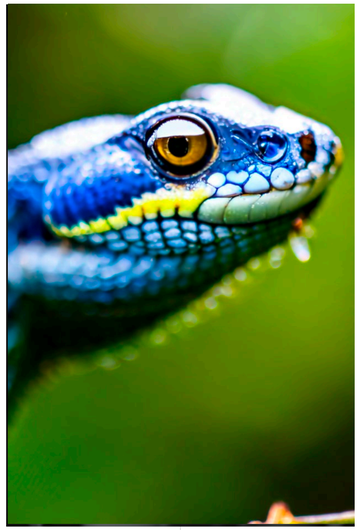


Architecture &
Interior Design

Create floorplans and explore architectural styles

Fashion & Product Design

Inspire unique design concepts

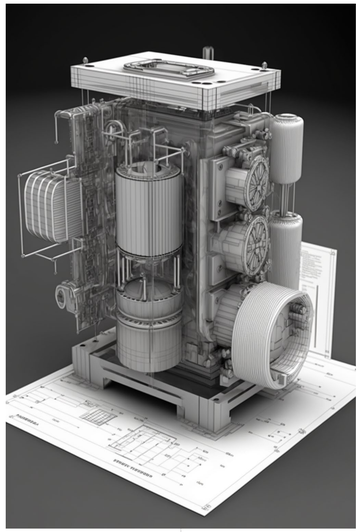


Photography & Photo Editing

Background and object replacement

Marketing and Advertising

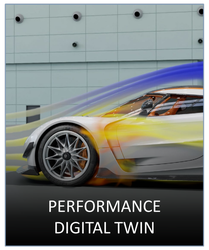
Create elements & reusable motifs



Manufacturing

Design parts
Explore structures & solutions

$50 Trillion Worth of Industries Racing to Digitalize

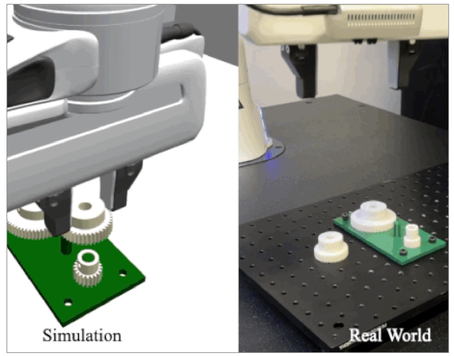


NVIDIA
Omniverse

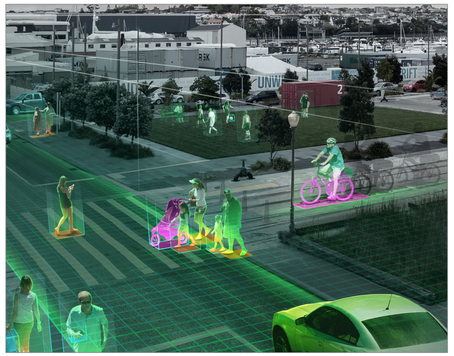
We built Omniverse for ourselves

From Research, to Design, Operations, to Product, Creative, Marketing & Sales

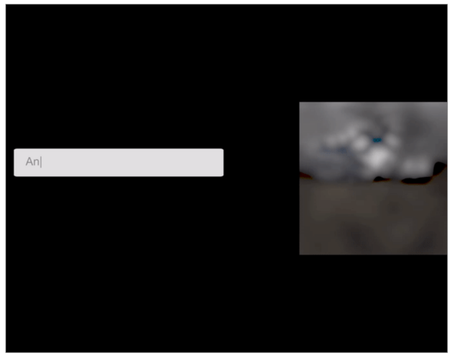
Autonomous Vehicles



Robotics



Computer Vision



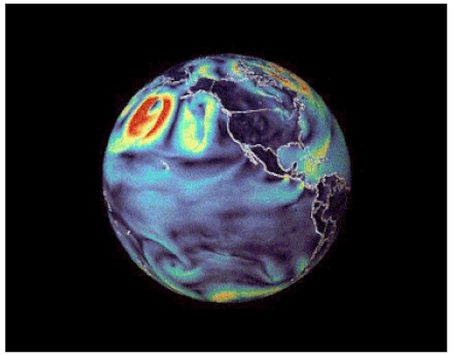
Generative AI

Research

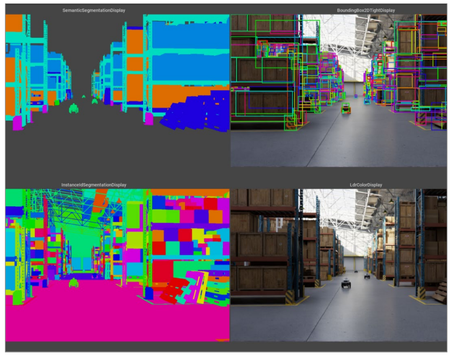
AI Avatars

Digital Human Tech

NeRFs



AI Physics



Synthetic Data Generation

Connect Your Existing Tools, and Easily Build Custom Tools

WPP, World's Largest Ad Agency, Builds 3D Content Creation Pipeline with Omniverse Enterprise

