NVIDIA OMNIVERSE - Building Blocks for the Industrial Metaverse

Uwe Rechkemmer – February 2025

Who’s presenting?

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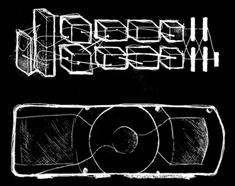
Pioneering Accelerated Computing

Accelerated computing requires full-stack optimization, from chip architecture, systems, and acceleration libraries, to refactoring the applications. The global NVIDIA ecosystem spans 4 million developers, 40,000 companies, and over 3,000 applications.

2012 ALEXNET



PERCEPTION AI

SPEECH RECOGNITION
DEEP RECSYS
MEDICAL IMAGING

GENERATIVE AI

DIGITAL MARKETING
CONTENT CREATION

AGENTIC AI

CODING ASSISTANT
CUSTOMER SERVICE
PATIENT CARE

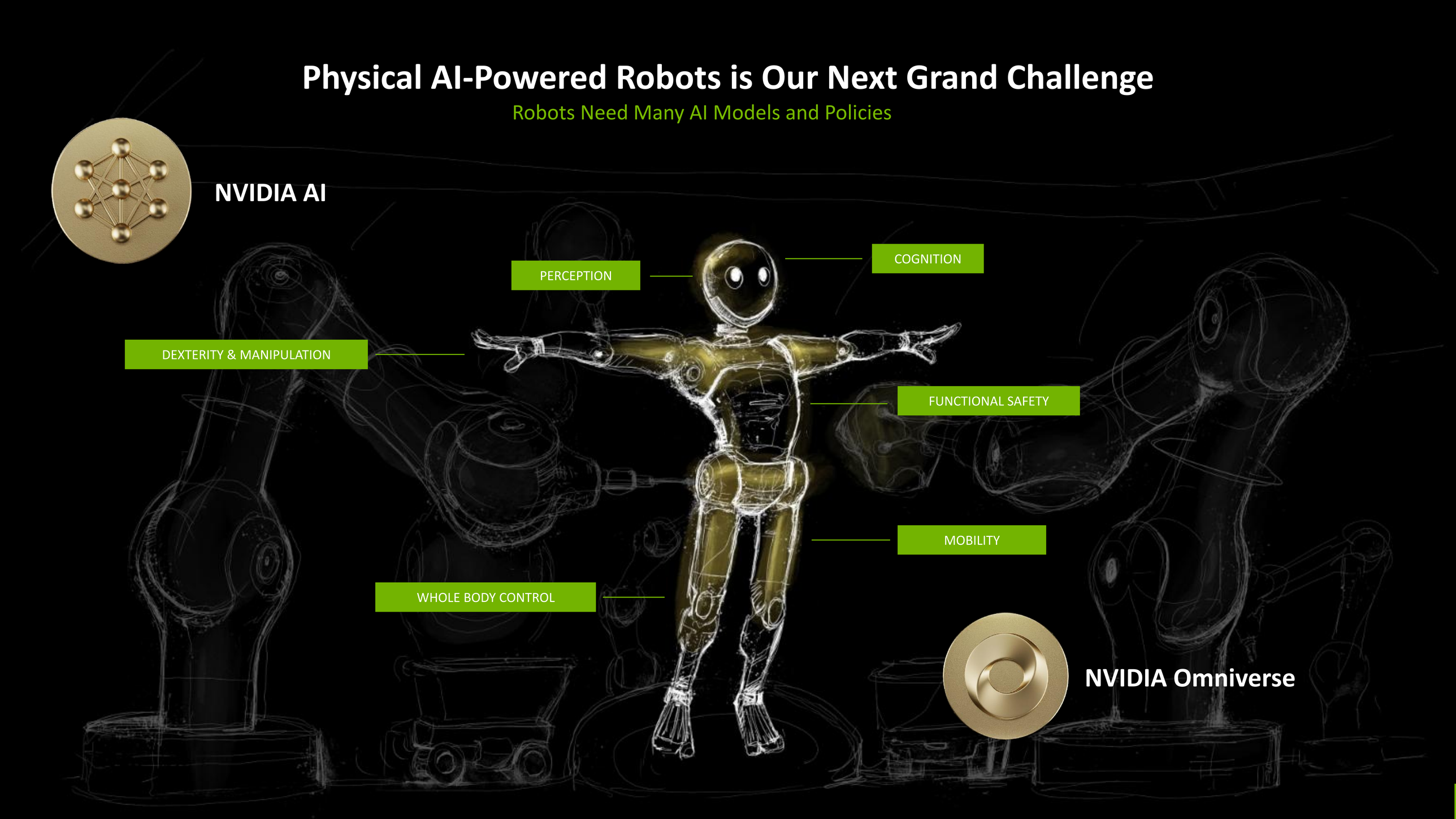
PHYSICAL AI

SELF-DRIVING CARS
GENERAL ROBOTICS

Physical AI-Powered Robots is Our Next Grand Challenge

Robots Need Many AI Models and Policies

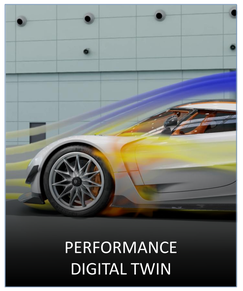
NVIDIA AI

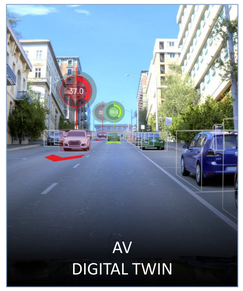


NVIDIA Omniverse

Enterprises Investing heavily in Industrial Scale Digital Twins

Increase Efficency and Enable Automation





NVIDIA
Omniverse

Key Attributes of a Live, Full Fidelity Digital Twin

Enabling Accurate and Trustworthy Virtual Testing, Experimentation and Optimization

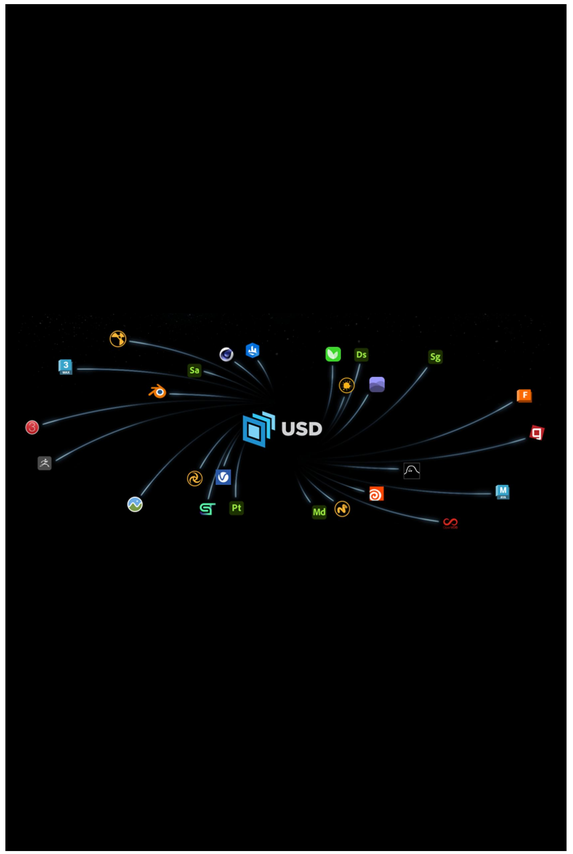
GROUND TRUTH DATA
Unified Virtual Datasets

PHYSICALLY ACCURATE REPLICA
Obeys the Laws of Physics

AI-ENABLING, AI-ENABLED
Optimized by AI & Enables Training of AI

PERFECTLY SYNCHRONIZED
Precision Timed, Perfectly Synced to the Real World

Key Technologies Accelerate Digitalization, Digital Twins, & Physical AI



OpenUSD

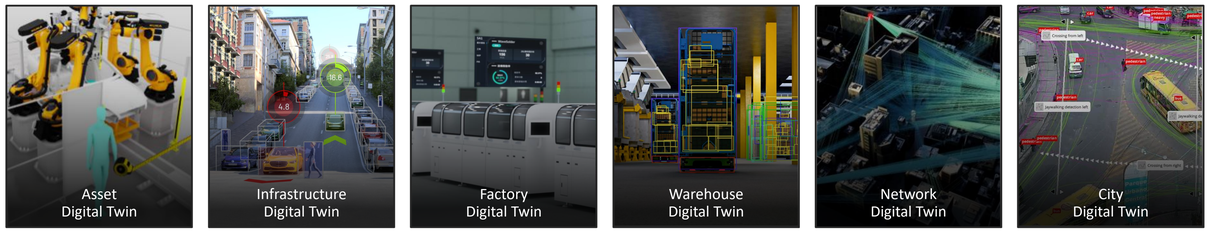
RTX Technology

Computer Vision, Synthetic Data Generation

Accelerated Computing

NVIDIA Omniverse

The Platform to Develop Industrial Digitalization and Physical AI Simulation Applications



