



# Rumo ao Metaverso

## Definições e Oportundiades

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© André Bedran

# O Metaverso vai acontecer???



# Premissa 1: como interagimos com o mundo digital



# Premissa 2: Eles já existem e lidamos com eles a muito tempo...



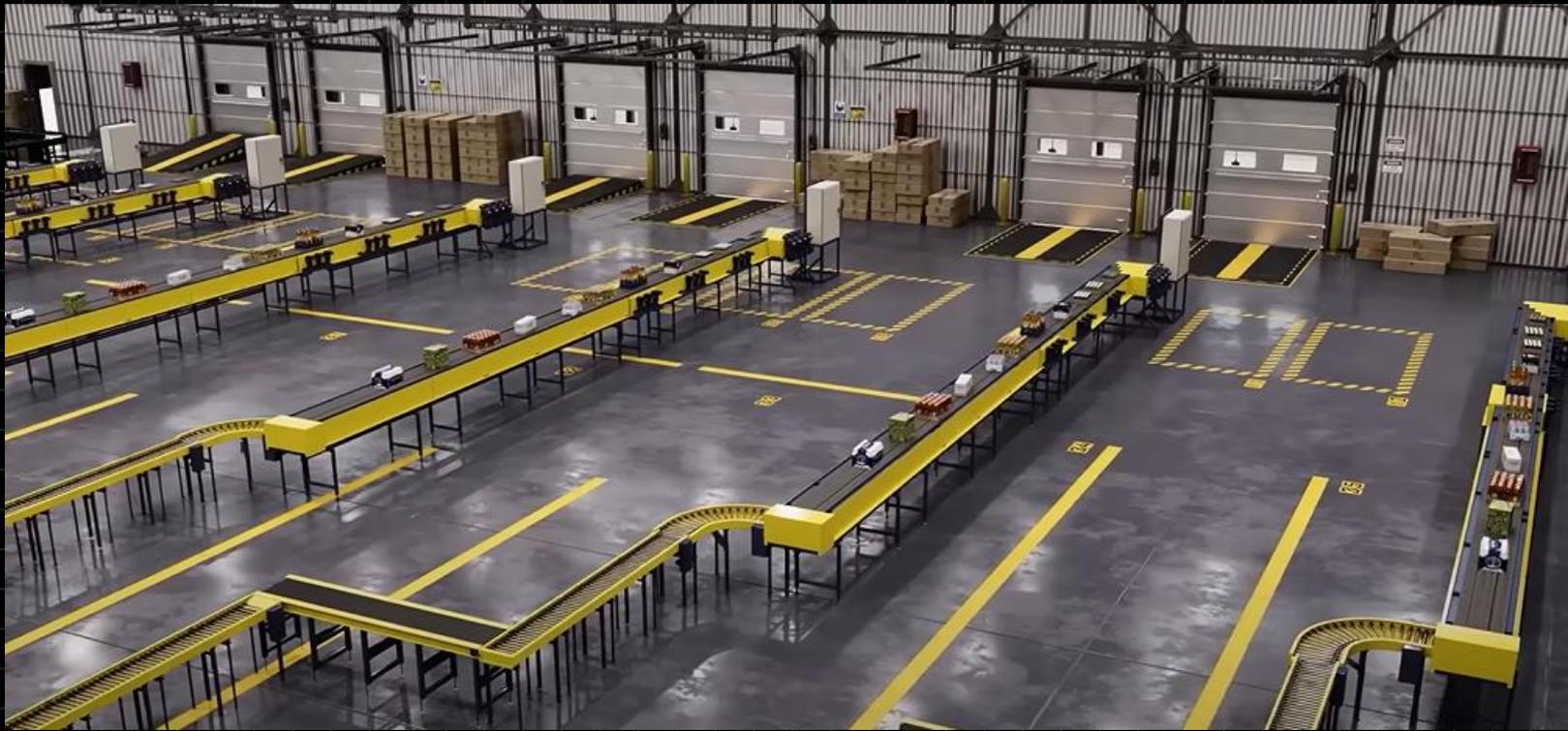
*Premissa 3: Precisamos (muito) deles...*



