SYNTHETIC DATA / AI

Rev Lebaredian - Vice President, Simulation Technolgy

NEURAL NETWORKS NEED DATA

And Labels!

Deep Learning is amazing!

Require huge amounts of quality data

Data needs labeling

For some problems, data + labeling is available

Good data doesn't exists for most problems

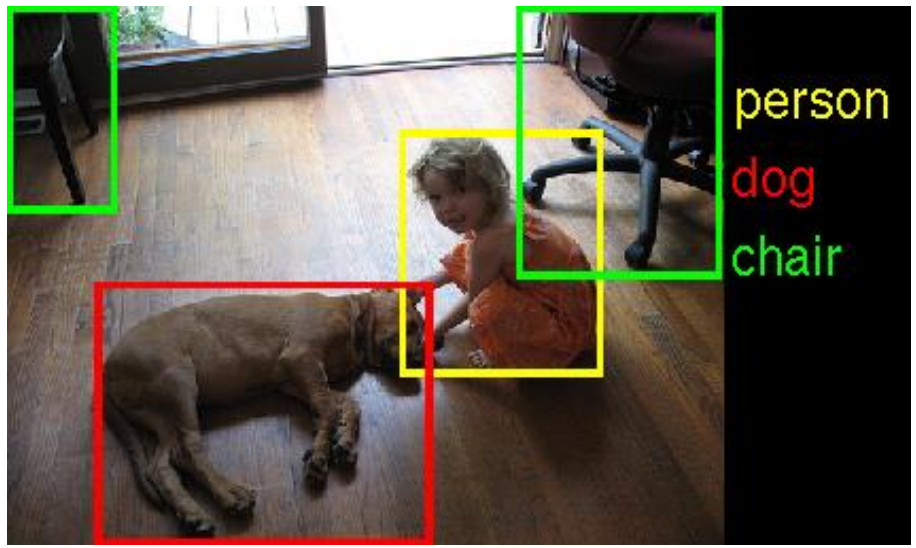
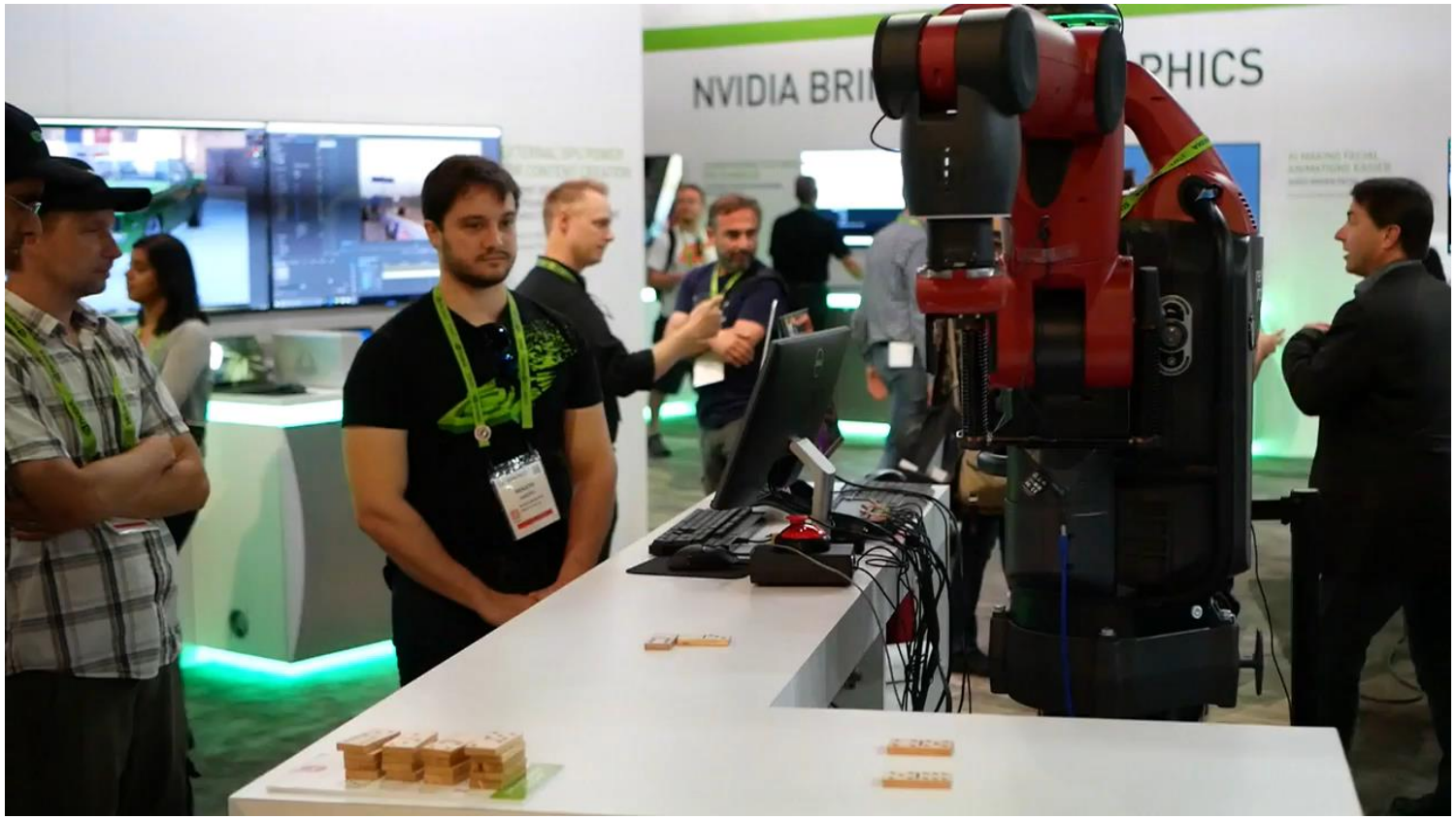


Image-Net (http://www.image-net.org/) example

DOMINOS, ANYONE?

Isaac at SIGGRAPH 2017



NO EXISTING DATASET

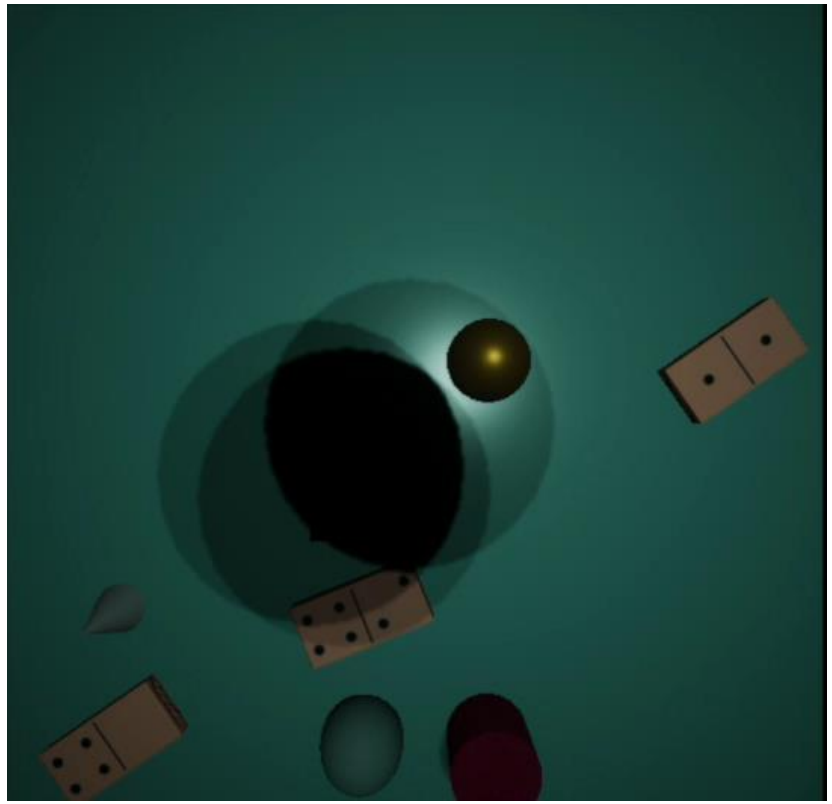
Labeled Data

SYNTHETIC DATA

Real data is expensive, sometimes dangerous

Synthetic labels are automatic and accurate

Useful for validation, in addition to training



AV SYNTHETIC DATASETS

Virtual KITTI

Adrien Gaidon, Qiao Wang, Yohann Cabon, Eleonora Vig: Virtual Worlds as Proxy for Multi-Object Tracking Analysis IEEE CVPR 2016