APIs and Services

USD Write	USD Render	USD Notify
USD Query	Omniverse Channel	App Streaming

SDKs

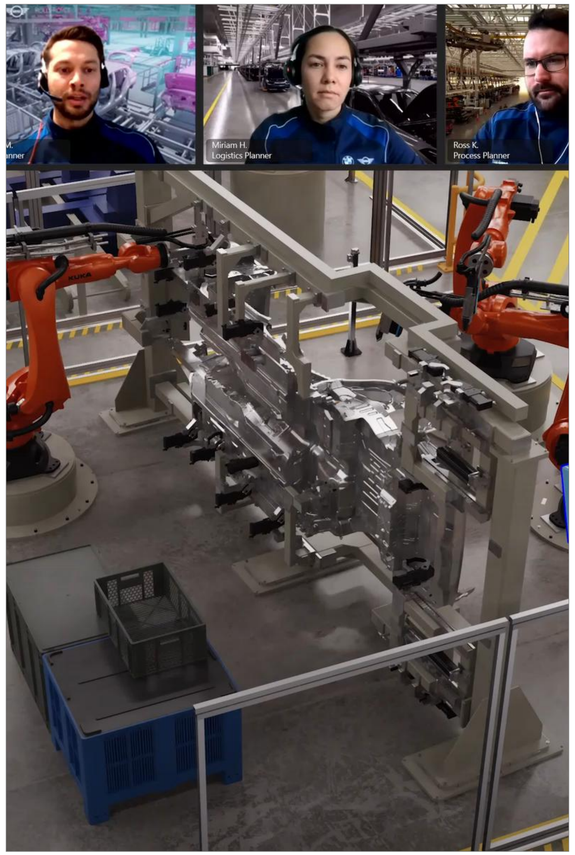
OpenUSD
Kit

NVIDIA
Omniverse Cloud

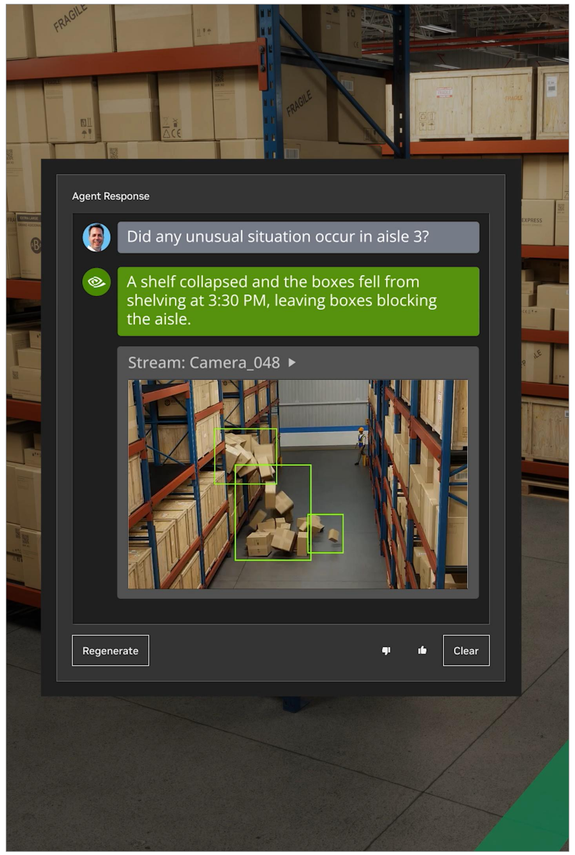
Microsoft
Azure

Digital Twins Built on Omniverse & OpenUSD Deliver New Possibilities

Physically Based Visualization



Streamlined Communications



AI Optimized Operations

Testing Ground - AI, Robotics

Platform to provide a unified pipeline from Planning to Operation

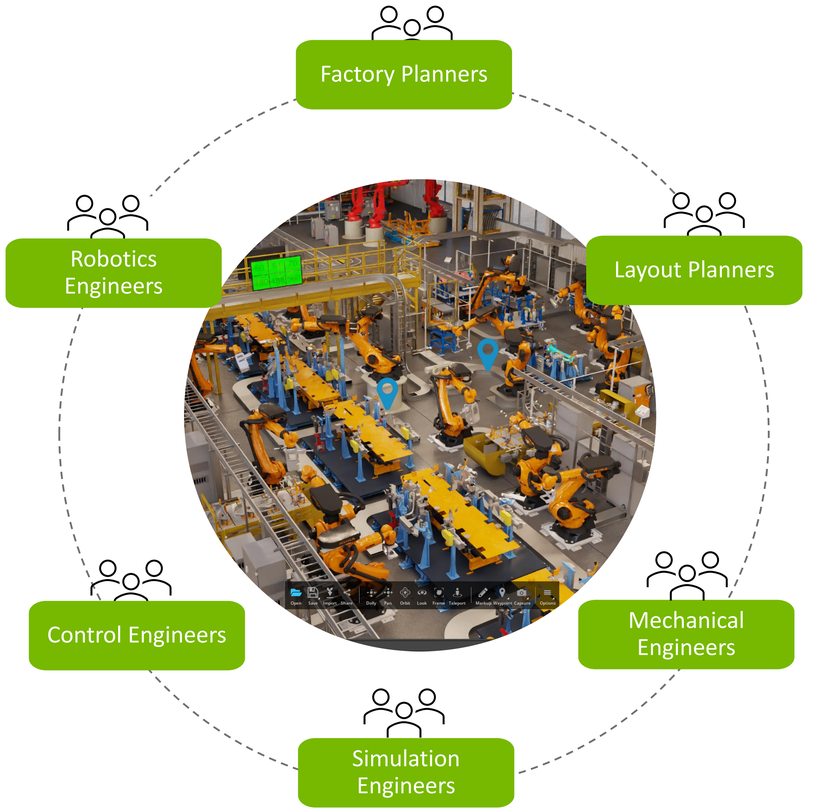
Data connection and collaboration engine <-> 3D Visualization <-> Simulation, Optimization, AI

Existing Data

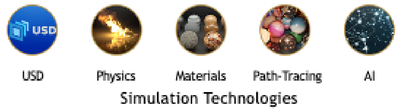
AUTODESK 3ds Max
AUTODESK Alias
AUTODESK VRED
AUTODESK Maya
AUTODESK Revit
CATIA
MicroStation CONNECT Edition
blender
ptc
SIEMENS
CINEMA 4D by MAXON
Ae Pt Ds
ParaView
Rhinoceros
SOLIDWORKS
Unity
UNREAL ENGINE

- Structure
- Layout
- Equipment
- Process & Metadata
- Product
- Logistics
- Robotics Animation
- Point Cloud

Omniverse
Unified Asset



USD



Integration & Planning

- Facility Design & Layout
- Process Simulation
  Clash Detection / Avoidance
- Material Flow
- Worker Safety & Ergonomics
- Point Cloud Visualization
- Process / Production Planning
- Robot Path Planning

Operations

- Defect Detection
- Predictive Maintenance
- Worker Training
- Process Optimization
- Robotics Training
- Robotics Orchestration
- IoT Simulation
- Lighting Optimization

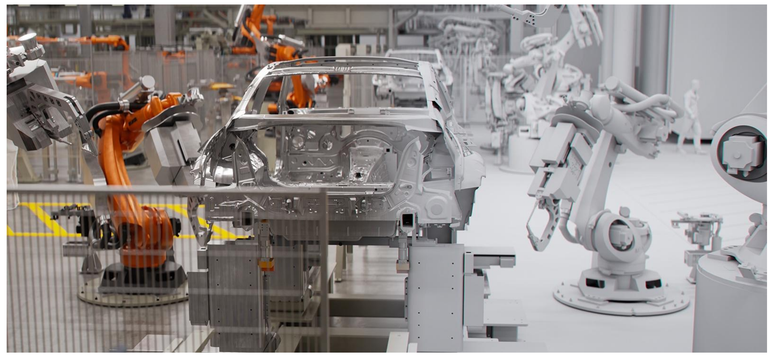
NVIDIA

Platform Capabilities

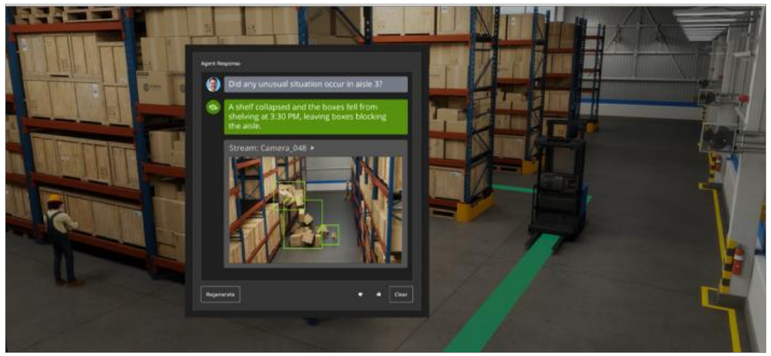
NVIDIA Omniverse deliver Building Blocks for the industrial Metaverse

Develop tools and apps for planning, simulation, and operations use cases

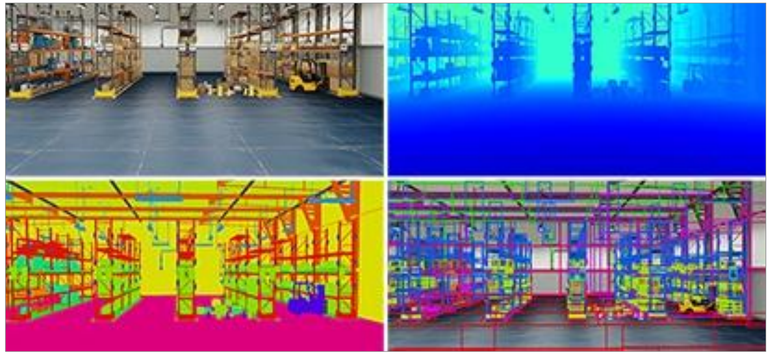
OpenUSD



Omniverse Cloud Sensor RTX APIs



NVIDIA NIM

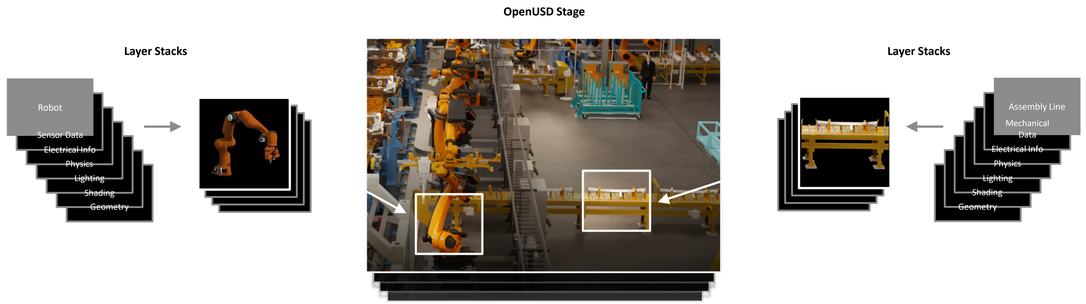


Synthetic Data Generation

Developer Tools, SDKs

Universal Scene Description (OpenUSD)

Powerful 3D Framework and Universal Data Interchange



Ecosystem Momentum

AOUSD
Alliance for OpenUSD

NVIDIA

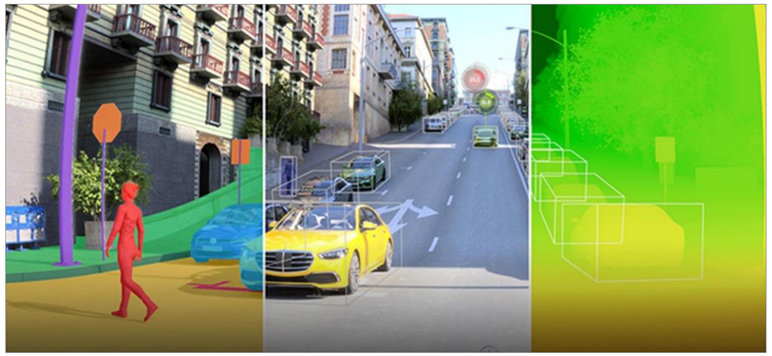
AOUSD

Alliance for OpenUSD

PIXAR Adobe AUTODESK NVIDIA

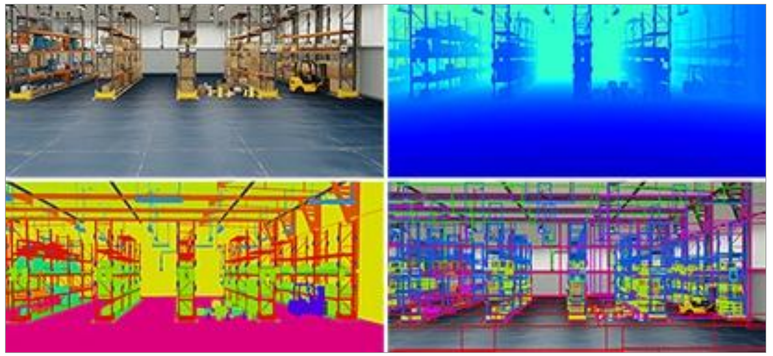
NVIDIA RTX

Real time graphics aren’t just for entertainment - rendering isn’t just for pretty pictures