Design & CAD Data

NVIDIA Edify360

Unified Car Digital Twin & AI Environment in NVIDIA Omniverse

WPP

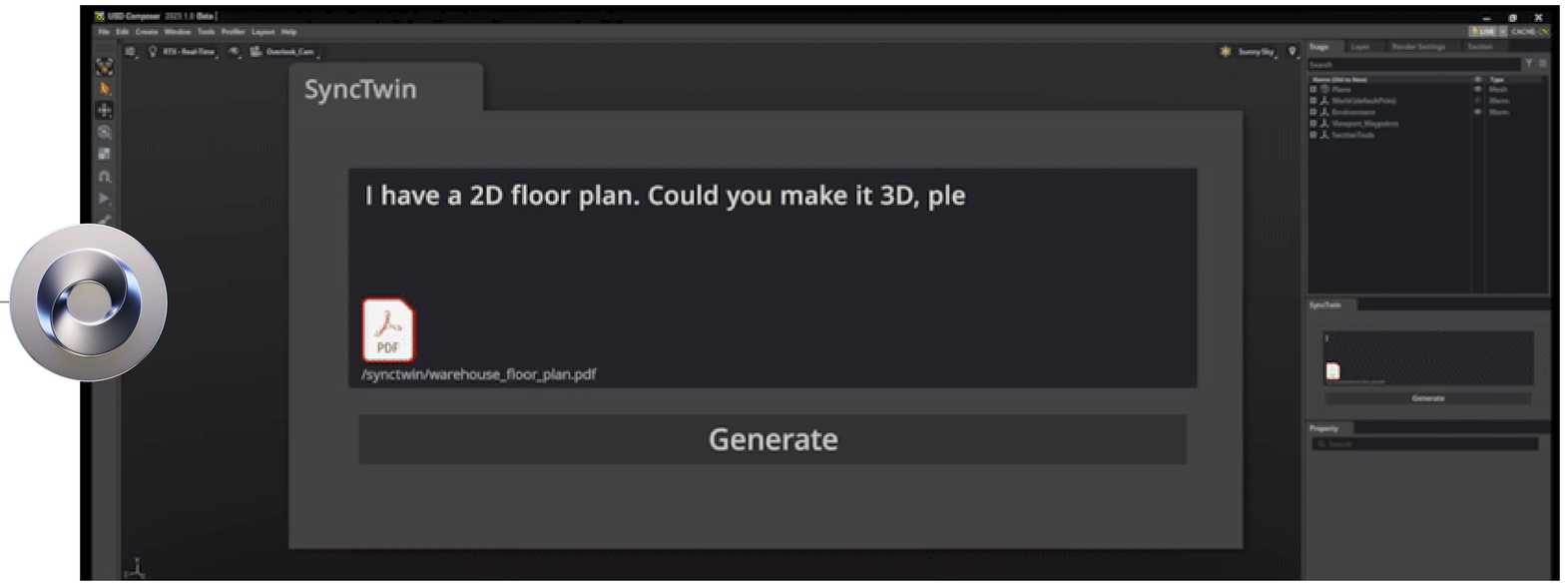
Deploy Real Time Configurator

Generate Cinematics

Generative AI in 3D Workflows

Omniverse Enterprise Lets You Connect Your 3D and Generative AI tools

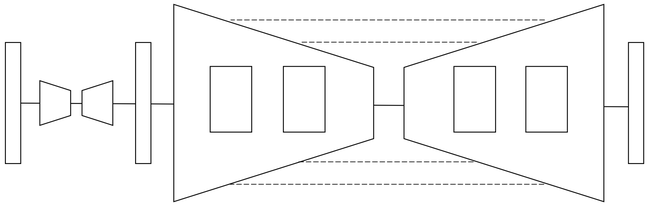
3D & Generative AI Tools



Real Time, Unified View in NVIDIA Omniverse

NVIDIA Edify NIMs

State-of-the-art generative AI models for visual design



High quality diffusion-based architecture

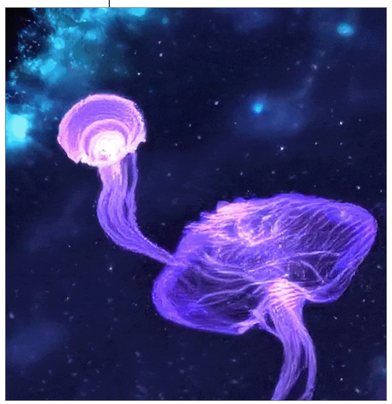
NSFW guardrails & human diversity options