DOMAIN RANDOMIZATION

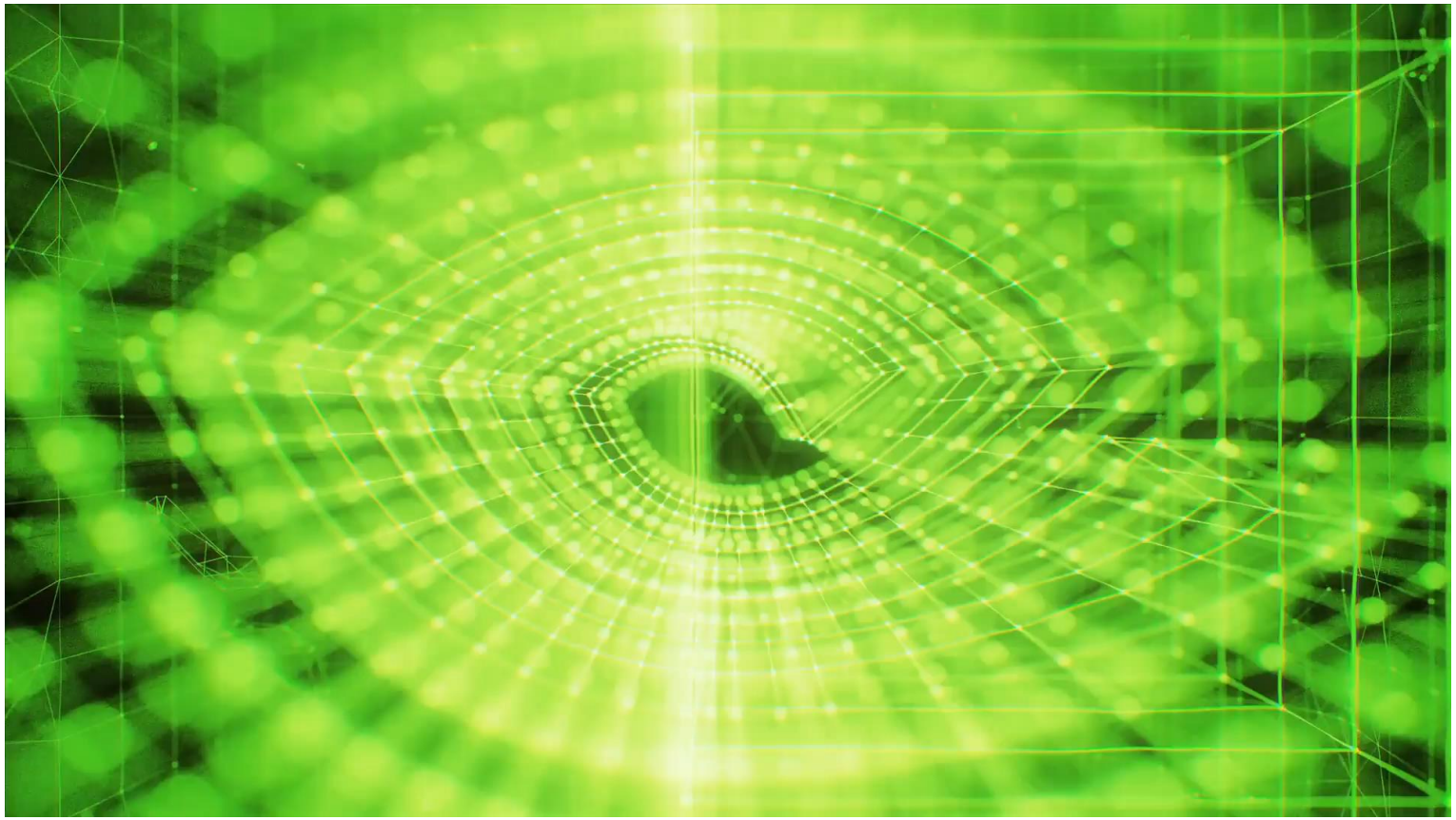
Explore the gap using random cars, textures, camera, distractors, etc