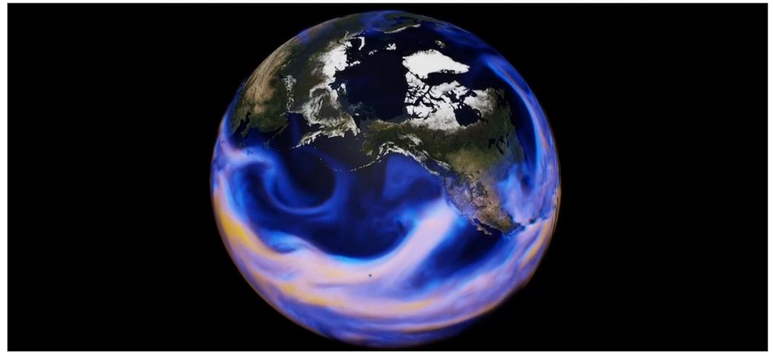
Autonomous Vehicles Simulation

Robot Simulation



Synthetic Data Generation

Industrial Visualization



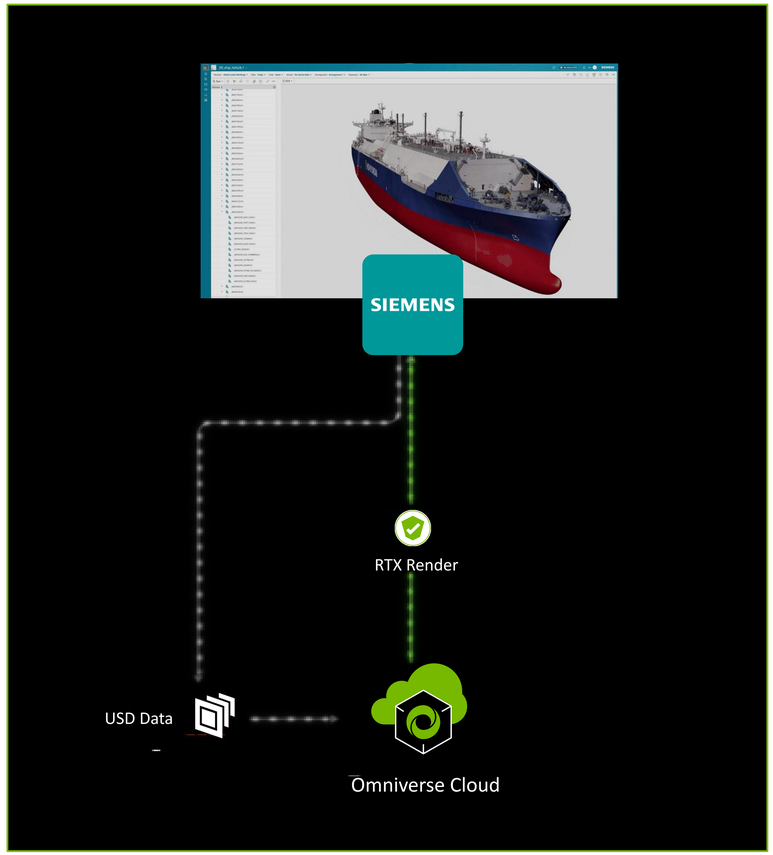
Scientific Visualization

Generative AI

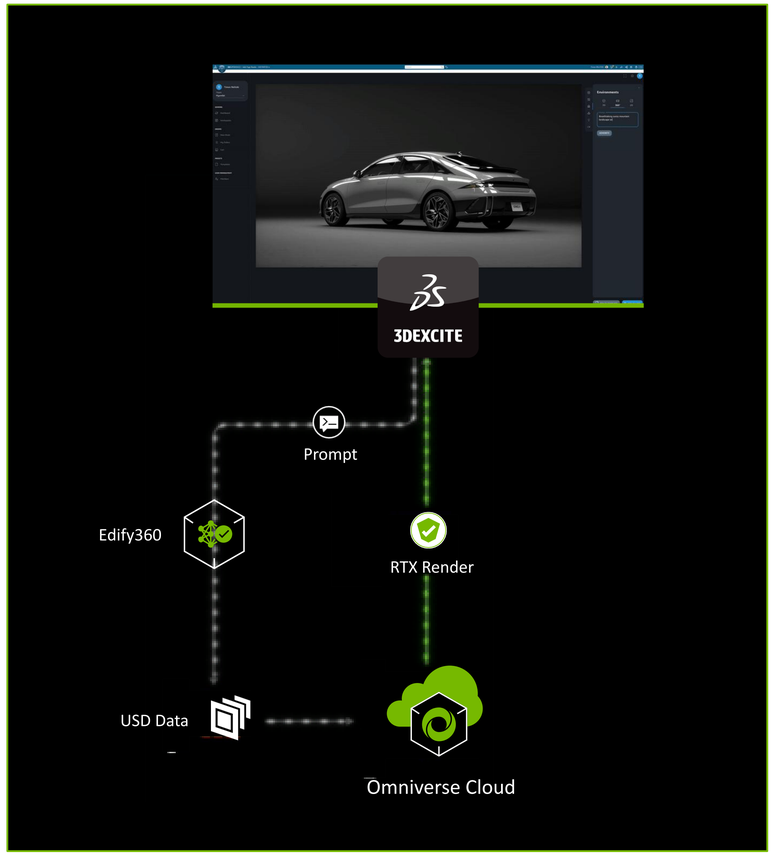
NVIDIA Omniverse Cloud Sensor RTX APIs

Primary Developer Use Cases

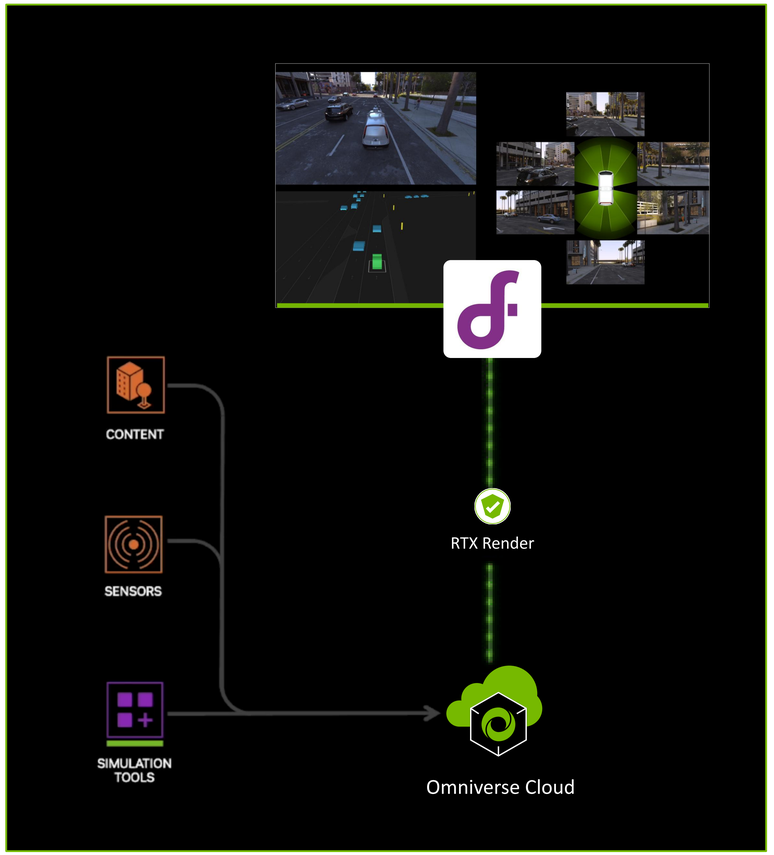
Embed Omniverse Viewports in 3D Apps



Connect Generative AI Tools to 3D Apps

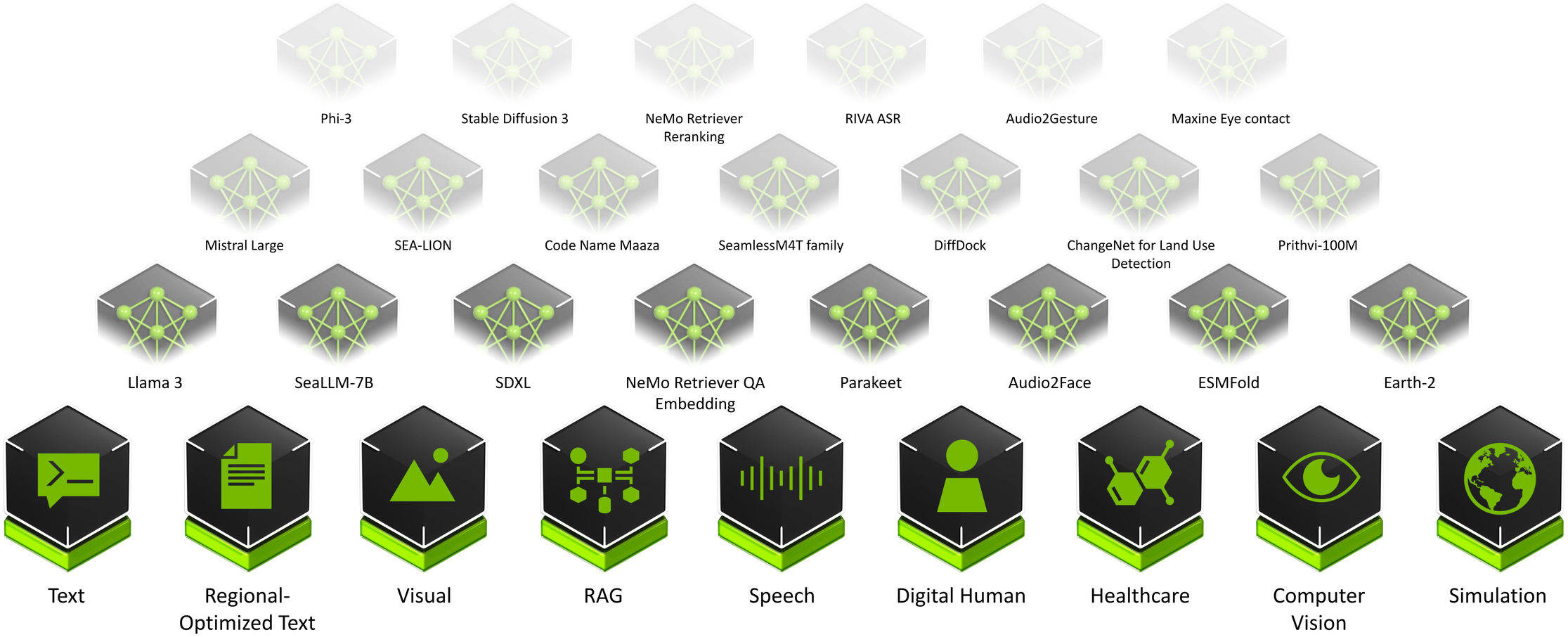


Scale Simulation Workflows for AI Systems



AI- NIM – NVIDIA Inference Microservices

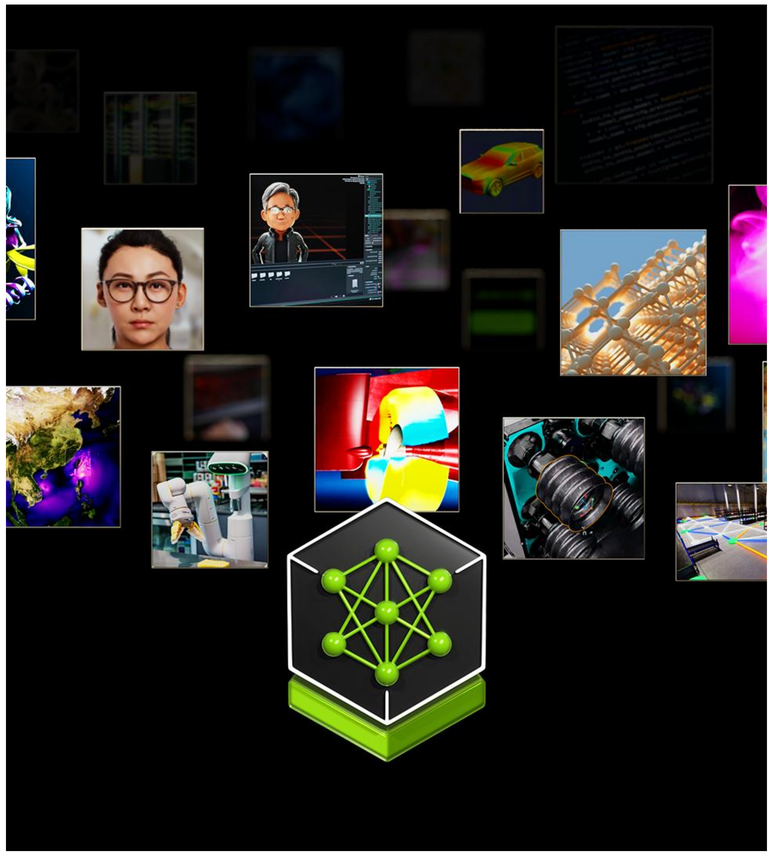
NVIDIA NIM For Every Domain



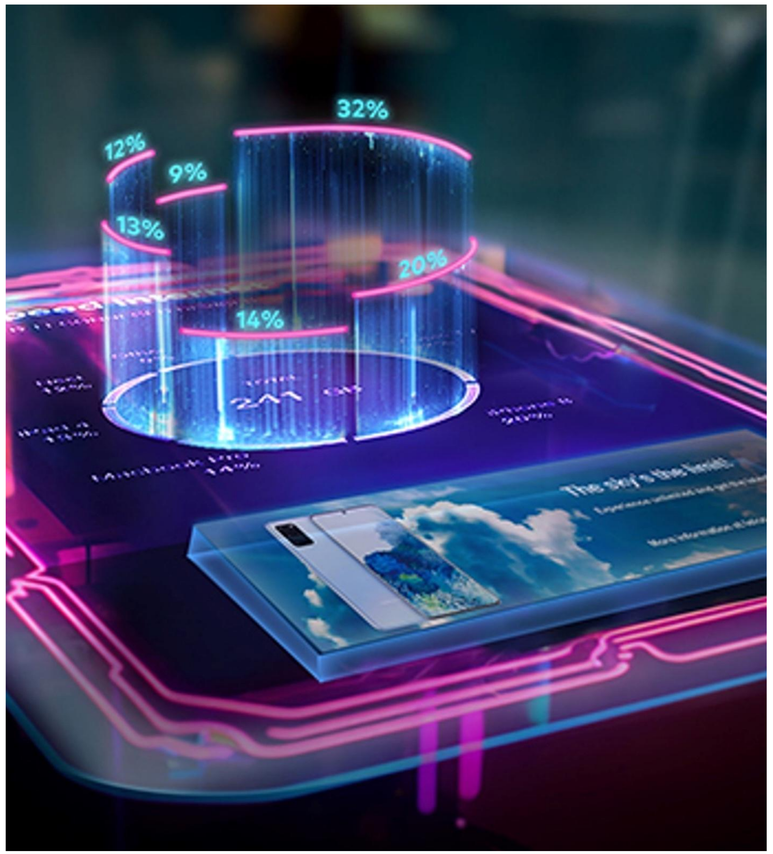
Putting Generative AI Into Production

```
Get API K

from openai import OpenAI

client = OpenAI(