# *Digital Twins (ou “serious metaverse”)*



# Digital Twins (ou “serious metaverse”)



<https://www.youtube.com/watch?v=39ubNuxnrK8>



# Fboat e lancha autonoma



# Visão computacional



# Visão computacional



# NVIDIA Omniverse

The screenshot displays the NVIDIA Omniverse application window. The main viewport shows a detailed 3D model of a car chassis (BMW) in a factory environment, rendered with ray-traced lighting and shadows. The interface includes a top menu bar with options like File, Edit, Create, Window, Rendering, and Help. Below the menu is a toolbar with various icons for navigation and editing. The right side of the interface features a settings panel with tabs for Stage, Layer, and RTX Settings. The RTX Settings panel is currently active, showing options for Anti-Aliasing, Direct Lighting, Sampled Direct Lighting, Reflections, Translucency, Caustics, and Indirect Diffuse Lighting. The console at the bottom left shows system messages related to authentication tokens.

File Edit Create Window Rendering Help

Viewport Perspective RTX Path-traced

layer\_Felix.usd  
Path Tracing: 63/64 top: 39.64 sec

Stage Layer RTX Settings

Renderer Real-Time

Common Ray Tracing Post Processing

Anti-Aliasing

Direct Lighting

Enable Shadows

Enable Fractional Opacity

Show Lights

Enable Sampled Direct Lighting

Auto-enable Sampled Lighting Above Light Count Threshold

Auto-enable Sampled Lighting: Light Count Threshold 10

Sampled Direct Lighting

Samples per Pixel 8

Clamp Sample Count to Light Count

Reflections: Light Samples per Pixel 8

Reflections: Clamp Sample Count to Light Count

Firefly Filter Median

History Clamping

Denoise Iterations 5

Reflections

Max Roughness 0.3

Max Reflection Bounces 1

Translucency

Max Refraction Bounces 6

Secondary Bounce Roughness Cutoff 0.1

Enable Fractional Cutoff Opacity

Caustics

Indirect Diffuse Lighting

Property

Content Console

2021-03-29 11:51:43 [Info] [omni.client.plugin] Tick: provider\_nucleus: Refreshing authorization token for nv-nucleus-0.muc:3009

2021-03-29 11:51:43 [Info] [omni.client.plugin] Tick: provider\_nucleus: Authorization token for nv-nucleus-0.muc:3009 refreshed



Produtos

Soluções

Aprendizado

Mais

Comece



FERRAMENTAS PARA ARTISTAS

# Ferramentas e conteúdo da Weta Digital

Unity e Weta Digital estão democratizando a mais completa cadeia de ferramentas para criação, simulação e renderização em 3D já criada.



***Em resumo...***



$$\text{Metaverso} = \sum_{k=0}^n X$$



Onde X:

Visualization	Management	Economy	Content Generation
Socialization	Authoring	Processing	...