DOMAIN RANDOMIZATION

Example Scenes

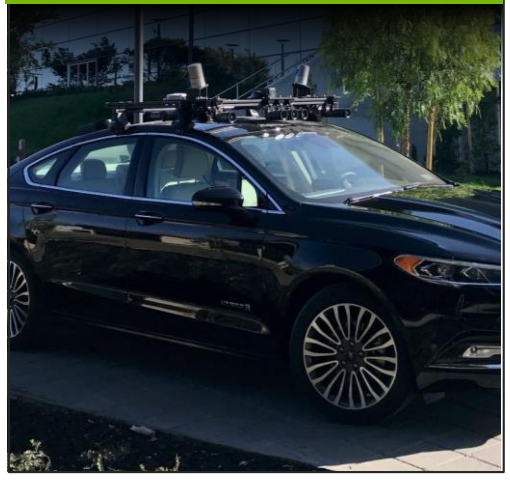
STRUCTURED DOMAIN RANDOMIZATION

Putting it all together

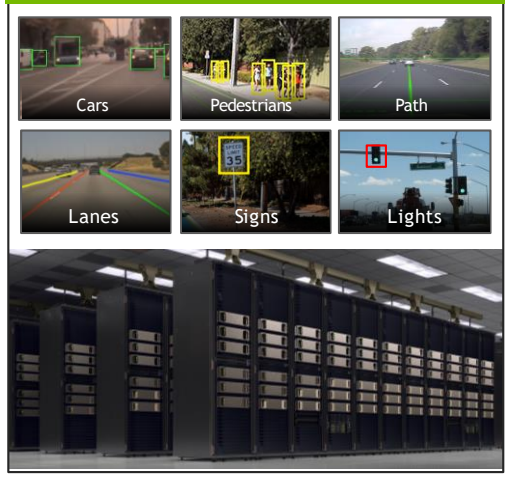


NVIDIA DRIVE
END-TO-END PLATFORM

COLLECT DATA

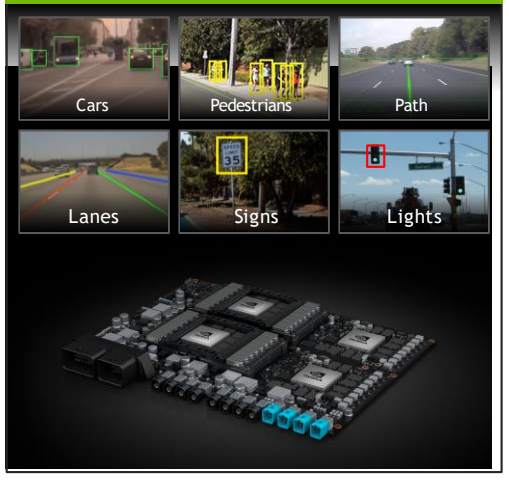


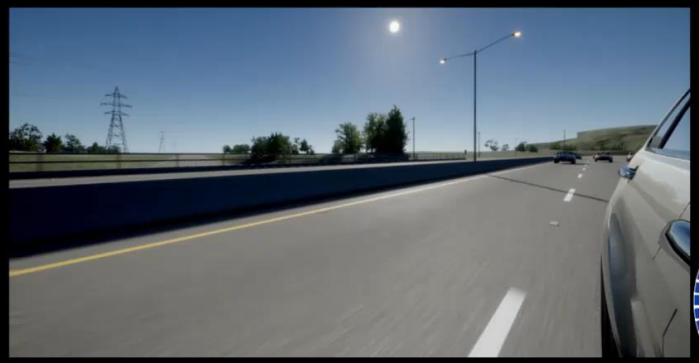