  base_url = "https://integrate.api.nvidia.com/v1",
  api_key = "$API_KEY_REQUIRED_IF_EXECUTING_OUTSIDE_N
)

completion = client.chat.completions.create(
  model="meta/llama-3.1-405b-instruct",
  messages=[{"role":"user","content":"Write a limeric
onders of GPU computing."}],
  temperature=0.2,
  top_p=0.7,
  max_tokens=1024,
  stream=True
)

for chunk in completion:
  if chunk.choices[0].delta.content is not None:
    print(chunk.choices[0].delta.content, end="")
```

Simplified development with a path to production



Applications require multiple models and complex reasoning

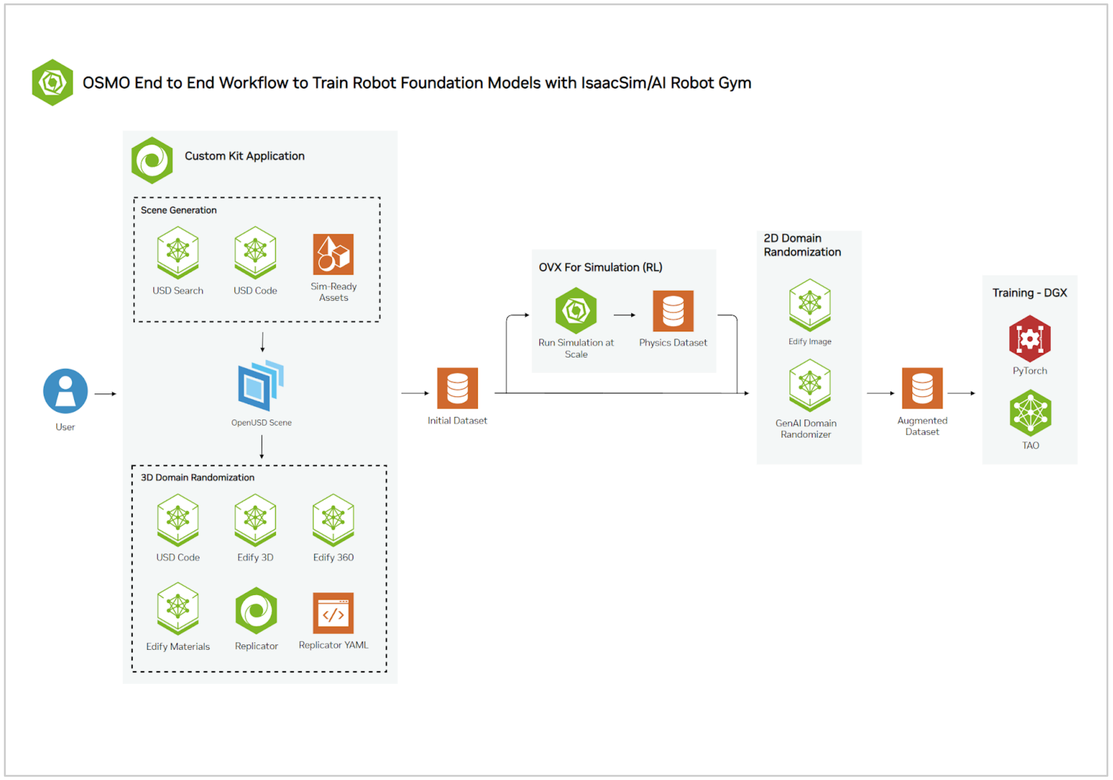


Businesses are looking to add revenue- generating features and services

NVIDIA Omniverse and NIM for Synthetic Data Generation

Generative AI-enabled synthetic data generation pipeline for perception robot models