One foundation model, many asset types

Edify-Image

High-Fidelity 4K Images

gettyimages



Edify-Video

Temporally Stable Videos

Edify-3D

Textured USD Meshes

shutterstock

Edify-360 HDRi

8K Environment Maps

Edify-Materials

4K PBR Materials

NVIDIA

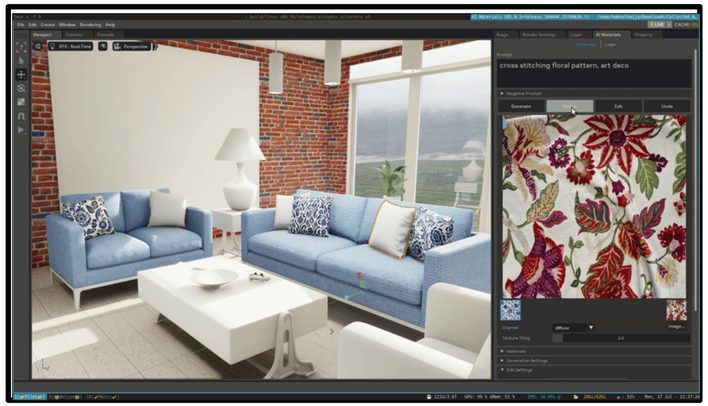
Generate Custom Materials

Edify Image with Omniverse Cloud APIs

Cross stitching floral pattern, art deco

Edify API

PBR Material



Example implementation

Generate Scene Backdrops and Lighting with 360 HDRi

Edify360 with Omniverse Cloud APIs

Snowy winter landscape with a wintery tree with snow covered branches

Edify API

8K 360 HDRi

Example output

Generative AI for Synthetic Data Generation

Edify 3D, Edify 2D with Omniverse Cloud APIs

Generate 20 individual car geometries and textures

Edify API

Add graffiti to the stop sign

Add rust to the stop sign

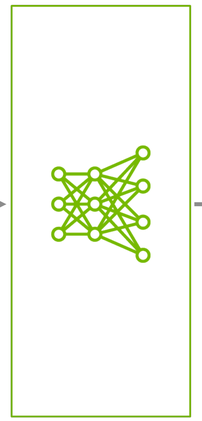
Edify API

NVIDIA Omniverse & AI APIs for Virtual World Building

Neural Reconstruction in Omniverse

CAPTURED SENSOR DATA

NEURAL RECONSTRUCTION ENGINE



Reconstruction
+
Generative AI

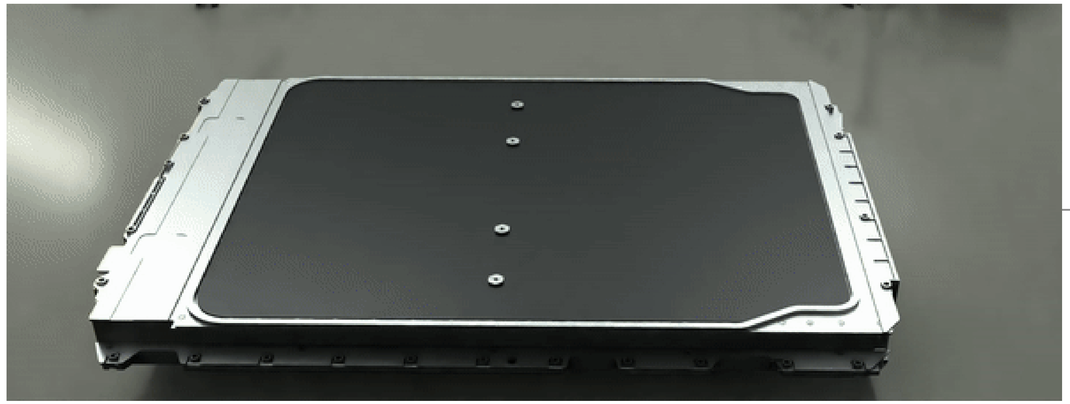
RECONSTRUCTED SCENE AND ASSETS

NVIDIA Omniverse & AI APIs in a Content Creation Pipeline