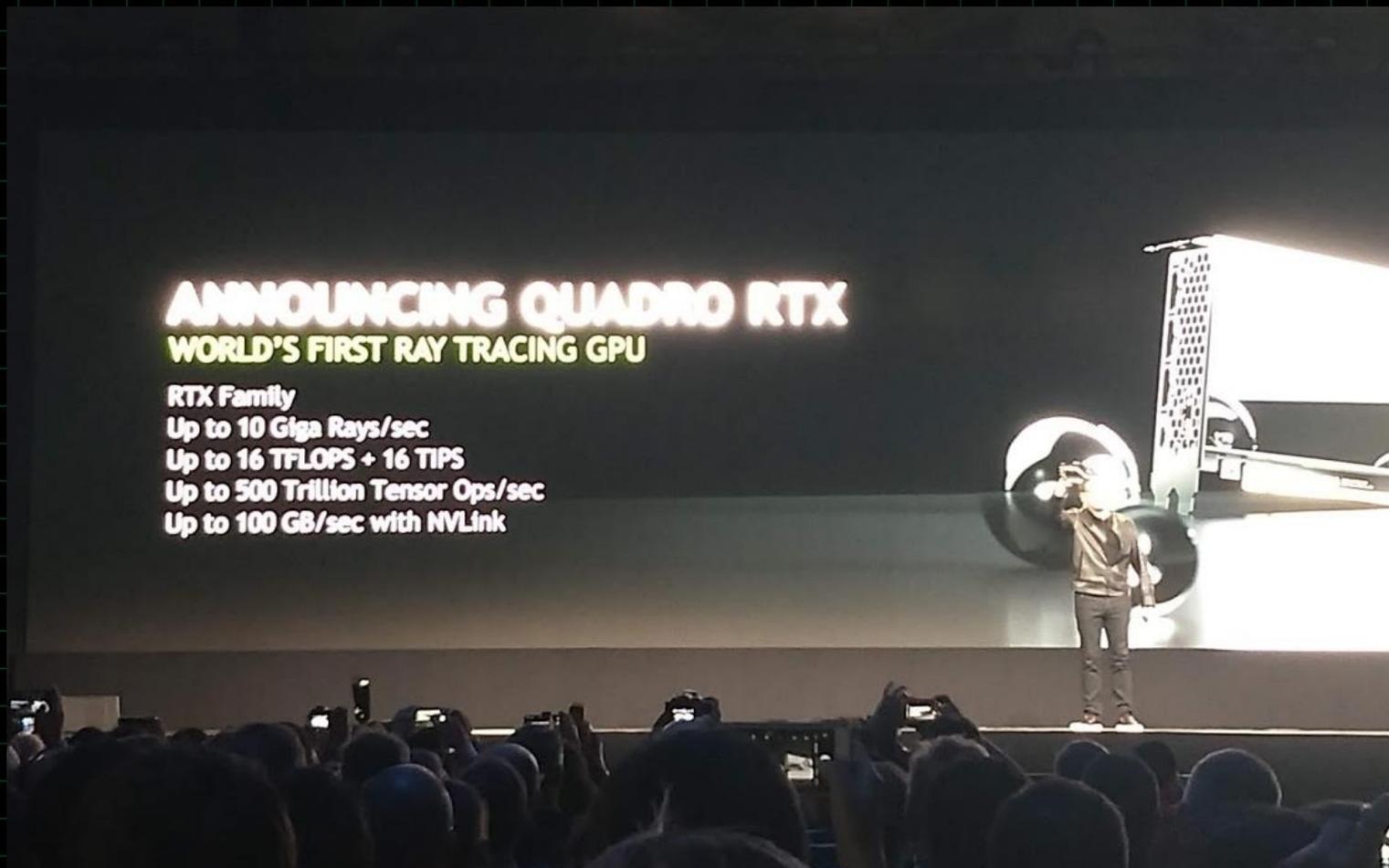
***O Metaverso não existe...***  
***Existem muitos metaversos...***  
***INTEGRAÇÃO***