Omniverse, Isaac Sim, USD NIM, SDXL NIM



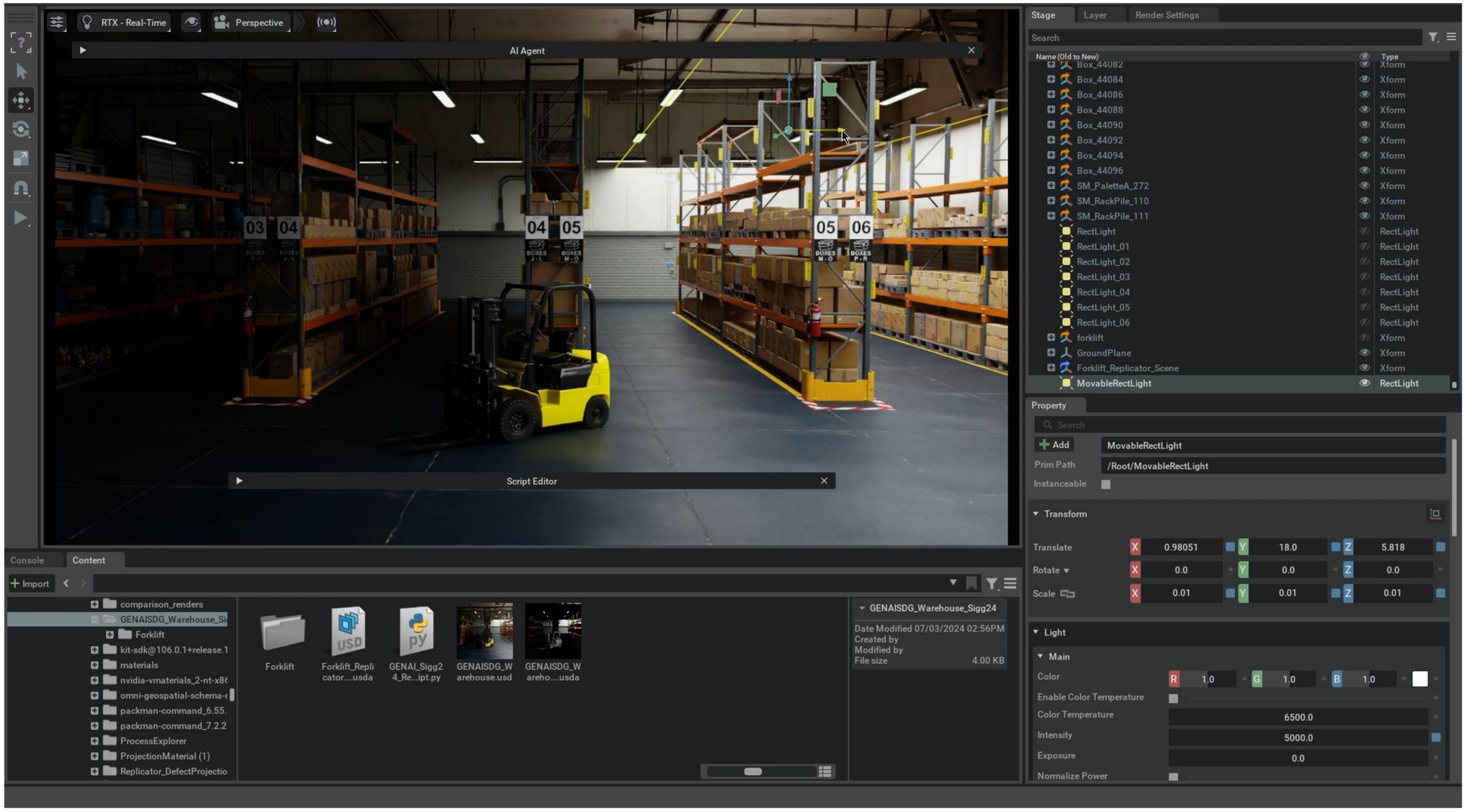
Available Now

- Reference Architecture
- Workflow Guide
- Technical Blog

NVIDIA

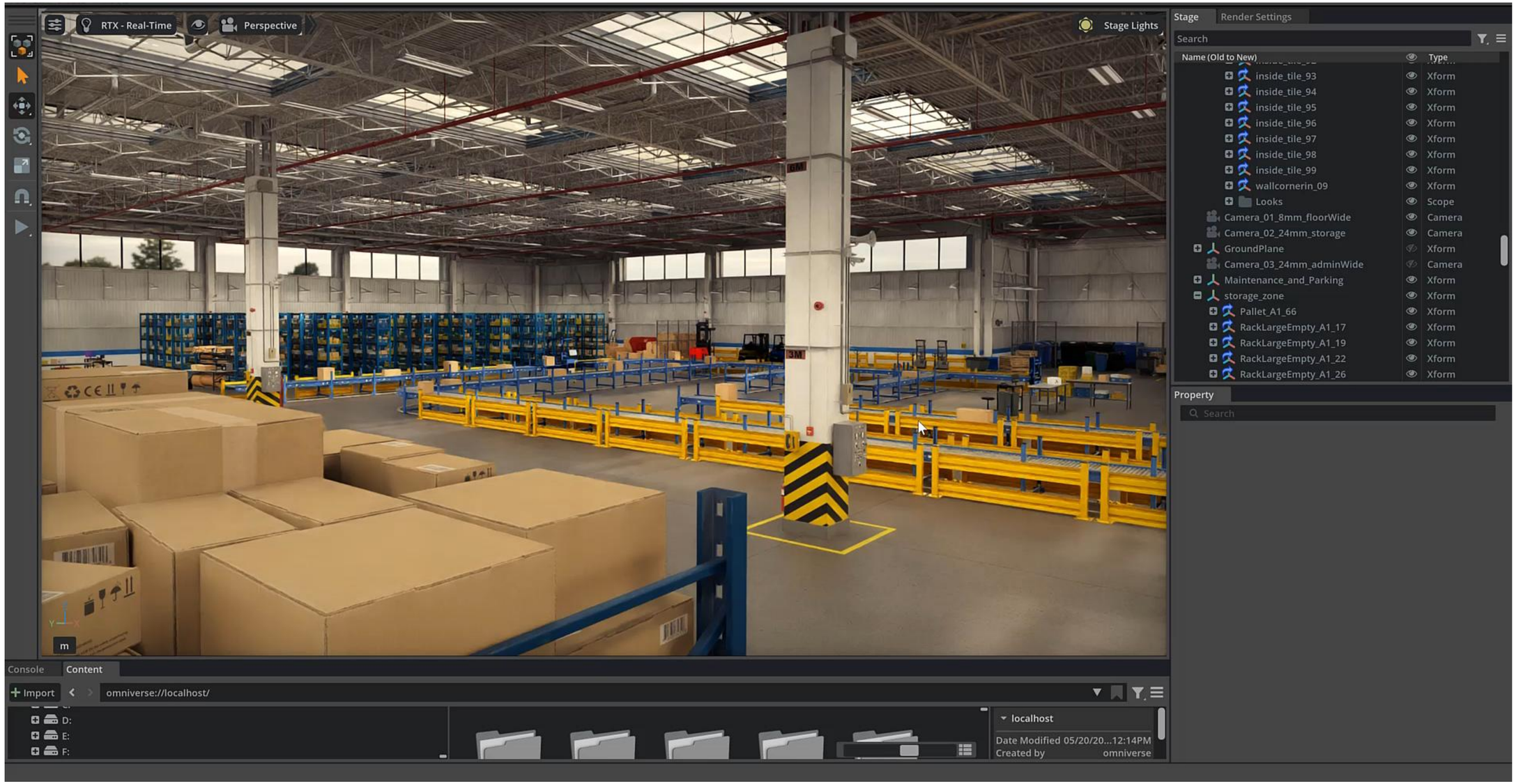
Use Case: Domain Randomization

Enrich datasets with USD Code



Use Case: Search Assets, Write Python Code

Simplify development and synthetic data generation workflows with USD Search, USD Code



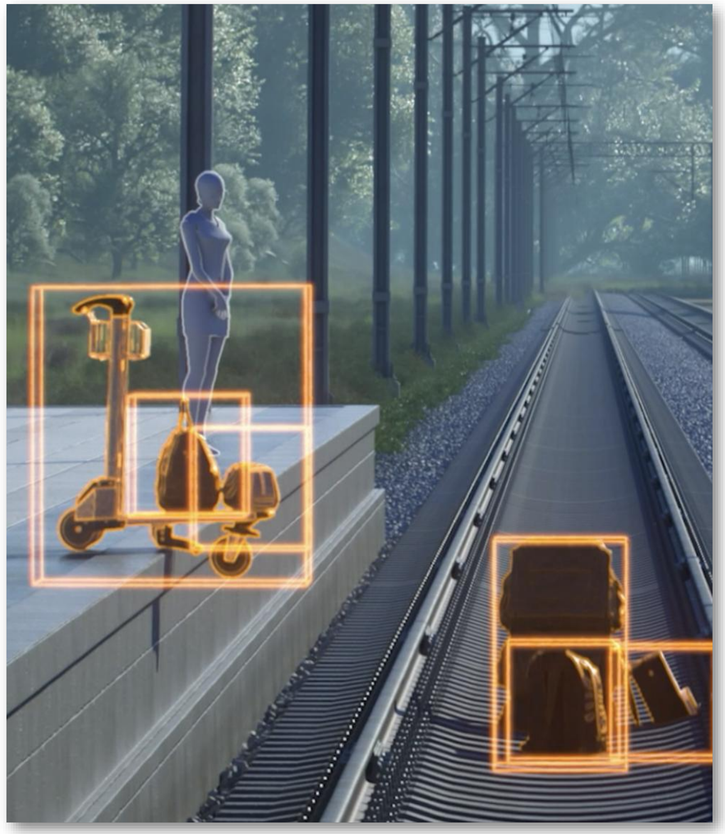
Use Case: Generative Augmentations for Photorealism

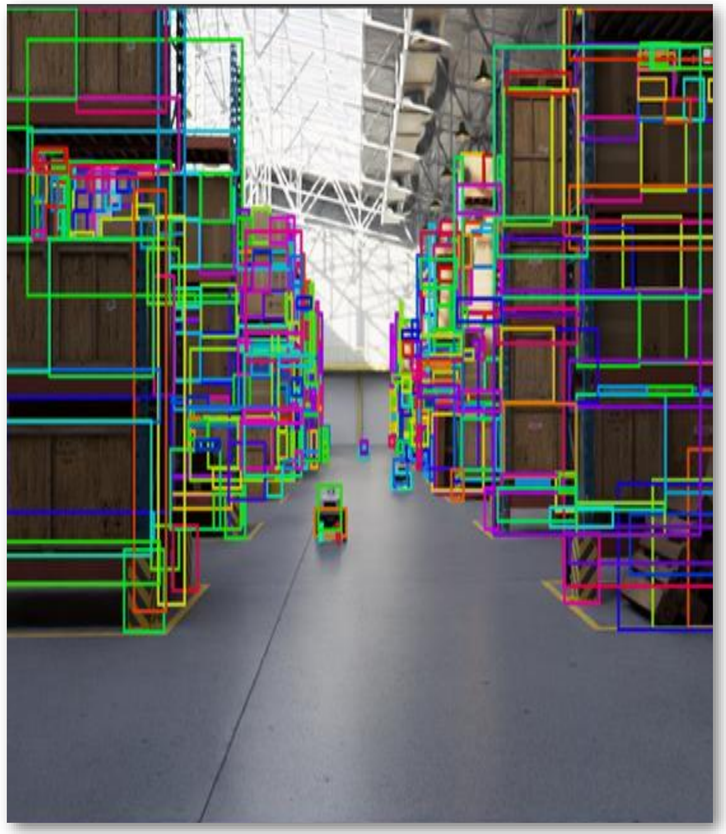
Modify synthetic data with Stable Diffusion XL and ComfyUI to create flexible augmentation pipelines

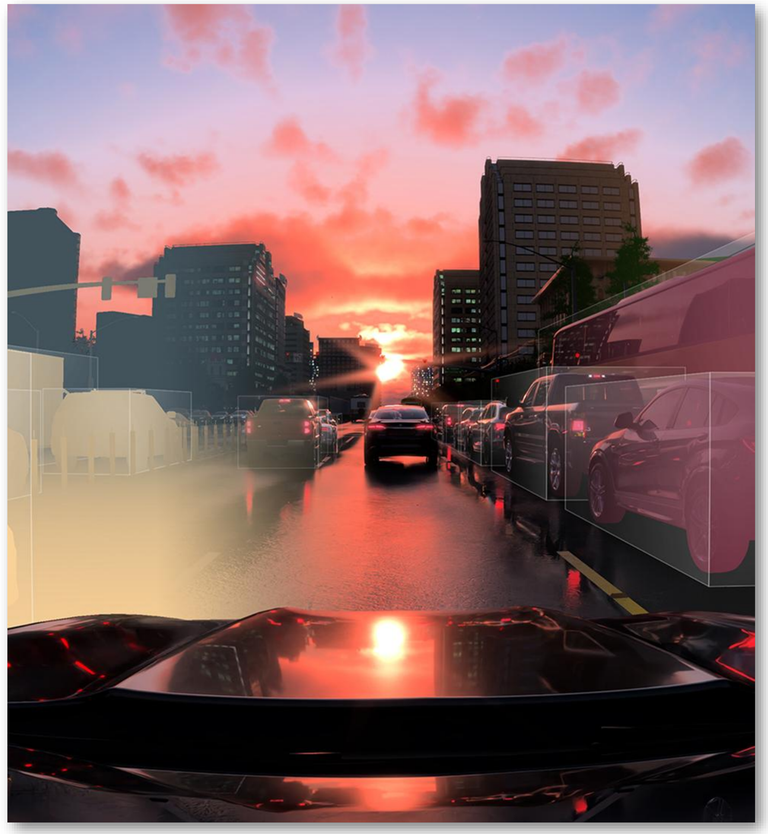
Synthetic Data Generation

What is Synthetic Data?