OpenUSD, RTX rendering, and Edify360

Design & CAD Data

NVIDIA AI or 3rd Party APIs



Unify data and call generative AI APIs in your app

Deploy Real Time Configurator

Generate Cinematics

NVIDIA AI or 3rd Party APIs

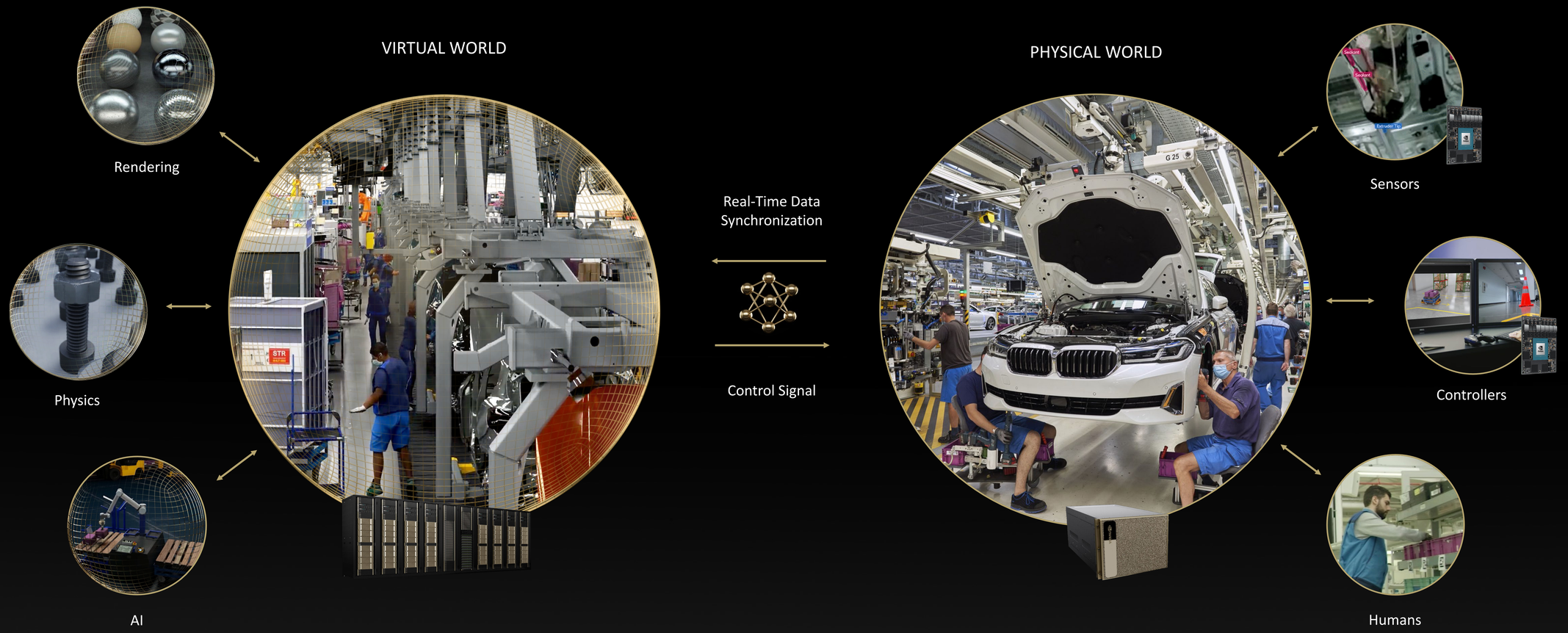
Edify Generative AI

Foundation Models Create Images, Videos and 3D from Text

NVIDIA

DIGITAL TWINS

Virtual World Simulations Live-Linked to the Physical World



BUILDING DIGITAL TWINS IS A COMPLEX TEAM SPORT

Today's 3D Workflows are Tedious for Designers, Artists, and Engineers

LARGE TEAMS WITH DIVERSE SKILLS

MANY VENDORS, MANY TOOLS

3D WORKFLOWS RISING IN COMPLEXITY

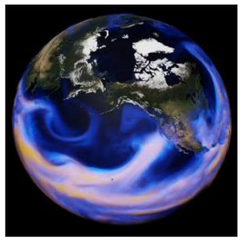
NVIDIA Omniverse

Platform for Connecting and Developing Industrial Digitalization Applications on OpenUSD

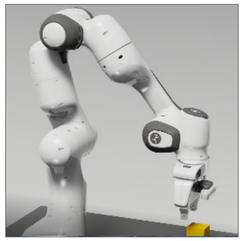
AI Avatars

3D Design

Autonomous Vehicles


Scientific Digital Twin

Industrial Digital Twin


Robotics

Synthetic Data Generation

Foundation Applications & APIs

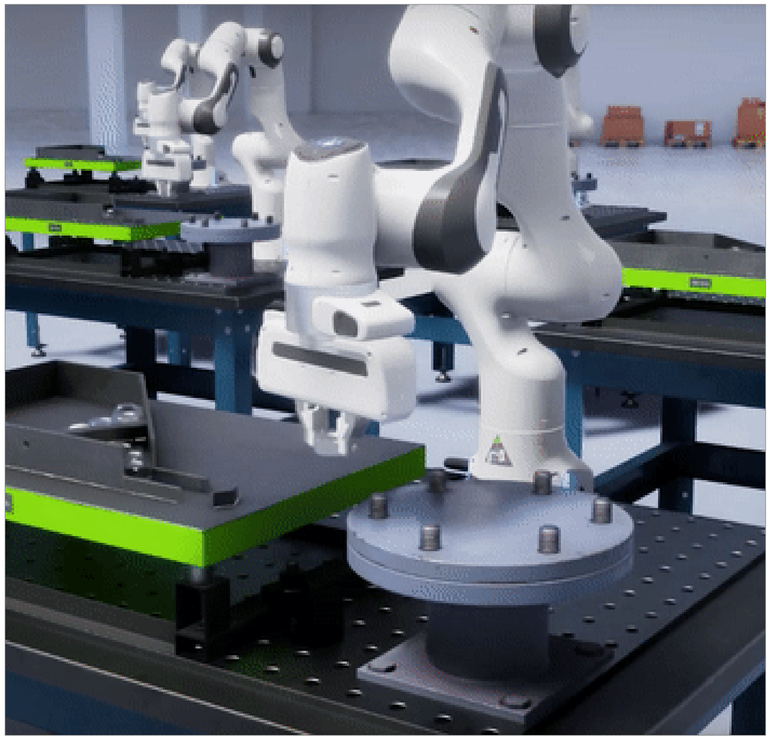
Code | USD Composer | DRIVE Sim | Isaac Sim | Replicator | USD-GDN Publisher

Development Platform

NVIDIA Omniverse

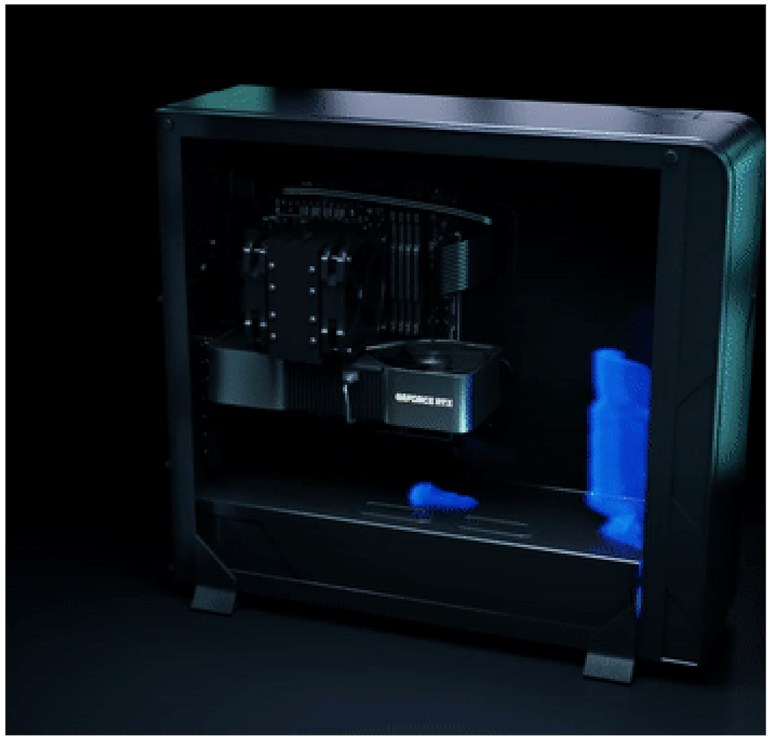
NVIDIA RTX-Enabled Systems from Edge to Cloud