TRAIN MODELS

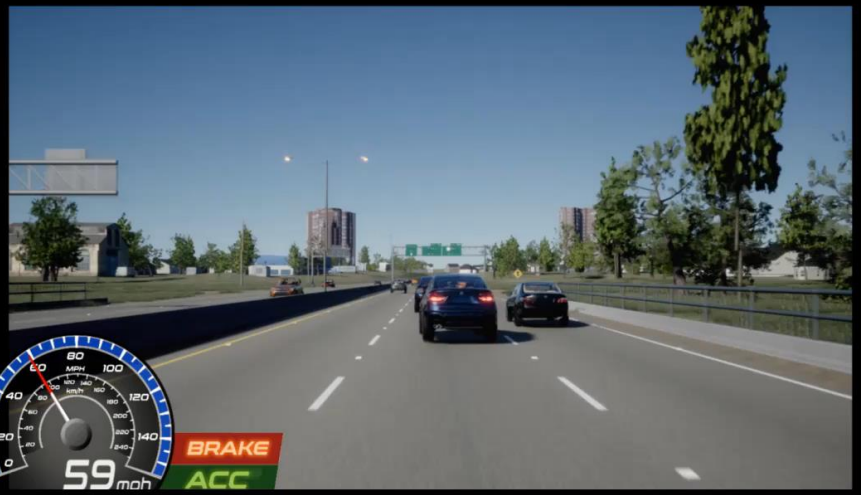


SIMULATE

DRIVE





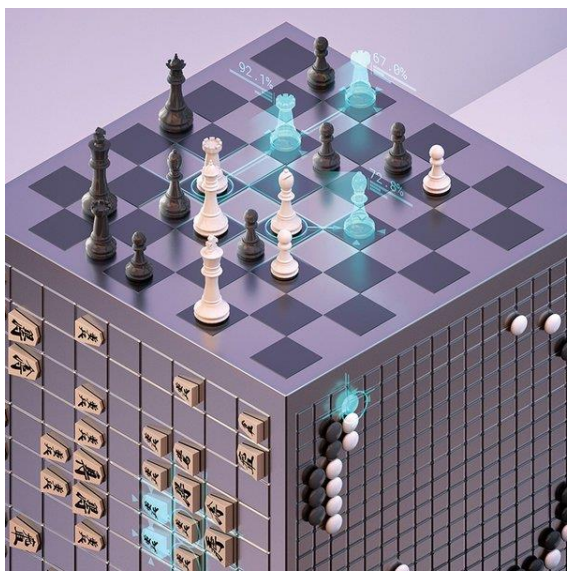

MPH
km/h
59 mph
BRAKE
ACC

NVIDIA. DRIVE™ CONSTELLATION

VIRTUAL TEST FLEET IN THE CLOUD

REINFORCEMENT LEARNING SUCCESSES

AlphaZero



Deepmind, 2018

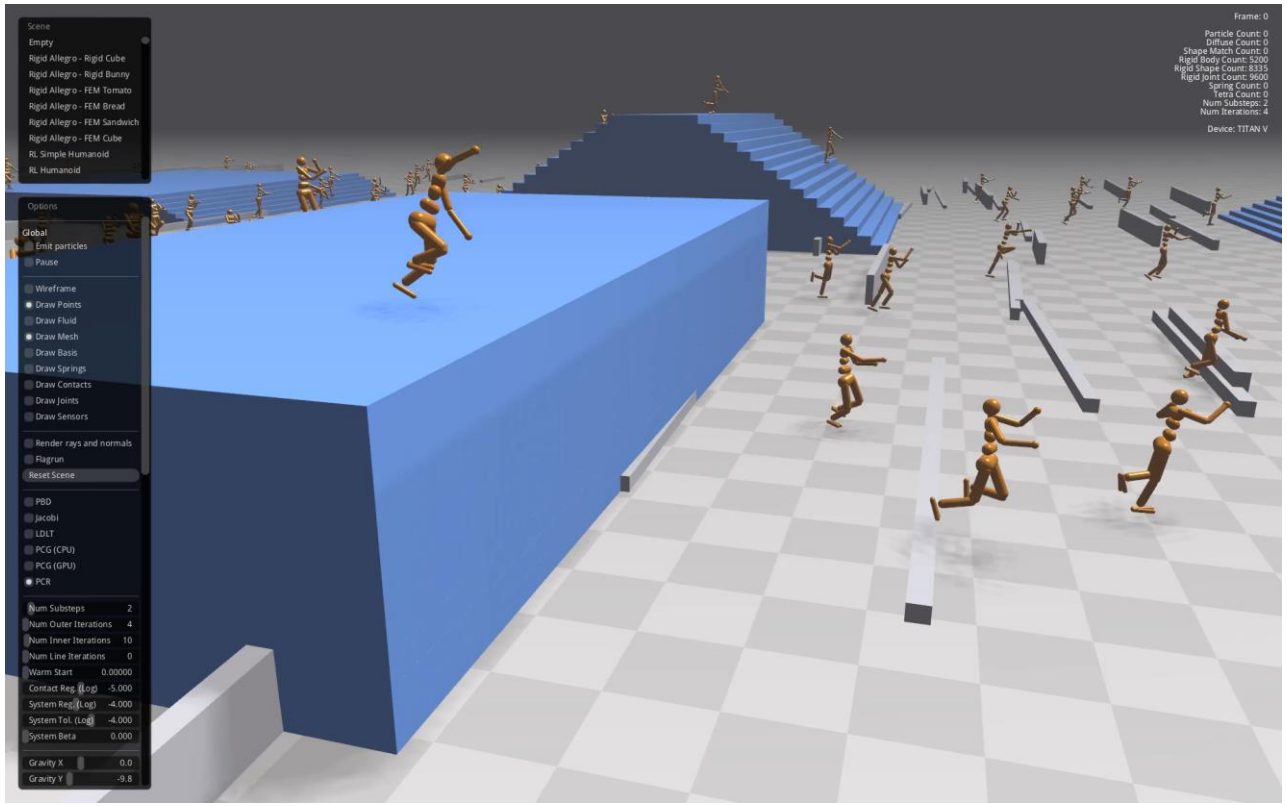