# ***Desafios técnicos...***



# *Real Time Ray Tracing*





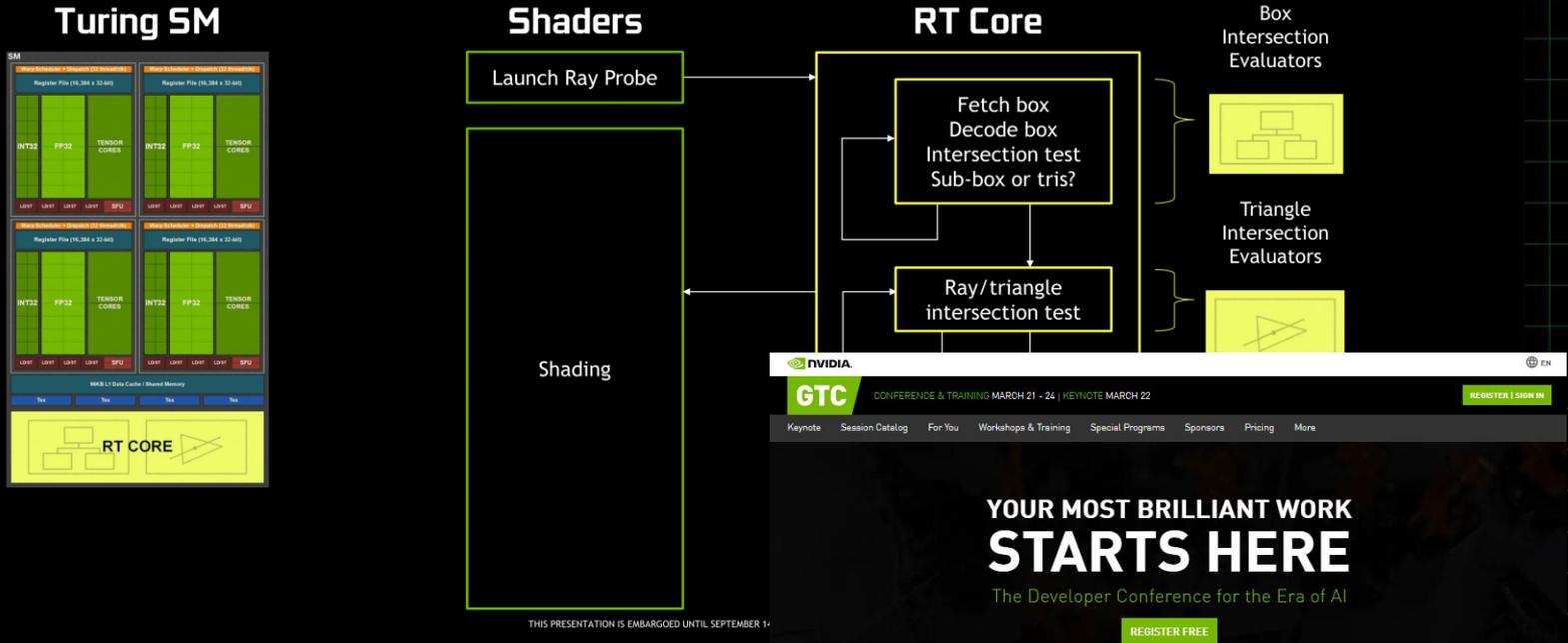
Courtesy of Peter Sivi/Motionland



# RTX Pipeline

## TURING RAY TRACING WITH RT CORES

Hardware Acceleration Replaces Software Emulation



# Displays em alta resolução

## Importance of Retina Display

Retina Display requires 16K!

Full HD 2K → 1980 x 1080 = 2,07 Mpixels/Frame

Ultra HD 4K → 8,29 Mpixels/Frame

**Nuclear** HD 16K → 132,7 Mpixels/Frame

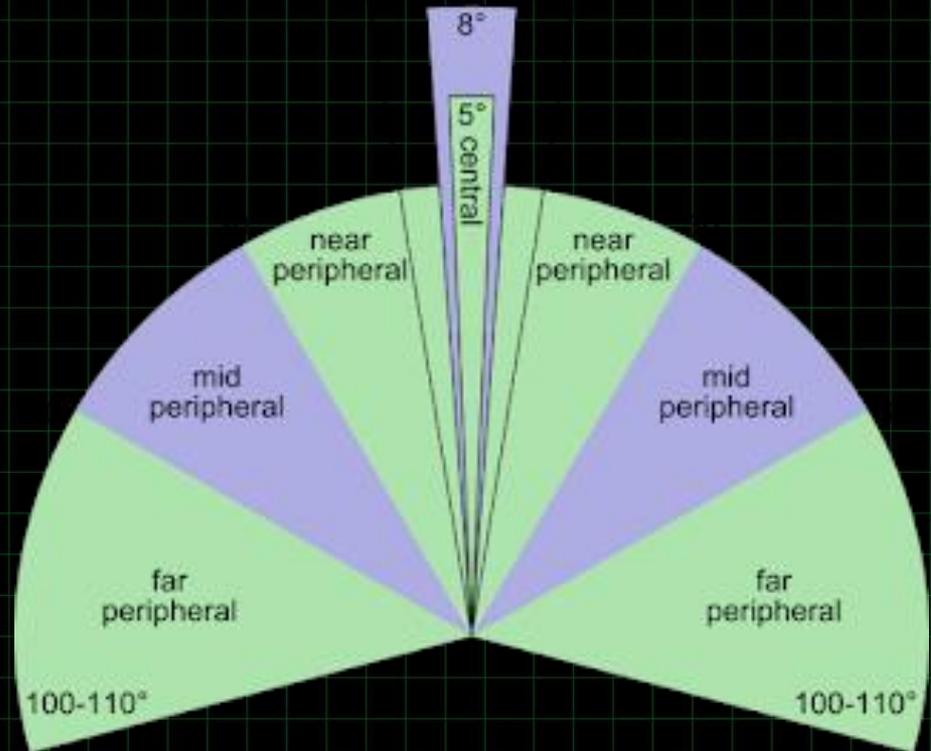
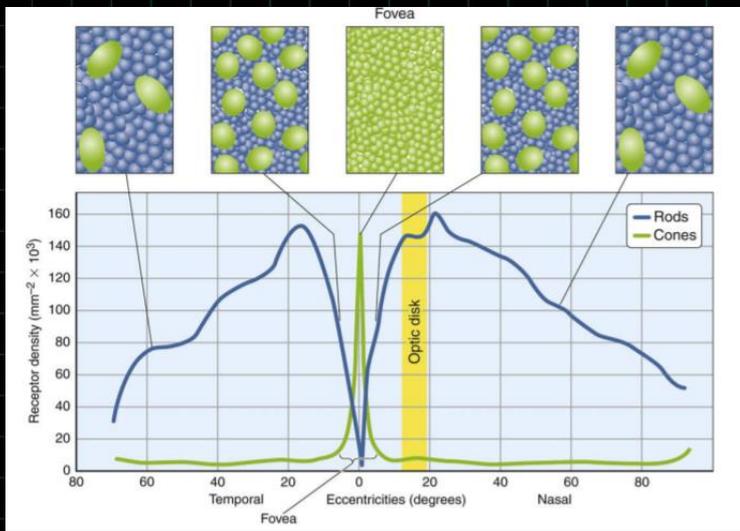
64 times more pixels than Full HD displays