NVIDIA PhysX
Rigid & Soft Body Dynamics, Destruction, Fluid & Fire



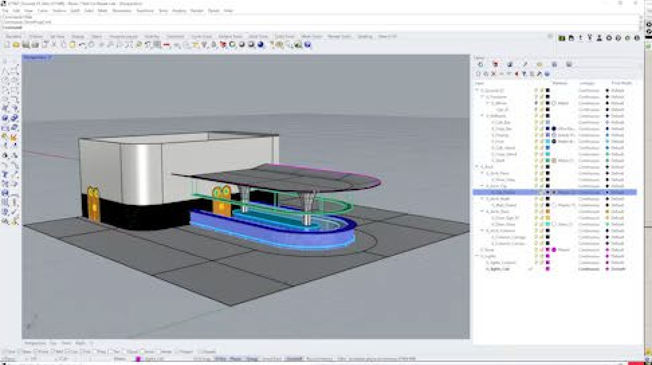
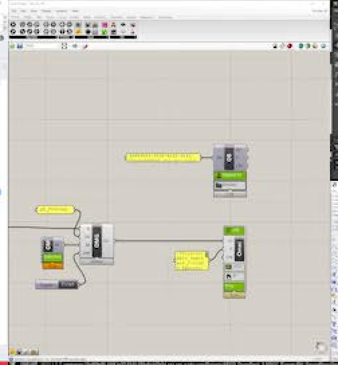
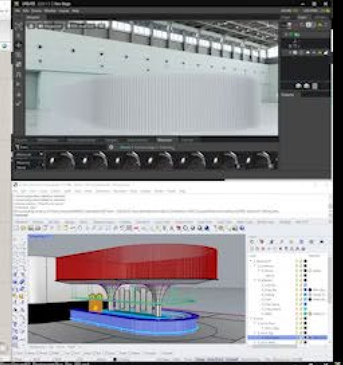
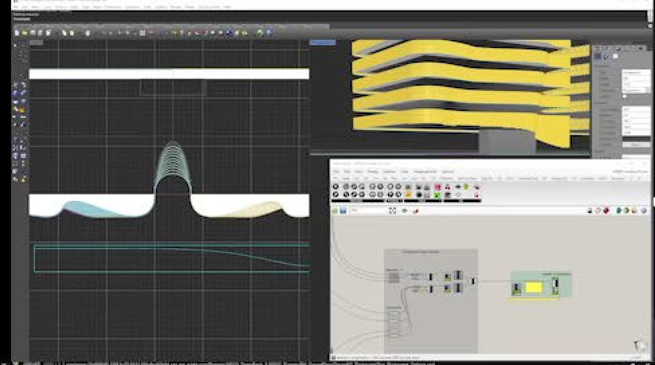
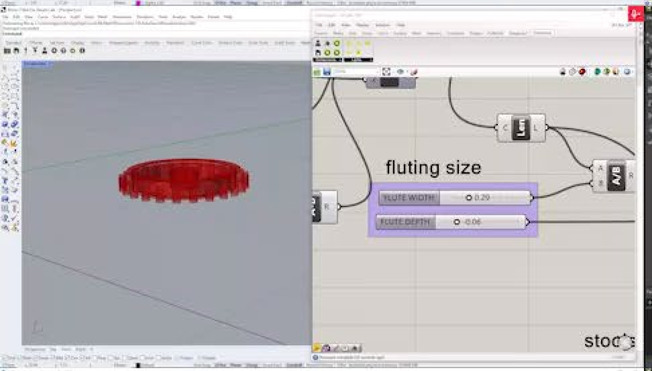
Import Physics Instance
Offline from External 3rd Party Application