OpenAI Five

OpenAI, 2018

APPLICATIONS

Reinforcement Learning

Locomotion/Animation

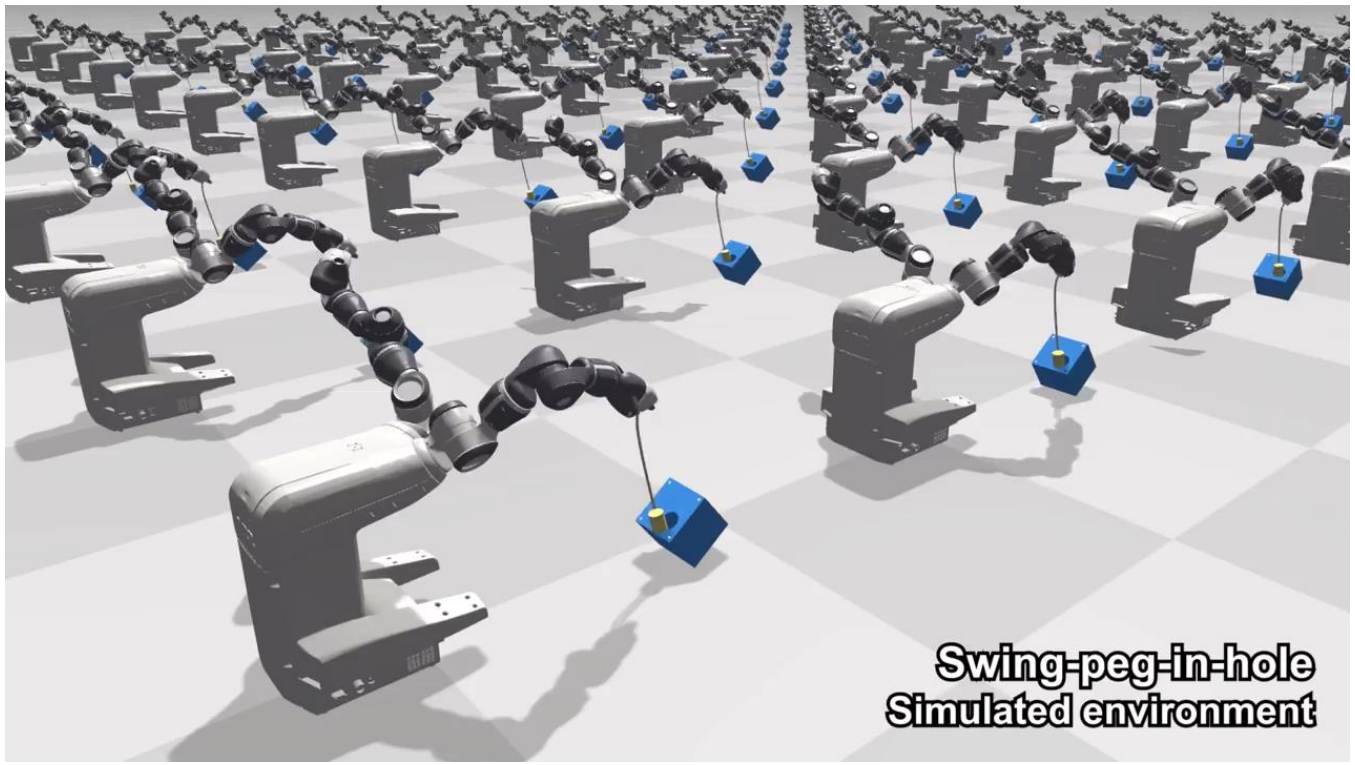


Liang, Makoviychuk, Handa etc, 2018
NVIDIA

APPLICATIONS

Robotics

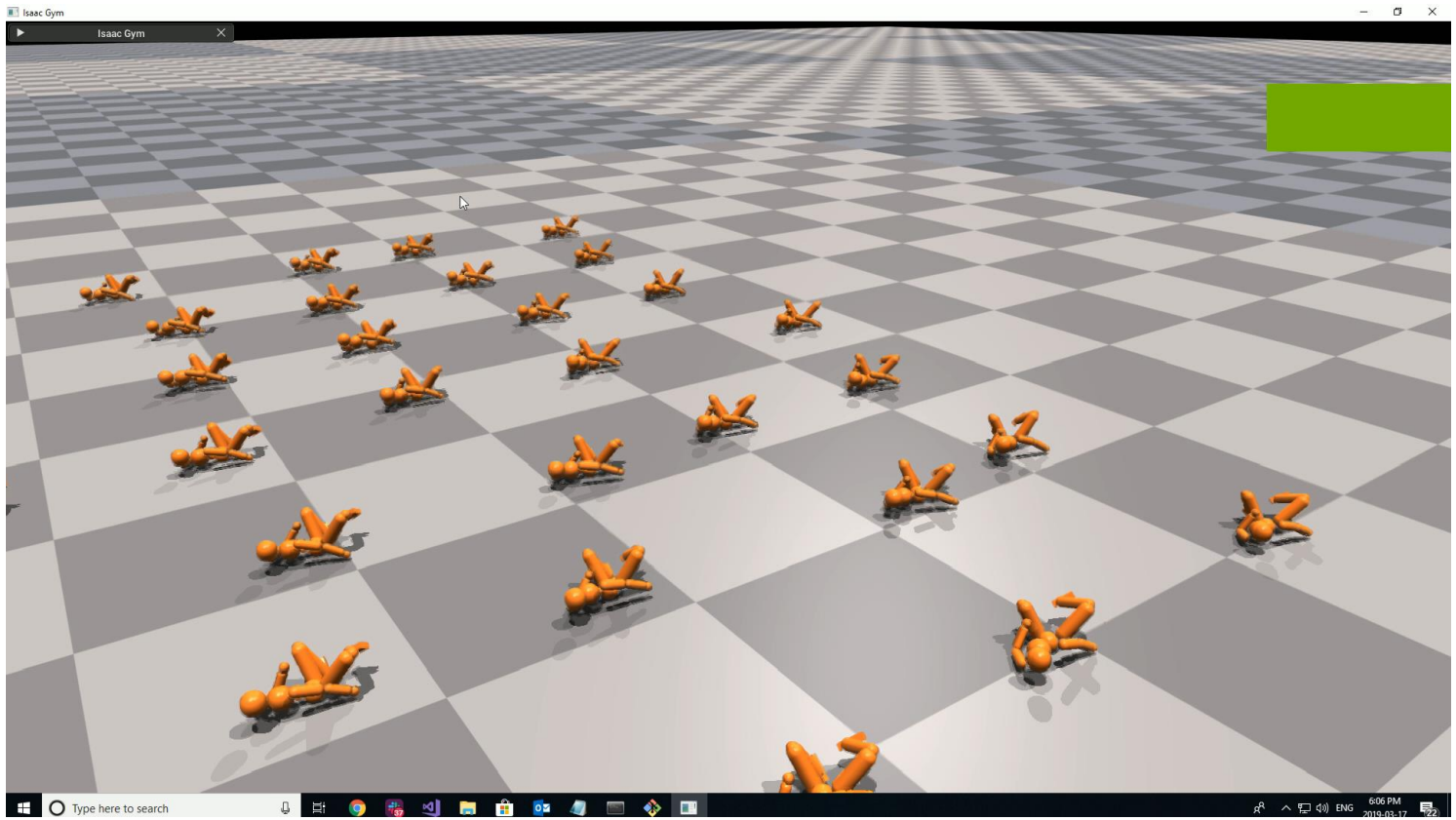
Sim2Real Robotics



Chebotar, Handa, Makoviychuk, etc, 2018
NVIDIA