Oculus Quest 2: (1832 x 1920 per eye)

Iphone Retina display: 2532 x 1170



# Foveated rendering



# Cybersickness



# Cybersickness identification

## 2021:

Porcino, T., Bernardini, F., Rodrigues, E. O., Silva, A., Clua, E., and Trevisan, D. **A symbolic machine learning approach for cybersickness potential-cause estimation.** In *International Conference on Entertainment Computing*. 2021. Springer.

Porcino, T., Trevisan, D., and Clua, E. **A cybersickness review: causes, strategies, and classification methods.** *Journal on Interactive Systems*, 12(1):269–282. 2021. SBC

Porcino, T., Rodrigues, E. O., Bernardini, F., Trevisan, D., and Clua, E. **Identifying cybersickness causes in virtual reality games using symbolic machine learning algorithms.** *Entertainment Computing*, page 100473. 2021. Springer.

## 2020:

Porcino, T., Rodrigues, E. O., Silva, A., Clua, E., and Trevisan, D. **Using the gameplay and user data to predict and identify causes of cybersickness manifestation in virtual reality games.** In *2020 IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH)*, pages 1–8. IEEE.

Porcino, T., Trevisan, D., and Clua, E. **Minimizing cybersickness in head-mounted display systems: causes and strategies review.** In *2020 22nd Symposium on Virtual and Augmented Reality (SVR)*, pages 154–163. IEEE.

## 2017:

Porcino, T. M., Clua, E., Trevisan, D., Vasconcelos, C. N., and Valente, L. (2017). **Minimizing cybersickness in head-mounted display systems: design guidelines and applications.** In *Serious Games and Applications for Health (SeGAH), 2017 IEEE 5th International Conference on*, pages 1–6. IEEE.



# Cybersickness Prediction

## Procedure

### Data Collection Protocols

Content: 2 VR games using Unity 3D Engine.

Hardware: 2 types of HMDs (HTC Vive and Oculus Rift)

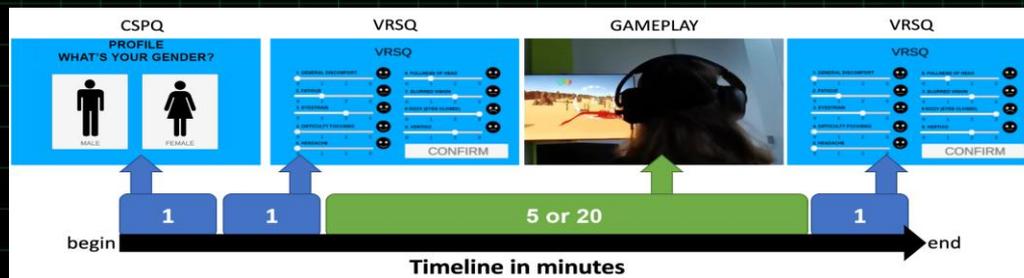
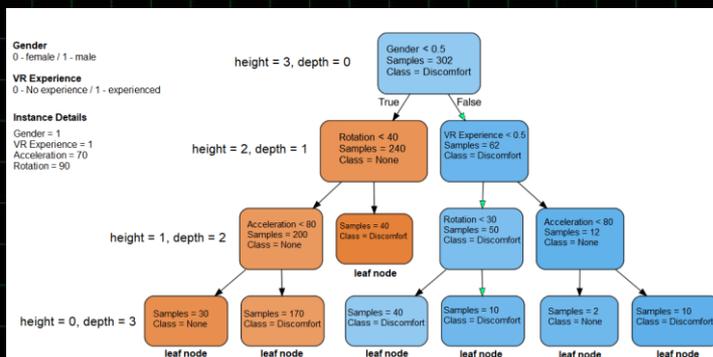
Participants: 88 (19 females) divided in 6 protocols.