Annotated data generated from computer simulations or algorithms

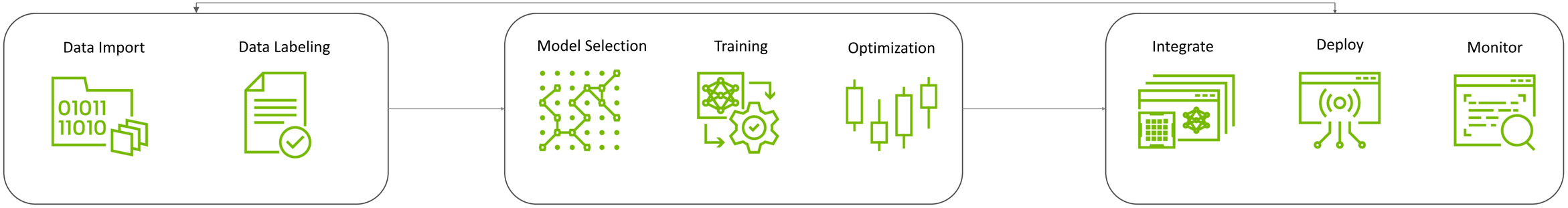






Synthetic Data Generation

Data is still the Limiting Factor

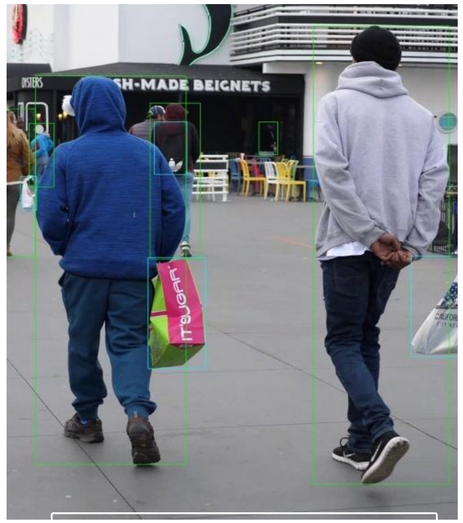


DATA PREPARATION

MODEL TRAINING

DEPLOYMENT

DIFFICULT TO COLLECT AND LABEL



PRIVACY

BEYOND RGB SPECTRUM

CONSTANT CHANGES

Core Components of Omniverse Replicator

Randomizers, Annotators and Writers

DOMAIN RANDOMIZATION

Randomize lighting, materials, colors, positions, and more to help the AI train on relevant information

GROUND TRUTH ANNOTATION

Perfectly labeled image for model training

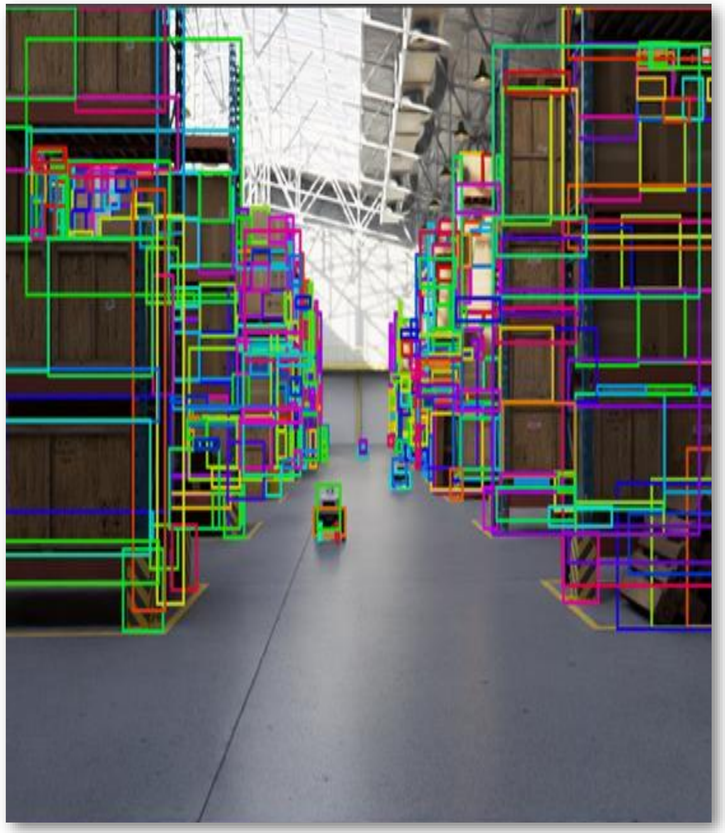
DATA GENERATION AND OUTPUT

Output data in the right format to seamlessly work with TAO toolkit and streamline the training workflow

Summary

Synthetic Data Generation

- Synthetic data can bootstrap the training of computer vision models where data is limited, restricted or doesn’t exist
- Omniverse Replicator is a framework for building custom synthetic data generation pipelines and services
- Primary go to market is through ISVs that provide SDG services (e.g Rendered.AI) and end-to-end model training and deployment services (e.g. Edge Impulse)



Robotics Development & Simulation

3 Computers for the Next Wave of AI

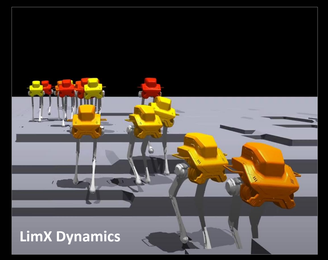
OMNIVERSE

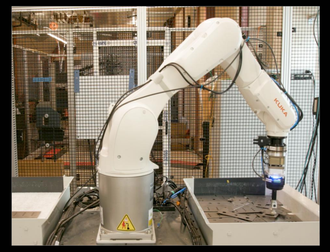
AI

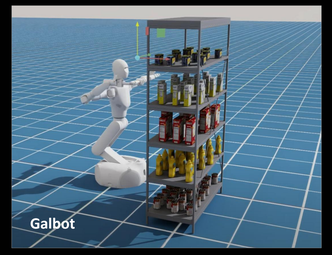
ROBOT

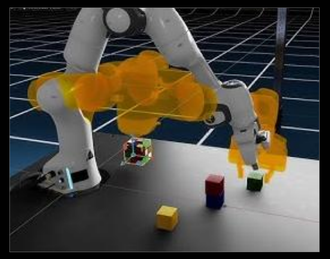
Physical AI is born in simulation

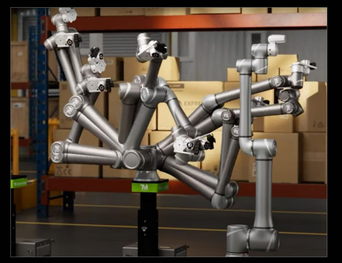
OMNIVERSE

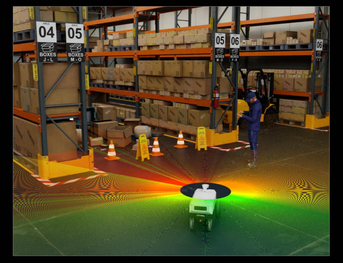


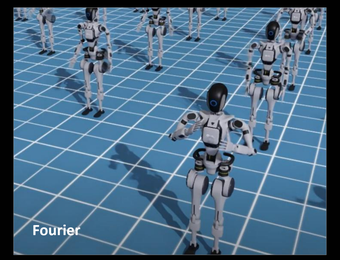


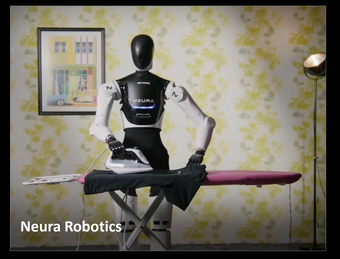












Develop Robot Simulation Applications on NVIDIA Omniverse

Isaac Sim for synthetic data generation, robot simulation and testing

Isaac Sim
to test and simulate

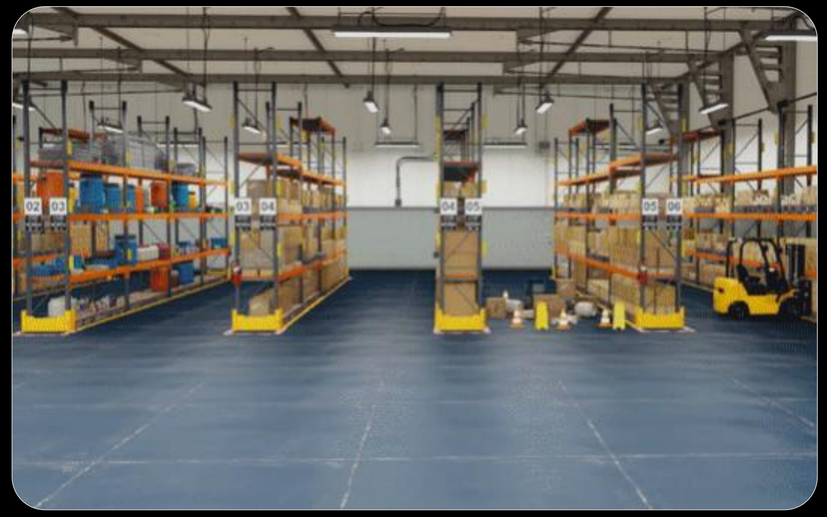
DATA	SENSORS	UTILITIES	SDG	INTERFACES
URDF	Stereo & RGBD	PhysX	Annotations	ROS
CAD	Lidar, Ultrasonic	RMP Controller	Randomization	ROS2
Gazebo	IMU	Optimizers	Writers	PYTHON
Mujoco	Contact Sensors	OCC Mapping	Pose Estimation	OmniGraph
	Sensor Models	Robot Assembler	Object & People Detection	CUSTOM