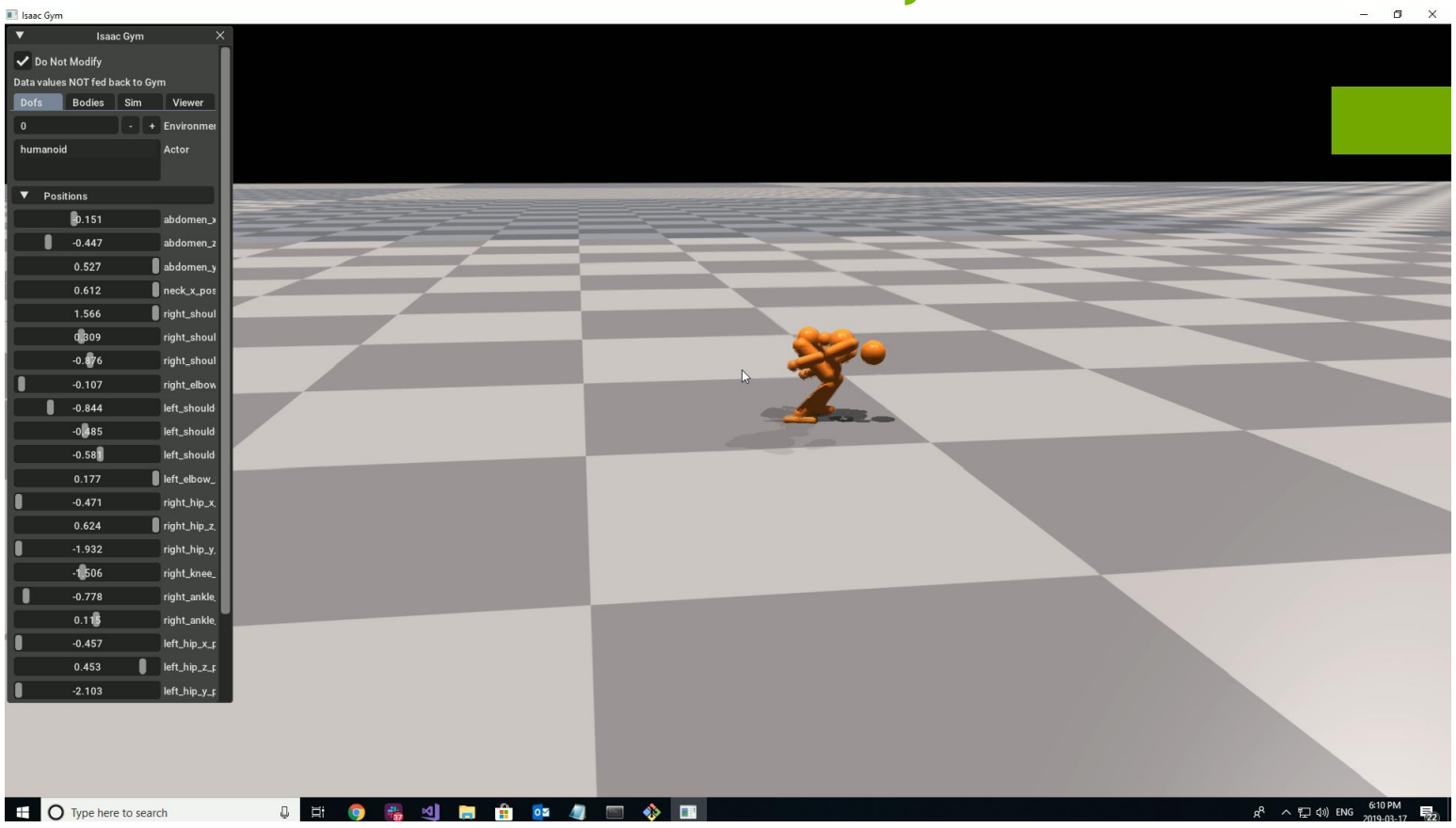
EXAMPLES

Locomotion



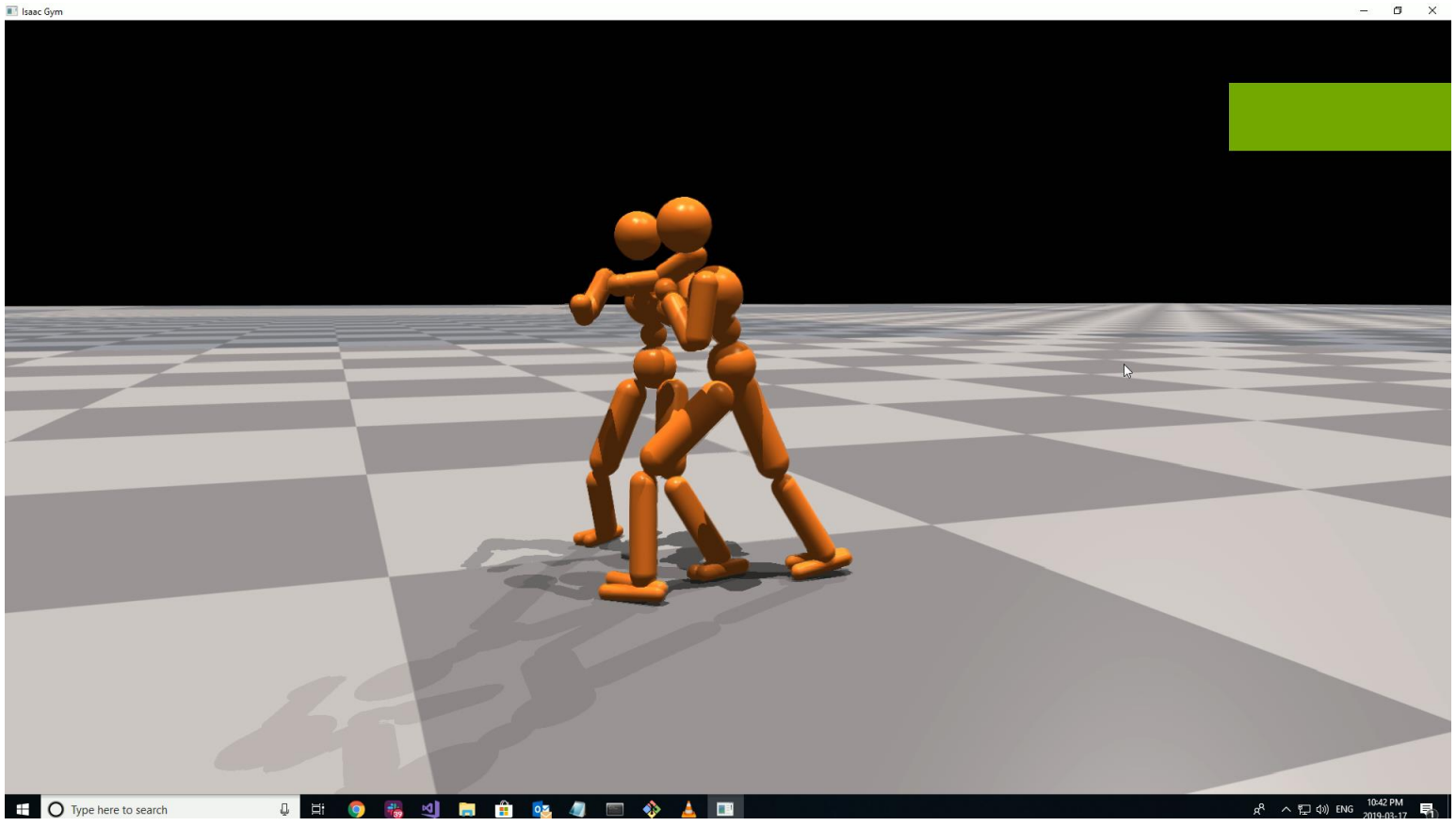
EXAMPLES

Locomotion + Physics



EXAMPLES

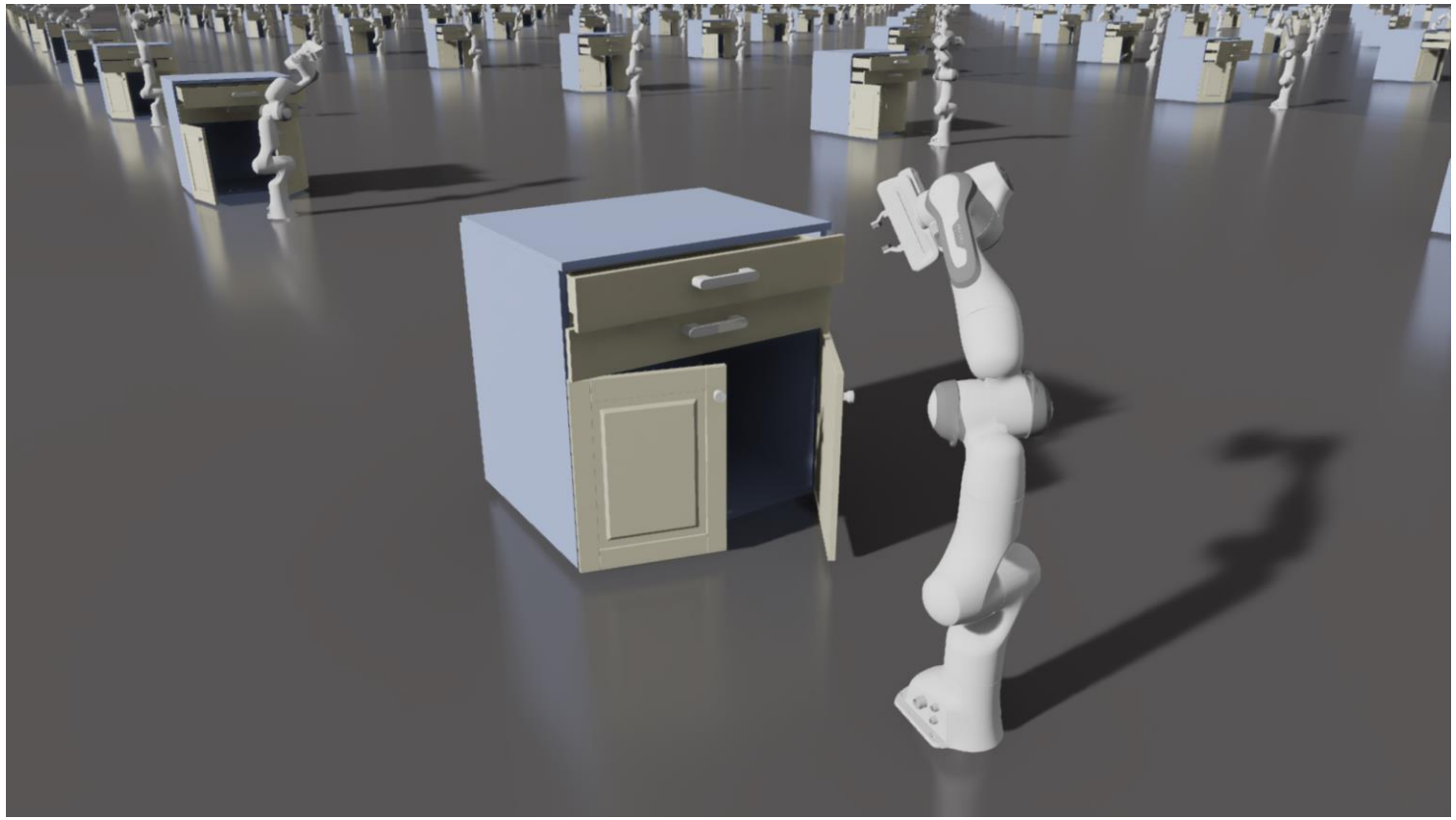
Locomotion + Physics



NVIDIA

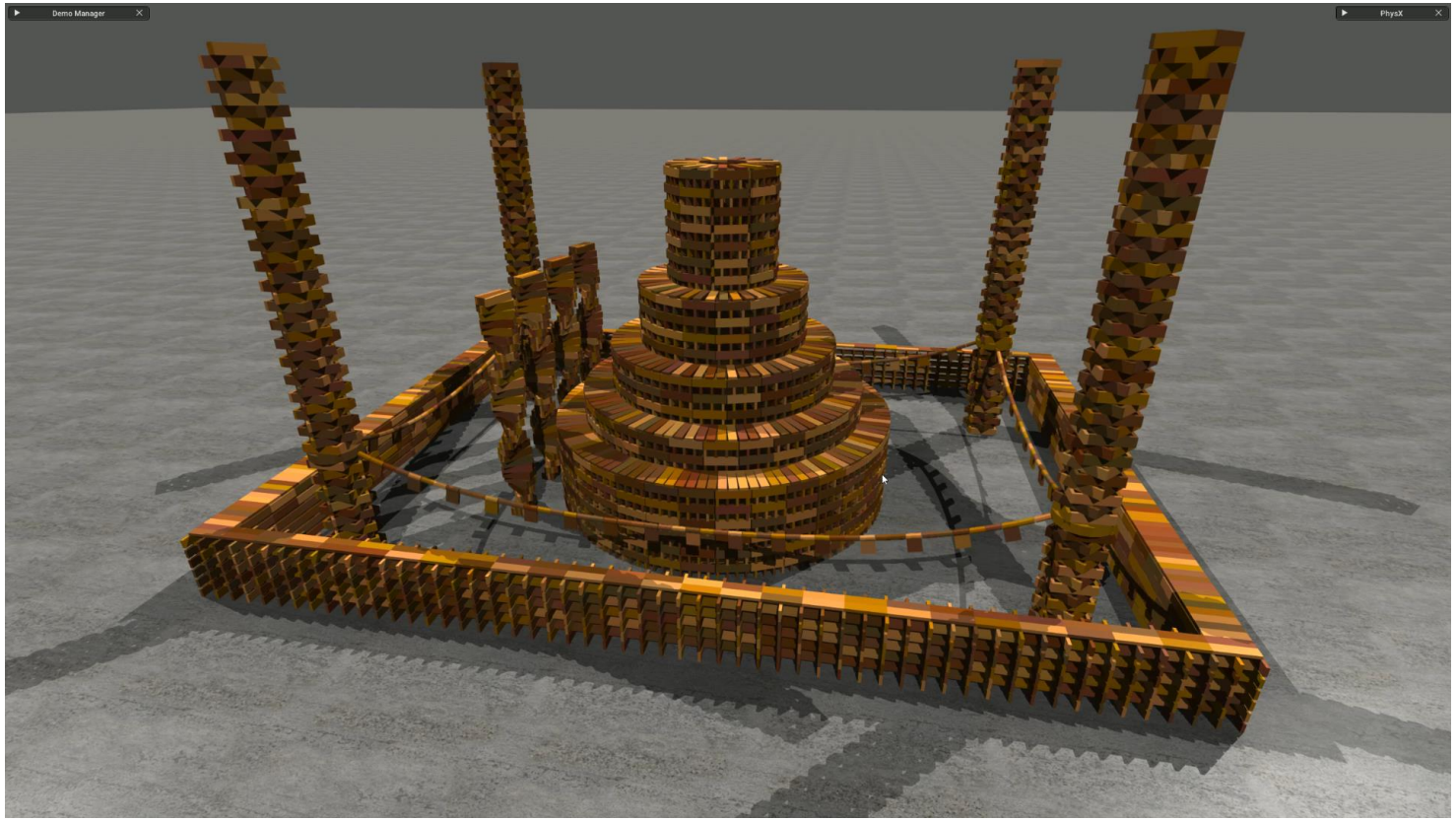
ISAAC GYM

Toolkit for Parallel AI Learning Experiments