NVIDIA Modulus
Accelerated with Physics-ML Platform



Physics Simulation in Omniverse

Multiple Ways to Visualize and Simulate Physics in Omniverse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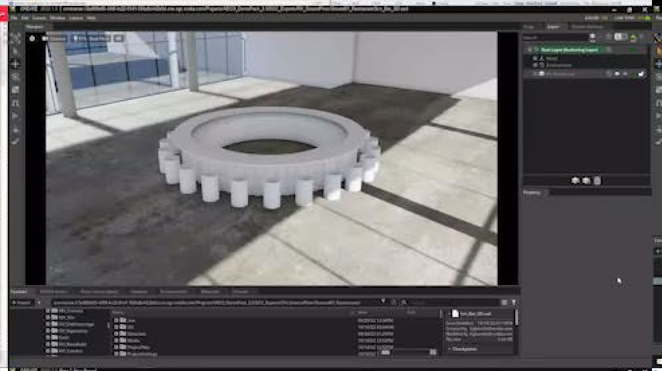
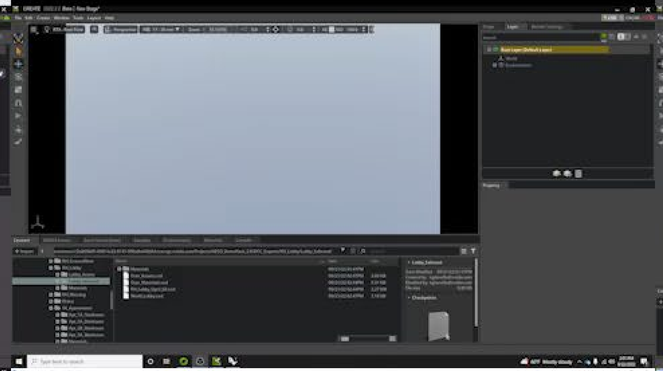
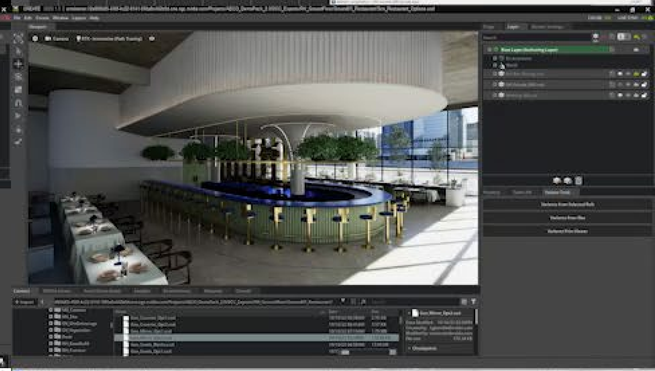
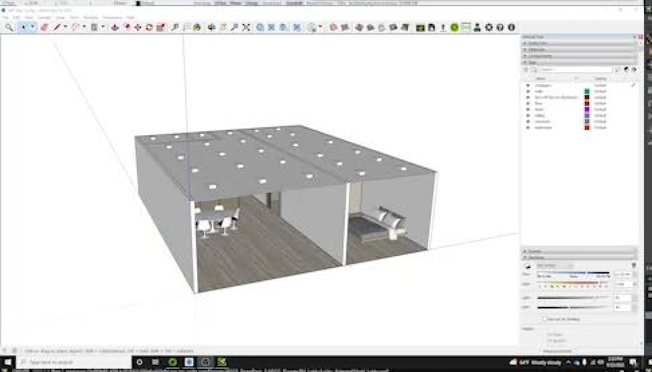
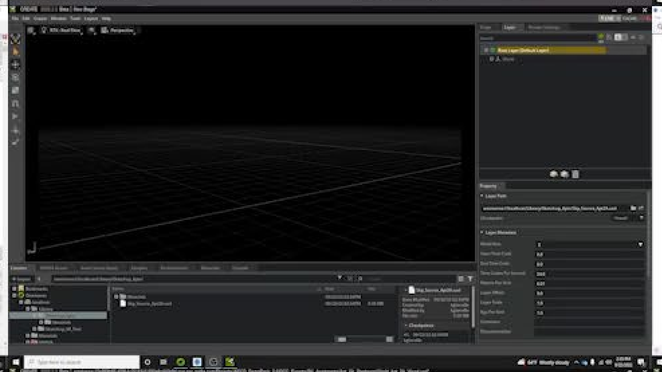
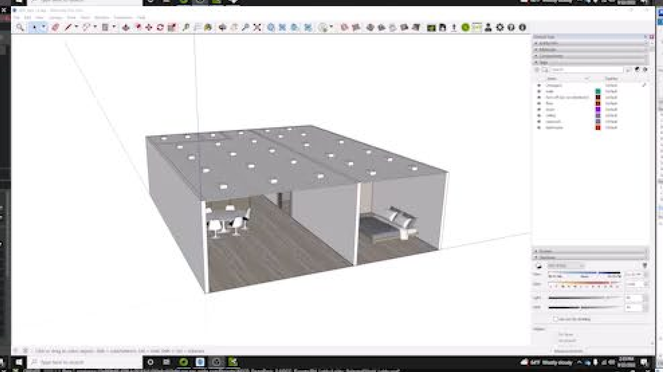