Omniverse Platform

SDKs & APIs

OpenUSD | RTX | PhysX

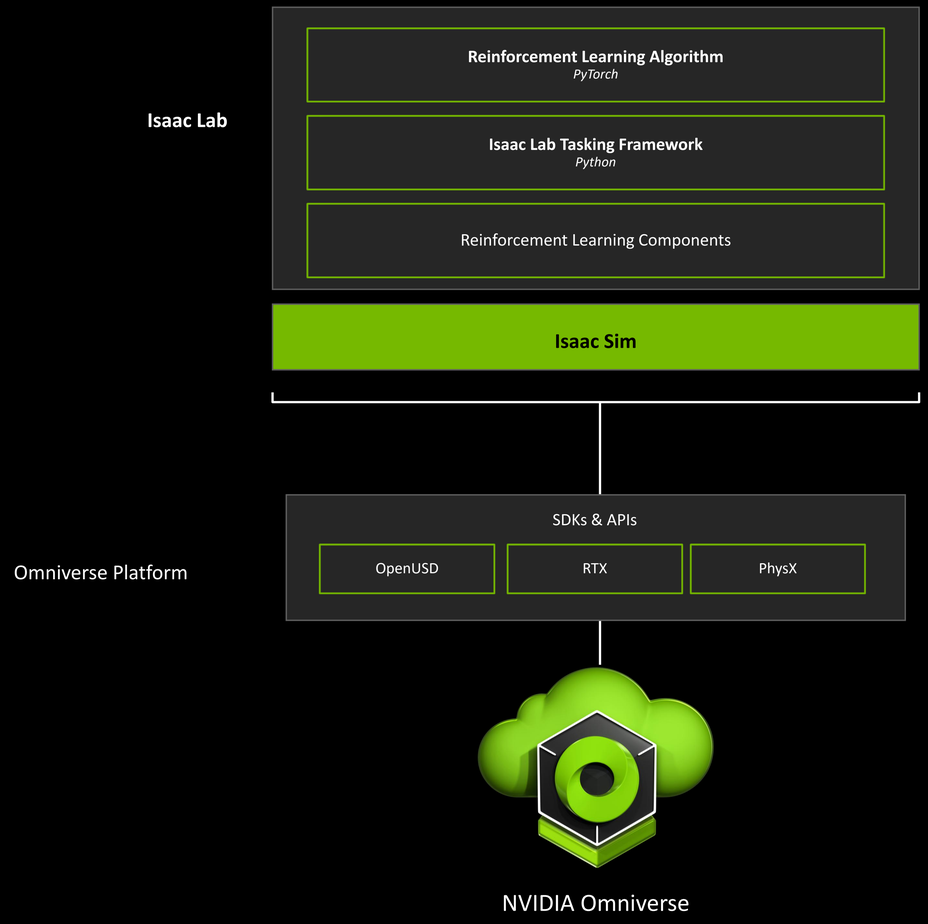
NVIDIA Omniverse



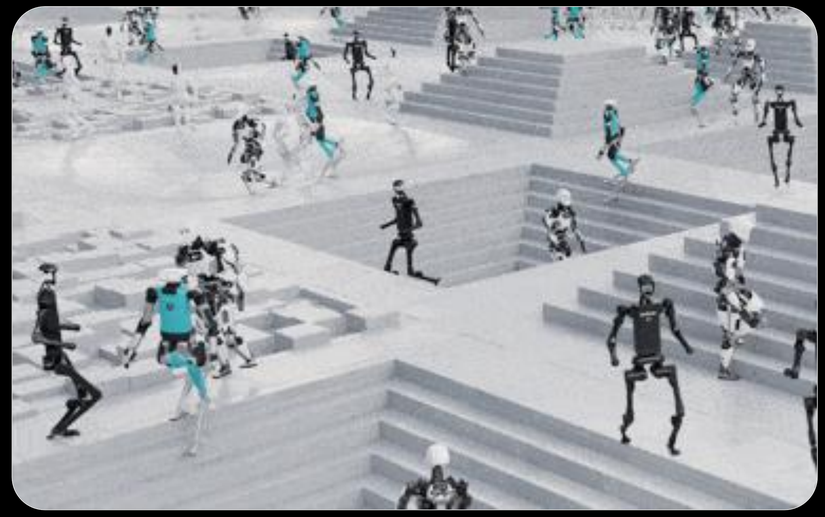
NVIDIA Isaac Sim

Develop Robot Simulation Applications on NVIDIA Omniverse

Isaac Sim for synthetic data generation, robot simulation and testing



NVIDIA Omniverse



NVIDIA Isaac Lab

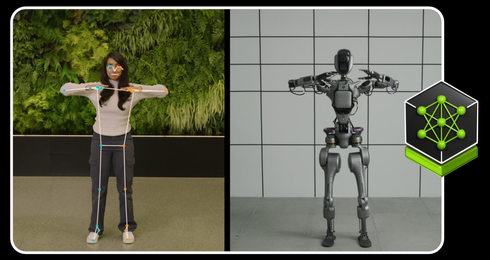
Performance Optimized for robotics training workflows

Deploy Anywhere, locally and on the cloud

Open Sourced, community contributions

Project GR00T for Humanoid Robots

Robot Learning



Human Demonstration

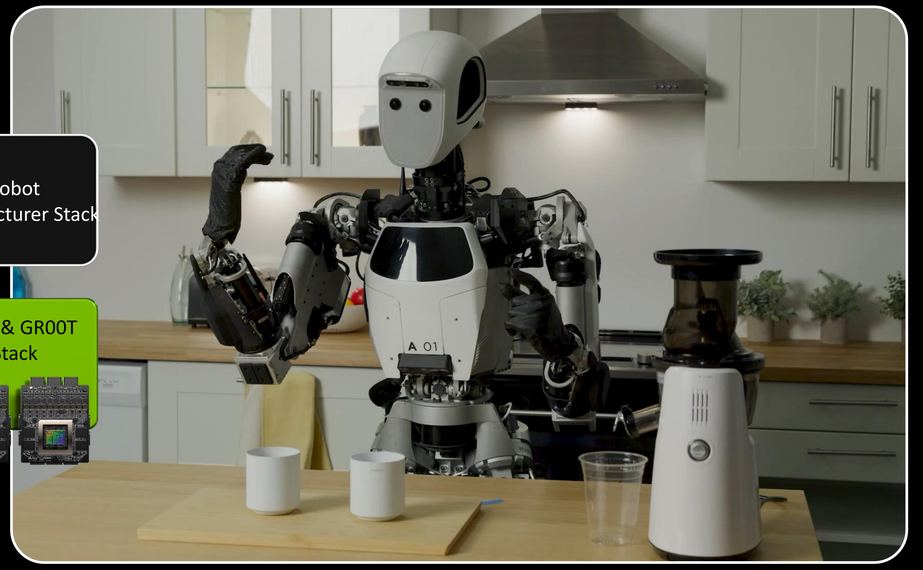
Teleoperation

NVIDIA Omniverse

NVIDIA
DGX Cloud

Robot
Manufacturer Stack

Isaac & GR00T
Stack



AGILITY ROBOTICS · APPTRONIK · BostonDynamics · Field AI · FIGURE · Fourier Intelligence · NEURA ROBOTICS · SANCTUARY

NVIDIA

Robotic Factories, Orchestrating Robots Building Robots

with NVIDIA Omniverse, Isaac, Metropolis

AMR Robot Digital Twins

Isaac Sim

Warehouse Digital Twin

Isaac Sim

Worker Digital Twins

Isaac Sim

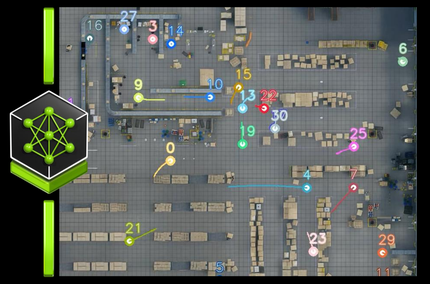
USD APIs

Omniverse Channel APIs

NVIDIA
Omniverse Cloud

NVIDIA
DGX Cloud

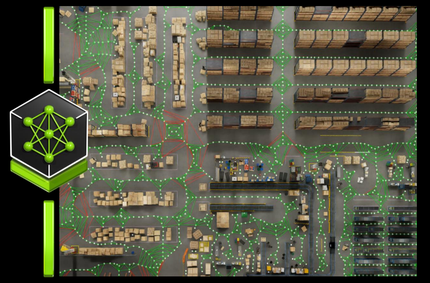
Sensor Fusion



Metropolis

Occupancy APIs

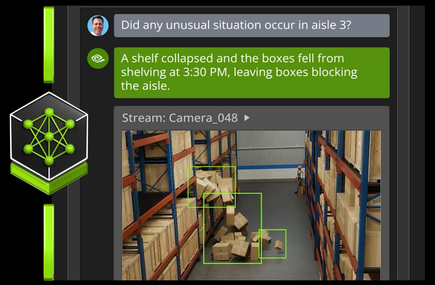
Route Planning



cuOpt

cuOpt APIs

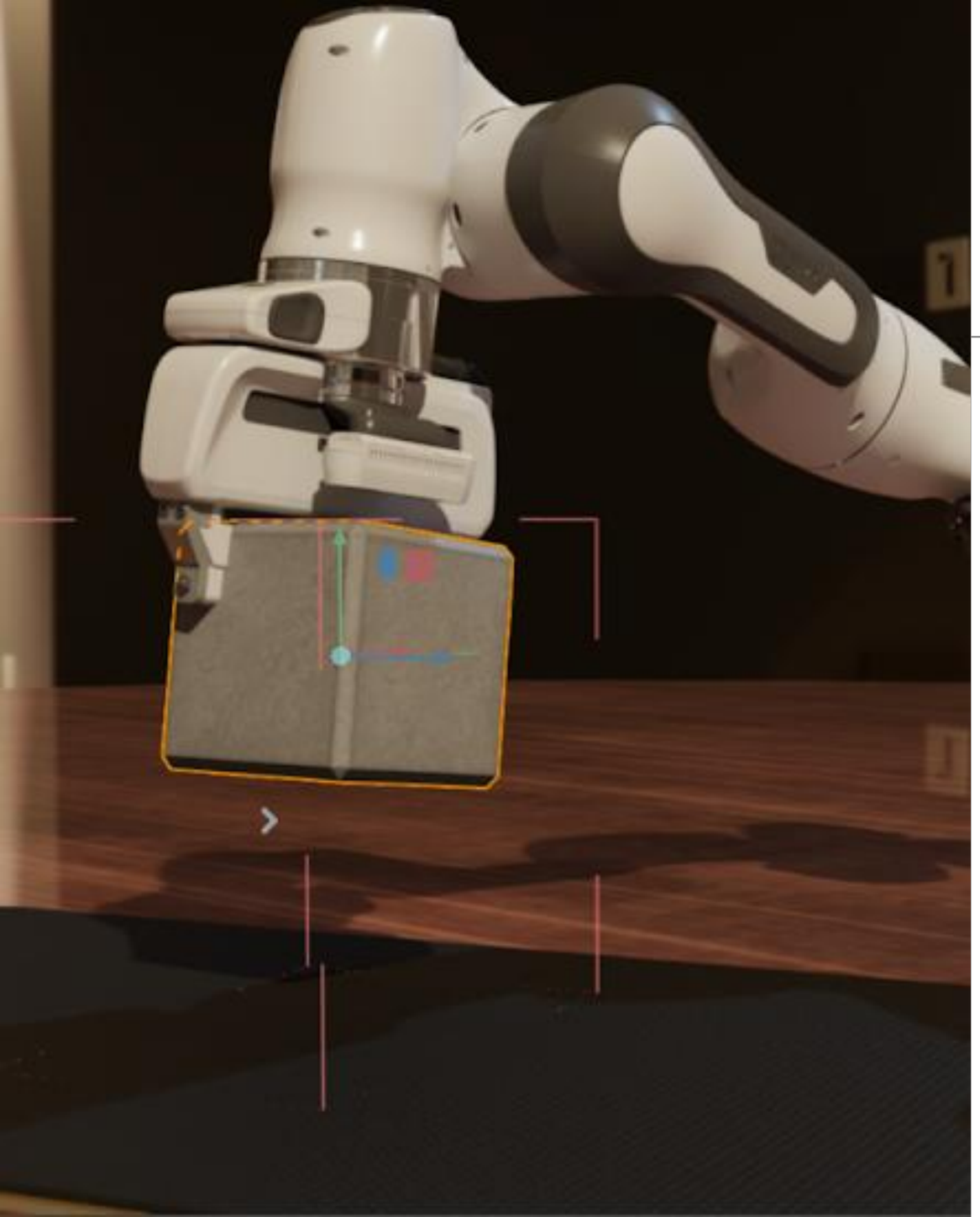
Operator UI



Metropolis

VLM APIs

Developer Tools & SDKs



Omniverse Developer Tools & SDK

Build USD-Native Applications

- Modular, extensible platform architecture
- Easy-to-customize templates
- Deploy on-prem or in the cloud

What's Included:

- **Omniverse Kit SDK (v106)** — Core tooling and functionality for building USD-Native applications
- **Omniverse Kit App Template Repository** — Standardized templates to bootstrap development
- **Omniverse App Streaming API** — Deploy Kit-based applications to the cloud

Try it out: Omniverse Kit Base Editor Sample

Omniverse Kit App Repository & Templates

Standardized Templates to Bootstrap Development

- Quickly stand up a fully functional Kit-based application with standardized templates
- Tooling enables easy creation, naming and deployment with just a series of questions

How:

1. Select a template
2. Customize for your needs
   - Integrate data sources using OpenUSD connectors
   - Add or edit features with Omniverse Kit Extensions
3. Deploy on-prem or in the cloud