PHYSICS

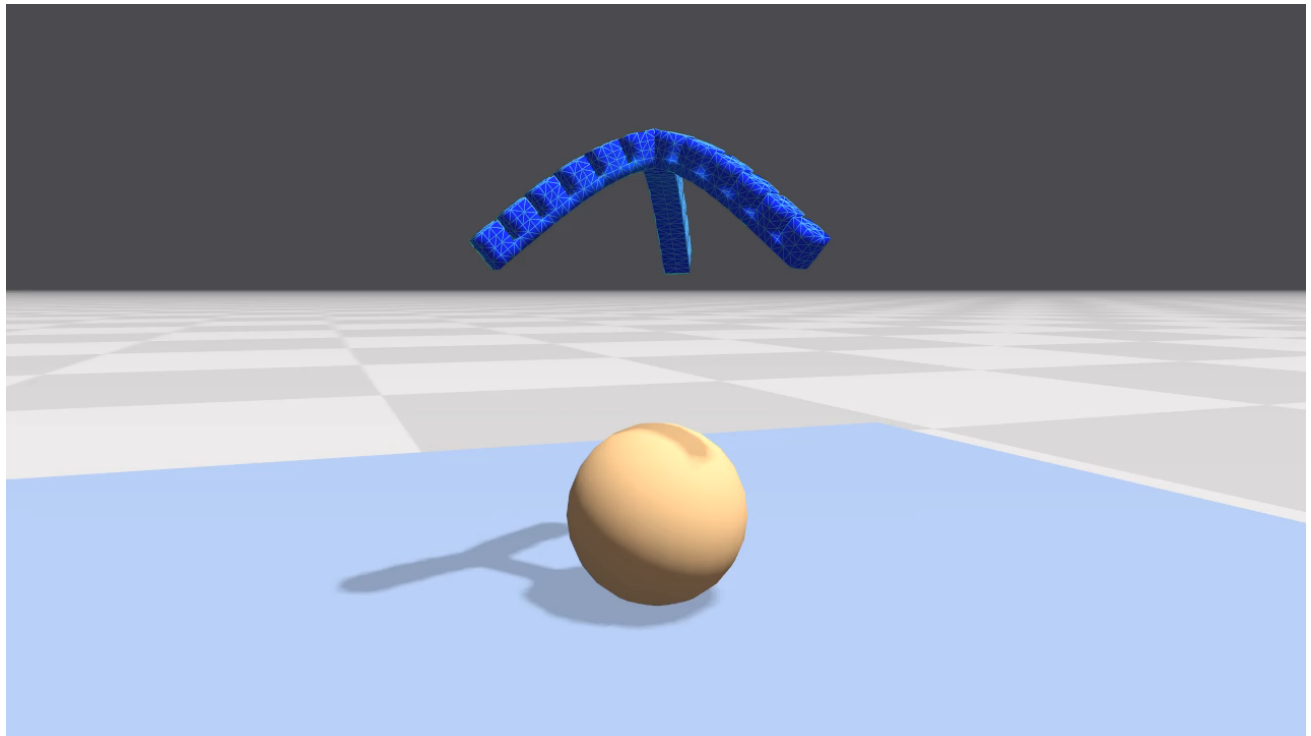
PhysX



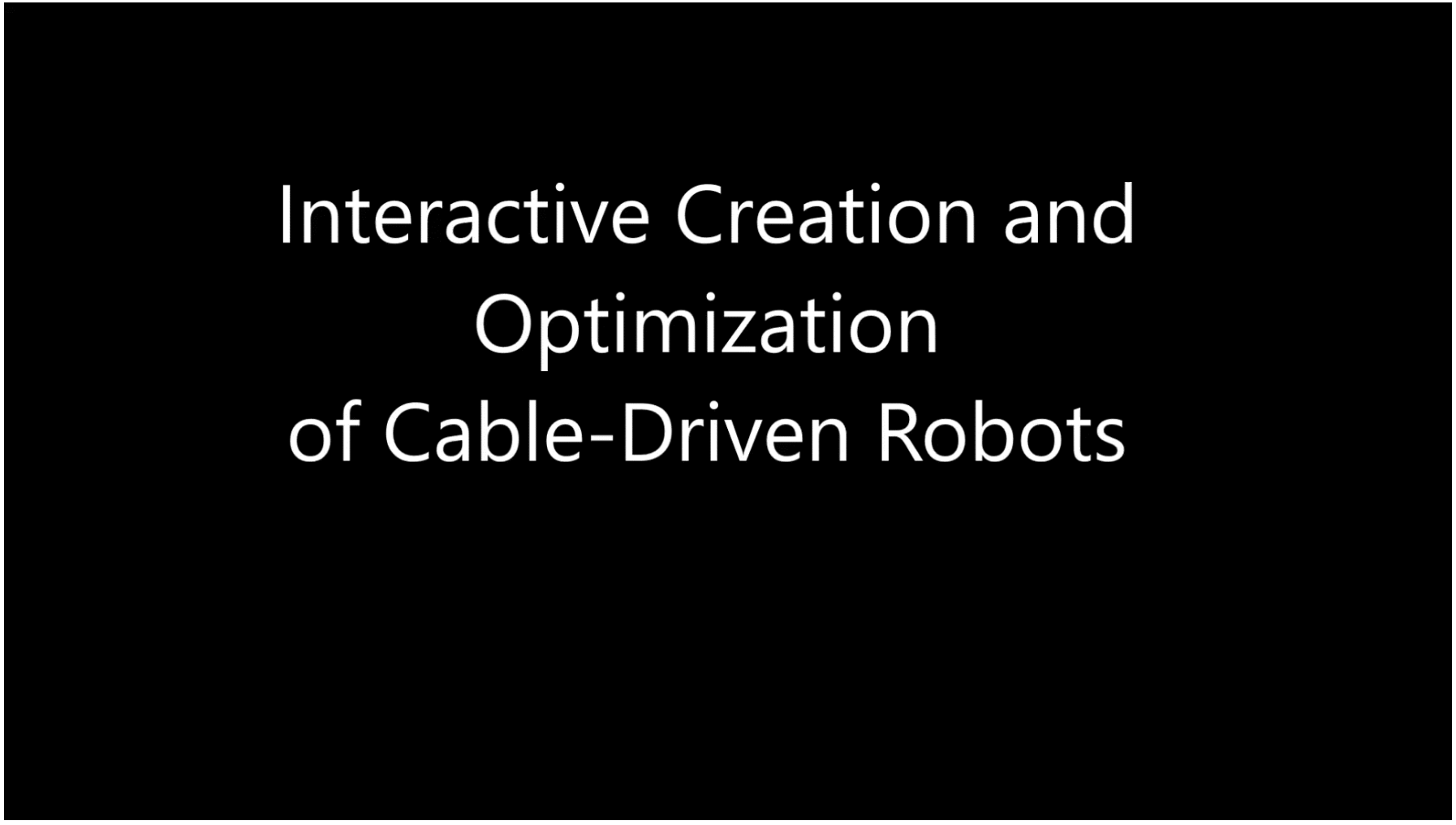
PHYSICS

FleX

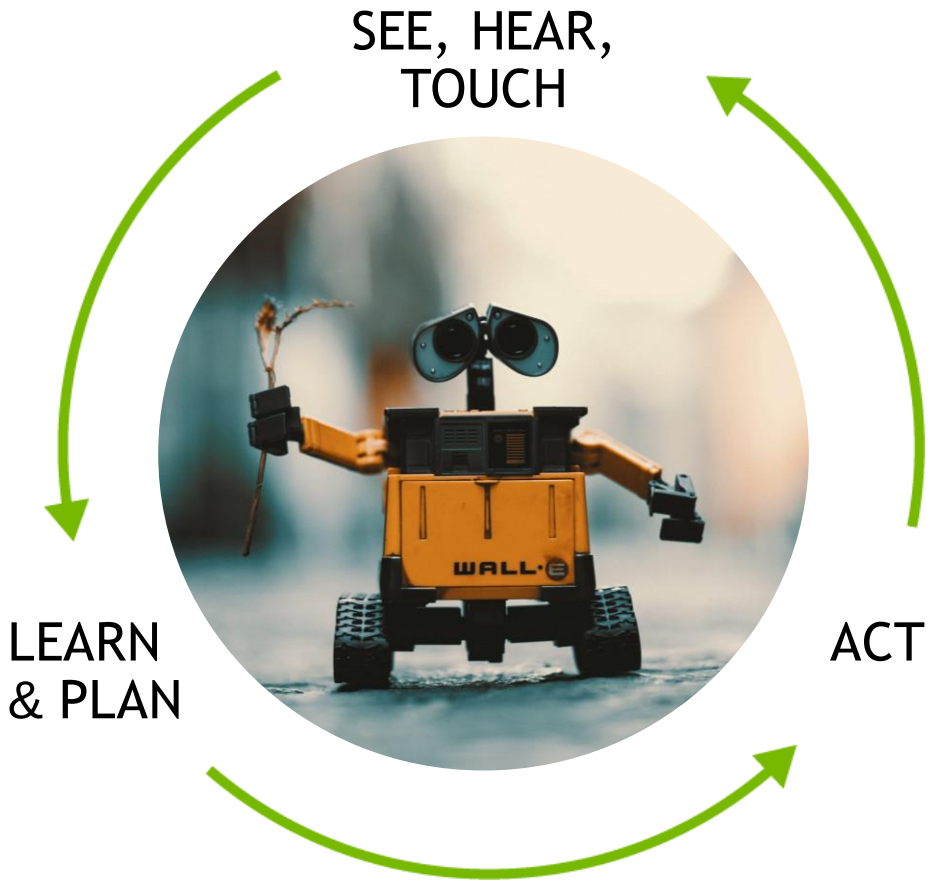
- Multi-physics
  - Rigid and FEM soft bodies
  - Cloth, ropes
  - Liquids
  - Two-way coupling and force propagation between different phases