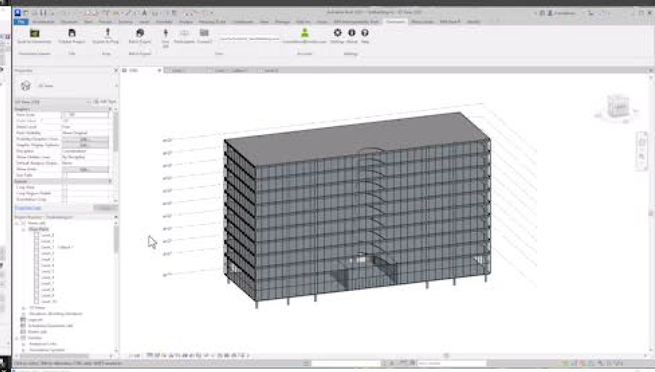
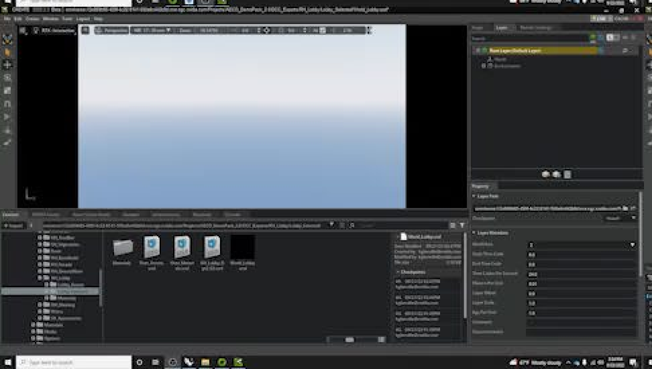
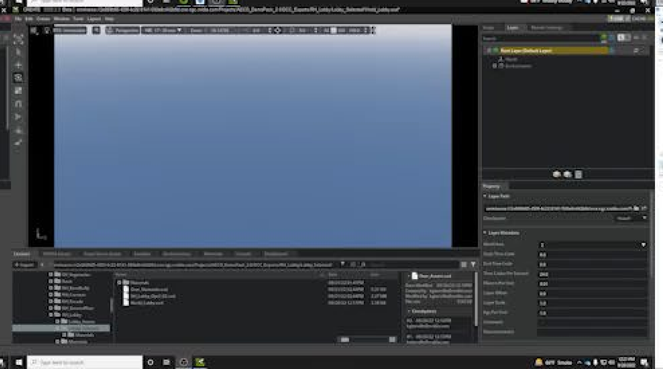
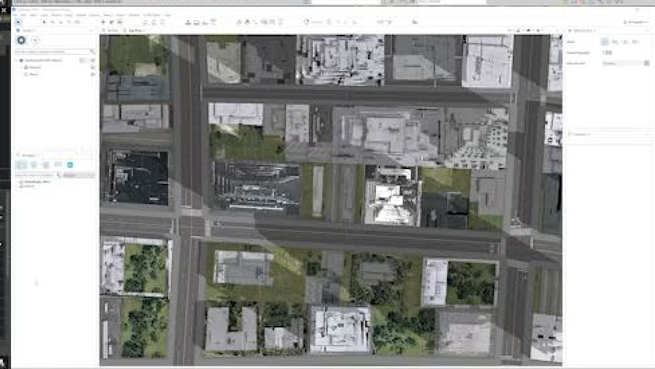
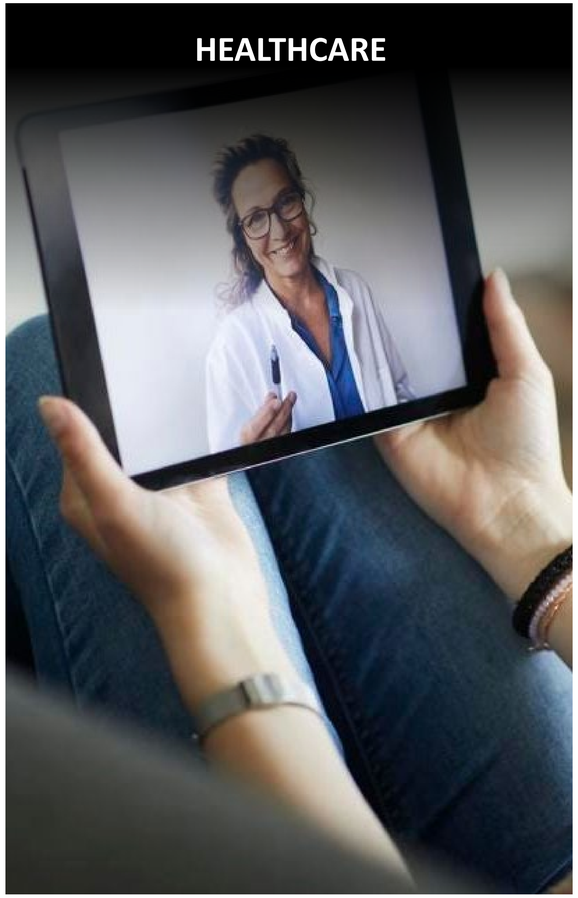
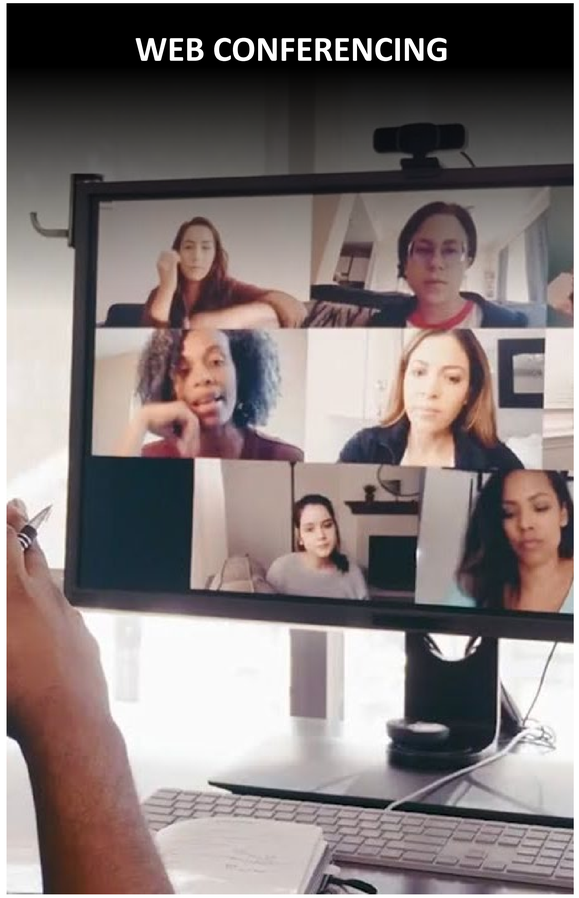
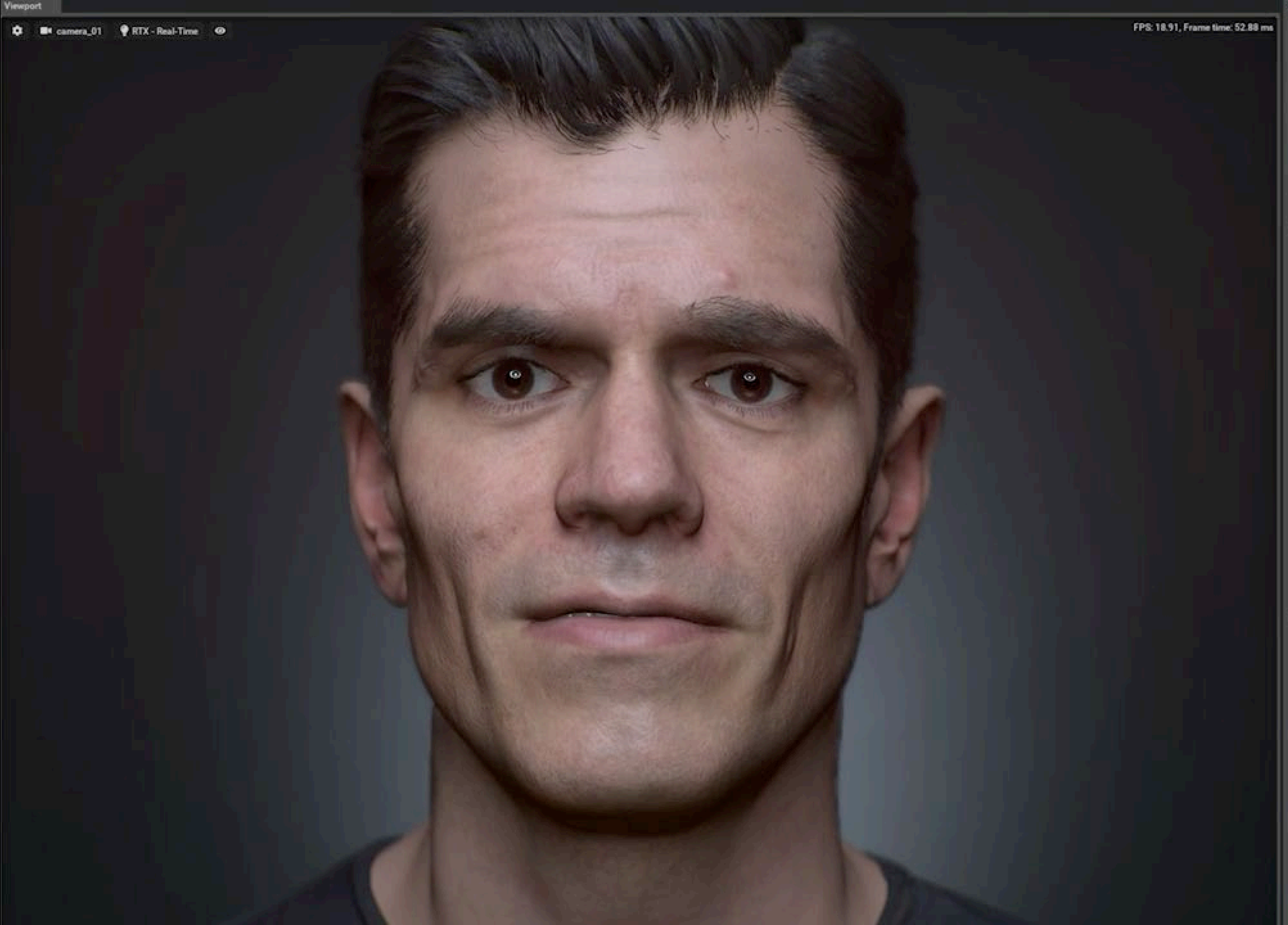









Avatars will exist for every application







Audio2Face Tool | Character Transfer | A2F Data Conversion | Rend

▼ AUDIO PLAYER

Track Root Path: audio2face-data/tracks

Track Name: voice_male_g1c.wav

Range: 0.00

▶ ATTACHED PRIMS

▼ EMOTION

Neutral	0.452
Amazement	0.1925
Anger	0.0
Cheekiness	0.0
Disgust	0.0
Fear	0.00007
Grief	0.0
Joy	0.338
Outofbreath	0.0
Pain	0.0
Sadness	0.0

▼ AUTO-EMOTION

Emotion Detection Range	
Keyframe Interval	1.406
Emotion Strength	1.0
Smoothing	1
Max Emotions	5
Emotion Contrast	1.361
Preferred Emotion	is not set
Strength	

☑ Auto Generate On Track Change

GENERATE EMOTION KEYFRAMES

Thank you