Omniverse Kit App Templates – Available Now

- Base Editor
- Service
- USD Composer
- USD Explorer
- USD Viewer

Coming Soon

- Embedded Web Viewer

Virtual Facility Integration - Use Cases & Target Workflows

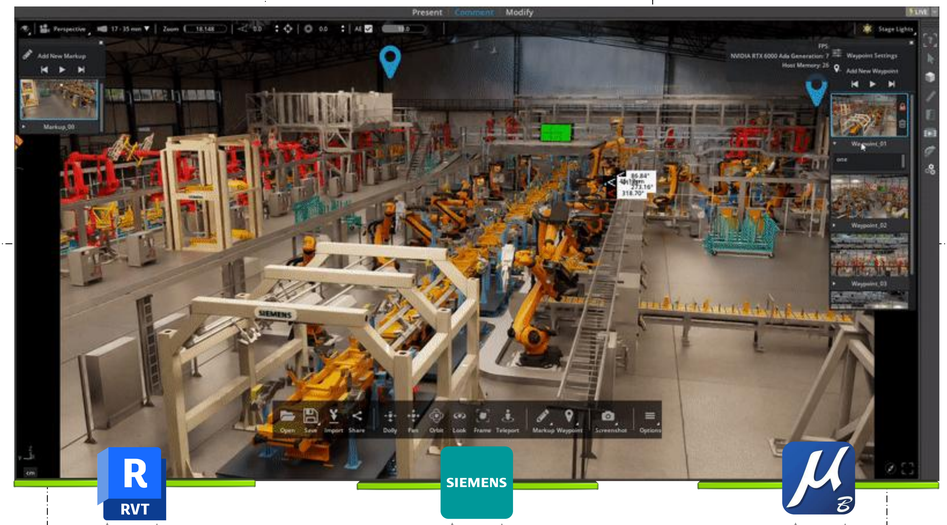
	Facility Development	Equipment & Process	Automation Systems	Operations & Maintenance
Phases				
				
Use Cases	**Layout Planning**	**Process Simulation**	**Robotics Integration**	**Monitoring & Inspection**
Workflows	Data Aggregation Equipment Layout Virtual Walkthrough	Clash checking Time & Motion Studies Material & Process Flow	Perception / Sensors AI Training & SDG Robot Learning & Testing	Monitor Production Data Quality Inspection & SDG
Personas	Production Planner, Facility Planner, Process Engineer, Mechanical Engineer, Simulation Engineer, Robotics Developer, Data Engineer, Automation Engineer, Factory Manager			
	Corporate IT			
	Software & AI Developers			

NVIDIA Omniverse and NIM for Facility-Scale Digital Twin Use Cases

Layout Planning

Process Simulation

Remote Monitoring



Omniverse Channel APIs

USD APIs

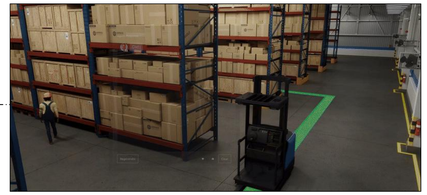
NVIDIA Omniverse

USD NIM

Industrial Inspection

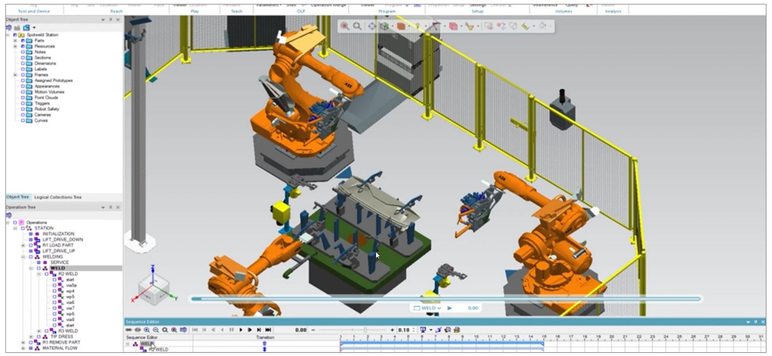
Robotics Integration

Industrial Co-Pilot



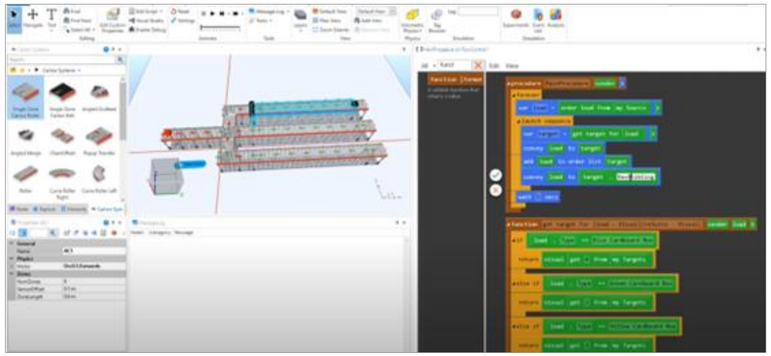
Third Party Connectors

Process Simulation



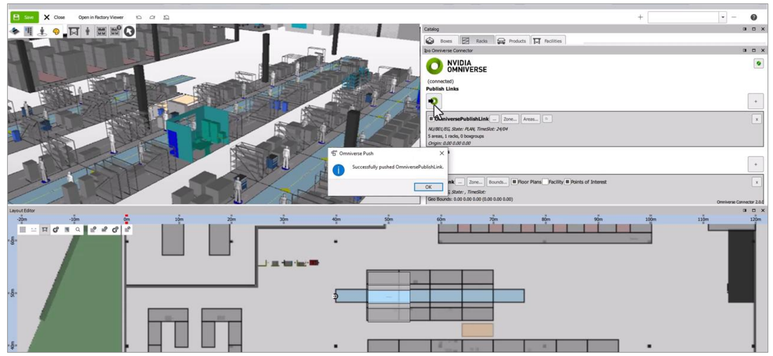
Siemens Process Simulate

Visual Components

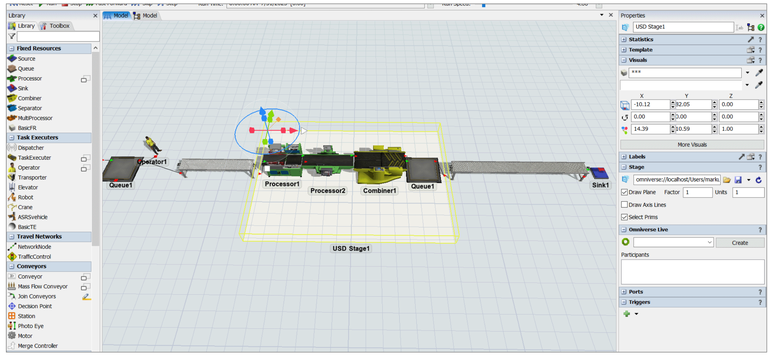


Emulate3D

AnyLogic



SyncTwin



FlexSim

Enterprise Developers Build Transformative Solutions on Omniverse

Tools and apps for planning, simulation, and operations use cases

98% CV model accuracy

Amazon Robotics
Robotic training tools

30% more efficient planning

BMW Group
Factory planning tools

10% productivity increase

Continental + SoftServe
Industrial CoPilot

100x faster AI training

Delta Electronics
Industrial inspection tools

Accelerated planning, AI training

Foxconn
Factory planning, AI training tools

Lowe's
Store layout planning tools

Improved collaboration, planning, and productivity

Mercedes Benz
Factory planning tools

50% reduction in supplier coordination processes

Pegatron
Operational digital twin platform

60% more defects detected

PepsiCo
Process simulation tools

Improved throughput, downtime, and energy use

Wistron
Operational digital twin platform

2x speed up in construction

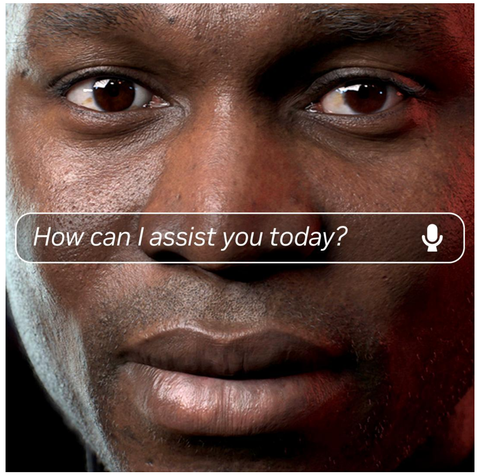

DEMAG

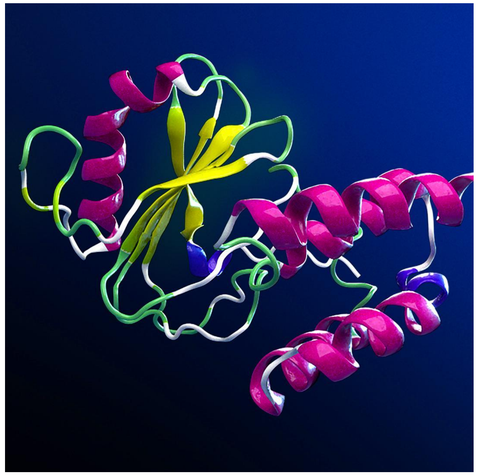
What’s Next in AI Starts Here

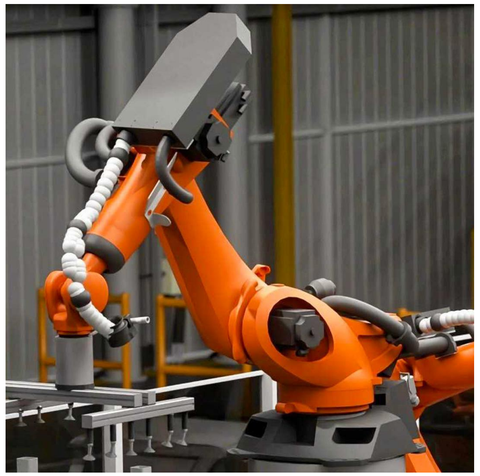
GTC is a unique developer conference that brings together thousands of innovators, developers, engineers, researchers, creators, and business leaders to explore how accelerated computing and AI are helping humanity solve our largest, most complex challenges.

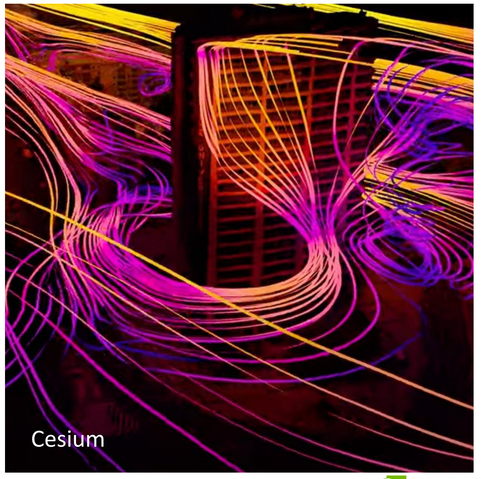
From NVIDIA CEO Jensen Huang keynote to hundreds of inspiring sessions, exhibits, technical hands-on training workshops, and unique networking events, GTC is the place to see real-world examples of applied AI in action.

March 17–21, 2025 | www.nvidia.com/gtc









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