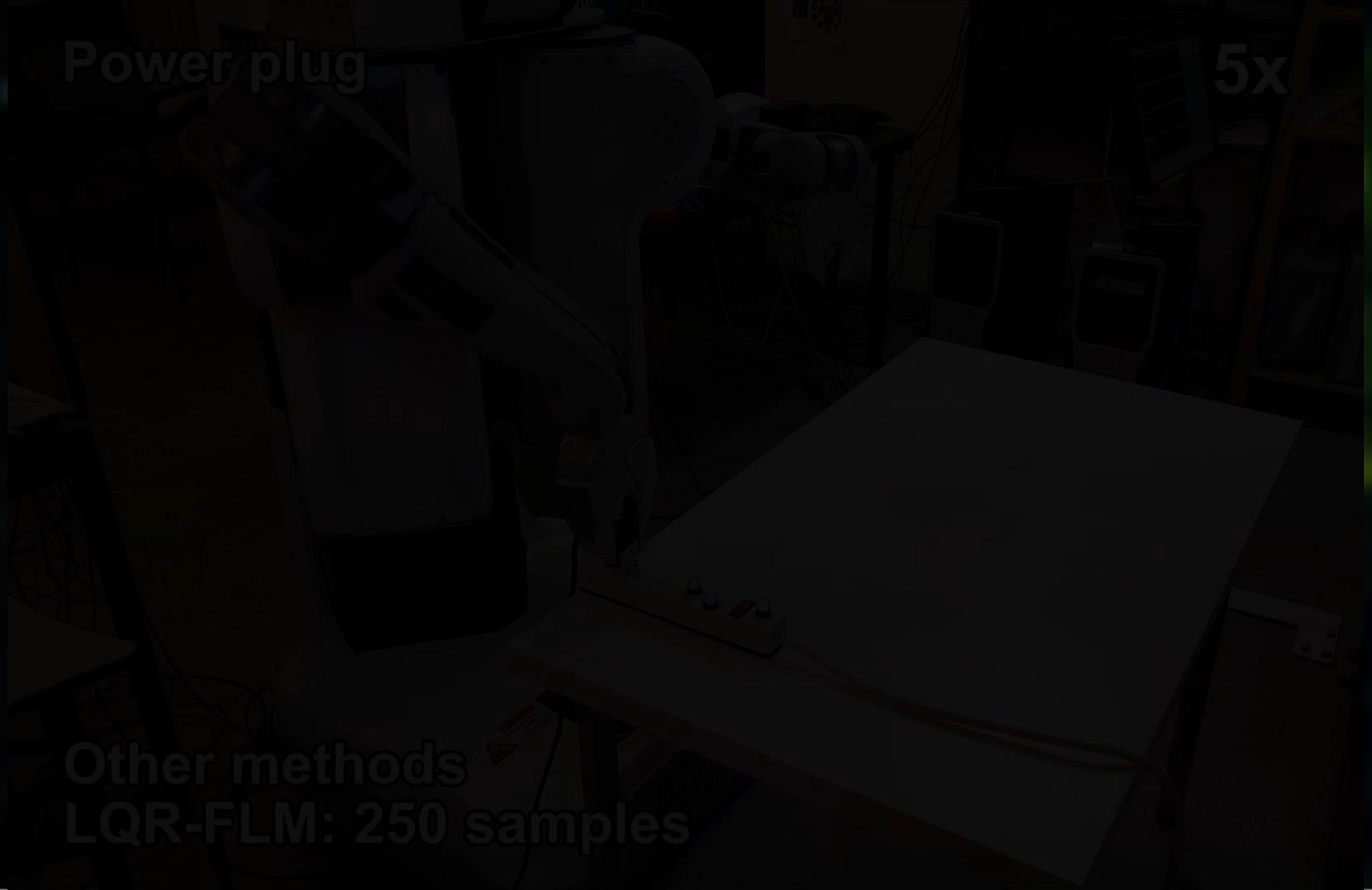


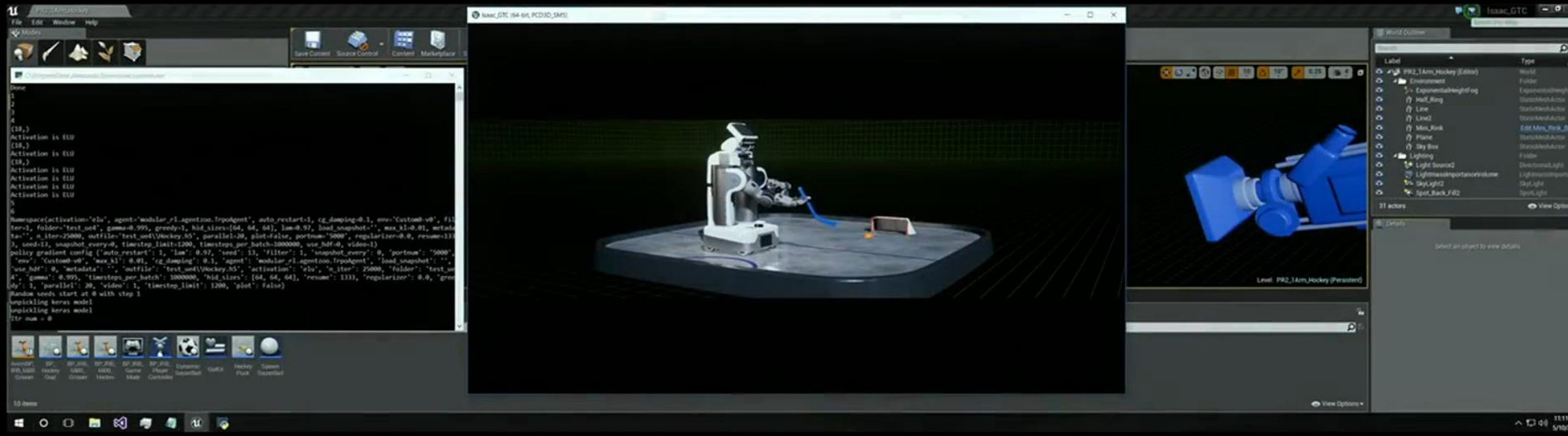
CABLE ROBOT


Interactive Creation and
Optimization
of Cable-Driven Robots

ROBOTS




Power plug
5x
Other methods
LQR-FLM: 250 samples


Isaac_GTC (64-bit, PCD3D_SM5)
Done
1
2
3
4
(10,)
Activation is ELU
(10,)
Activation is ELU
(10,)
Activation is ELU
Activation is ELU
Activation is ELU
Activation is ELU
5
6
Namespace(activation='elu', agent='modular_rl.agentzoo.TrpoAgent', auto_restart=1, cg_damping=0.1, env='Custom0-v0', fil
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ta='', n_iter=25000, outfile='test_us4\\Hockey.h5', parallel=20, plot=False, portnum='5000', regularizer=0.0, resume=133
3, seed=13, snapshot_every=0, timestep_limit=1200, timesteps_per_batch=1000000, use_hdf=0, video=1)
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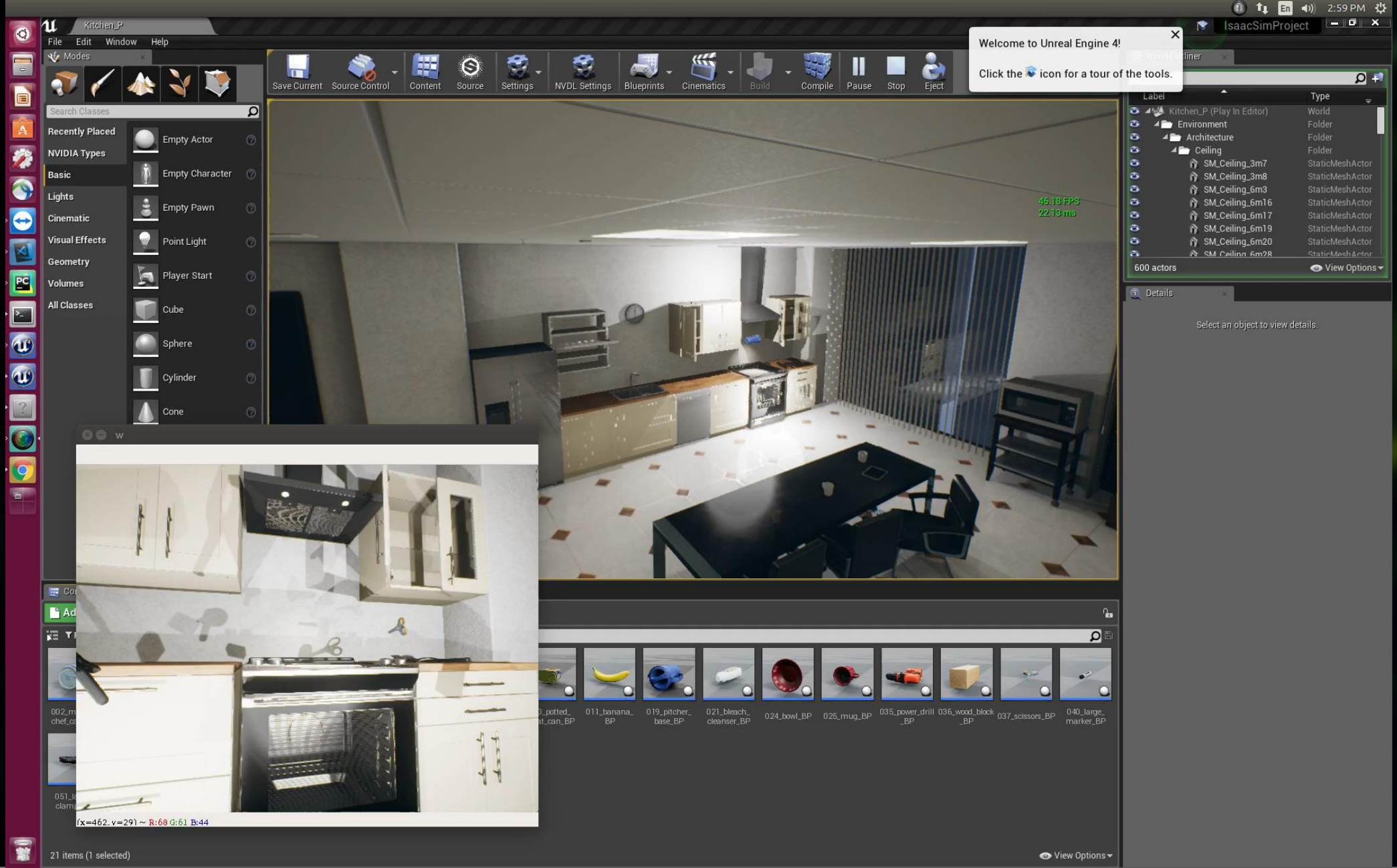
dy': 1, 'parallel': 20, 'video': 1, 'timestep_limit': 1200, 'plot': False}
@random seeds start at 0 with step 1
unpickling keras model
unpickling keras model
itr num = 0
Level: PR2_1Arm_Hockey (Persistent)


ENABLING ROBOTICS
AI TRAINING WITH
PHYSX 4.0 SIMULATION
Reinforcement Learning
Simulator
NVIDIA
PHYSX
AION ROBOTICS
Closing the circle on Big Data
Commercial
Agriculture
Security

ISAAC SIM


Kitchen_P
File Edit Window Help
IsaacSimProject
Welcome to Unreal Engine 4!
Click the icon for a tour of the tools.
Modes
Search Classes
Recently Placed
NVIDIA Types
Basic
Lights
Cinematic
Visual Effects
Geometry
Volumes
All Classes
Empty Actor
Empty Character
Empty Pawn
Point Light
Player Start
Cube
Sphere
Cylinder
Cone
Save Current
Source Control
Content
Source
Settings
NVDL Settings
Blueprints
Cinematics
Build
Compile
Pause
Stop
Eject
45.18 FPS
22.13 ms
World Outliner
Label
Type
Kitchen_P (Play In Editor)
World
Environment
Folder
Architecture
Folder
Ceiling
Folder
SM_Ceiling_3m7
SM_Ceiling_3m8
SM_Ceiling_6m3
SM_Ceiling_6m16
SM_Ceiling_6m17
SM_Ceiling_6m19
SM_Ceiling_6m20
StaticMeshActor
600 actors
View Options
Details
Select an object to view details.
002_master_chef_can_BP
011_banana_BP
019_pitcher_base_BP
021_bleach_cleanser_BP
024_bowl_BP
025_mug_BP
035_power_drill_BP
036_wood_block_BP
037_scissors_BP
040_large_marker_BP
051_large_clamp
21 items (1 selected)
View Options
(x=462, y=291) ~ R:68 G:61 B:44

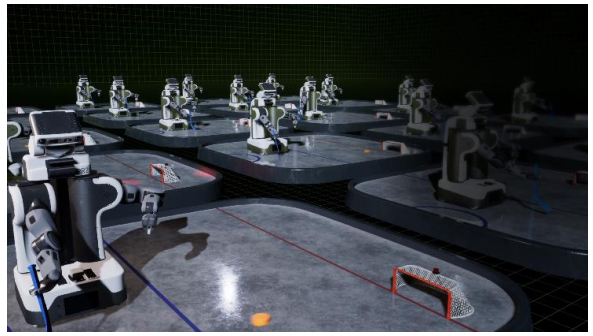

CHEEZ-IT


aws
ANALOG DEVICES
msi
PNY PRO
SK hynix
omni·sci
VIVE
Booz | Allen | Hamilton

Artificial

Intelligence

Human



Reality

Our Reality

Virtual Reality


NVIDIA