Dataset: During the protocols, the dataset and the software content was evolved to final stage. After all phases we considered 37 valid user.



### Symbolic Machine Learning Approach

We use symbolic machine learning to analyse and identify one or more causes of discomfort, which is user and context specific. In other words, the approach described in this manuscript is not a general rule for recognizing the presence of discomfort as previously approached in the current literature.

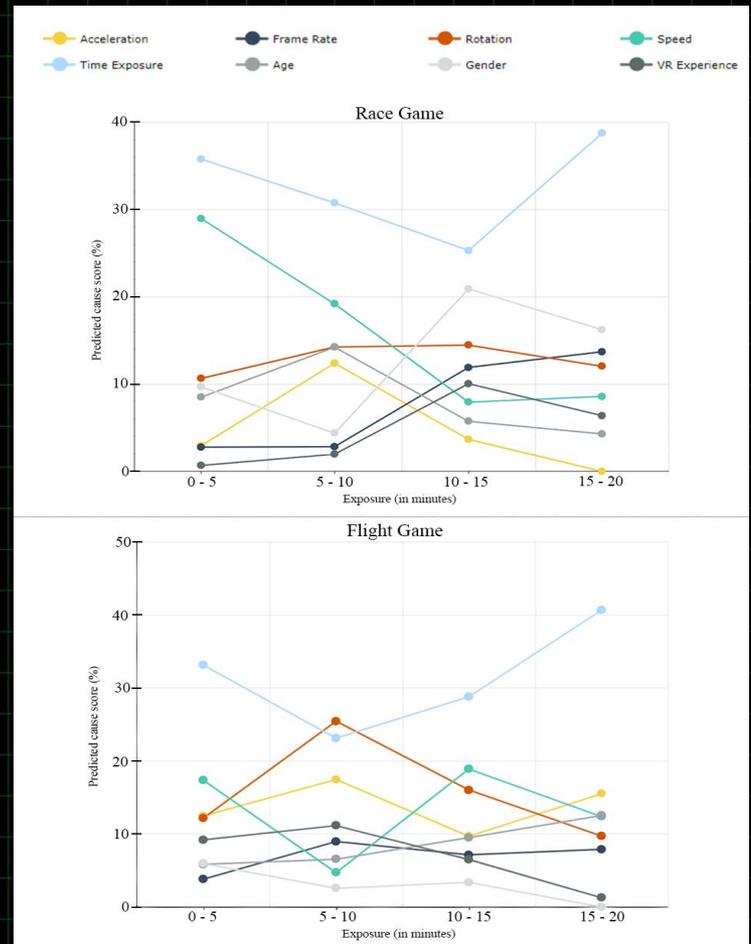


# Cybersickness Prediction

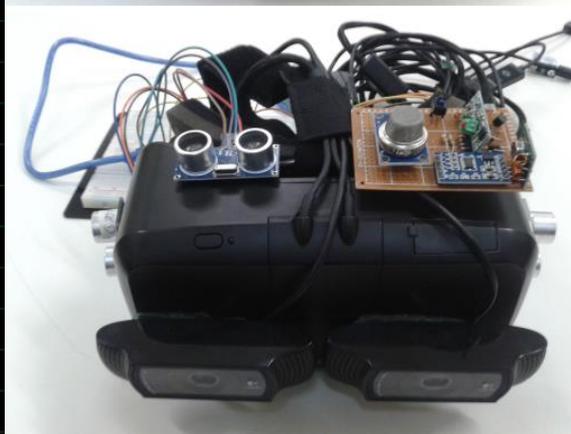
Random Forest feature ranking (identification of cybersickness causes) for the race (A) and flight game (B) for P5 subjects.



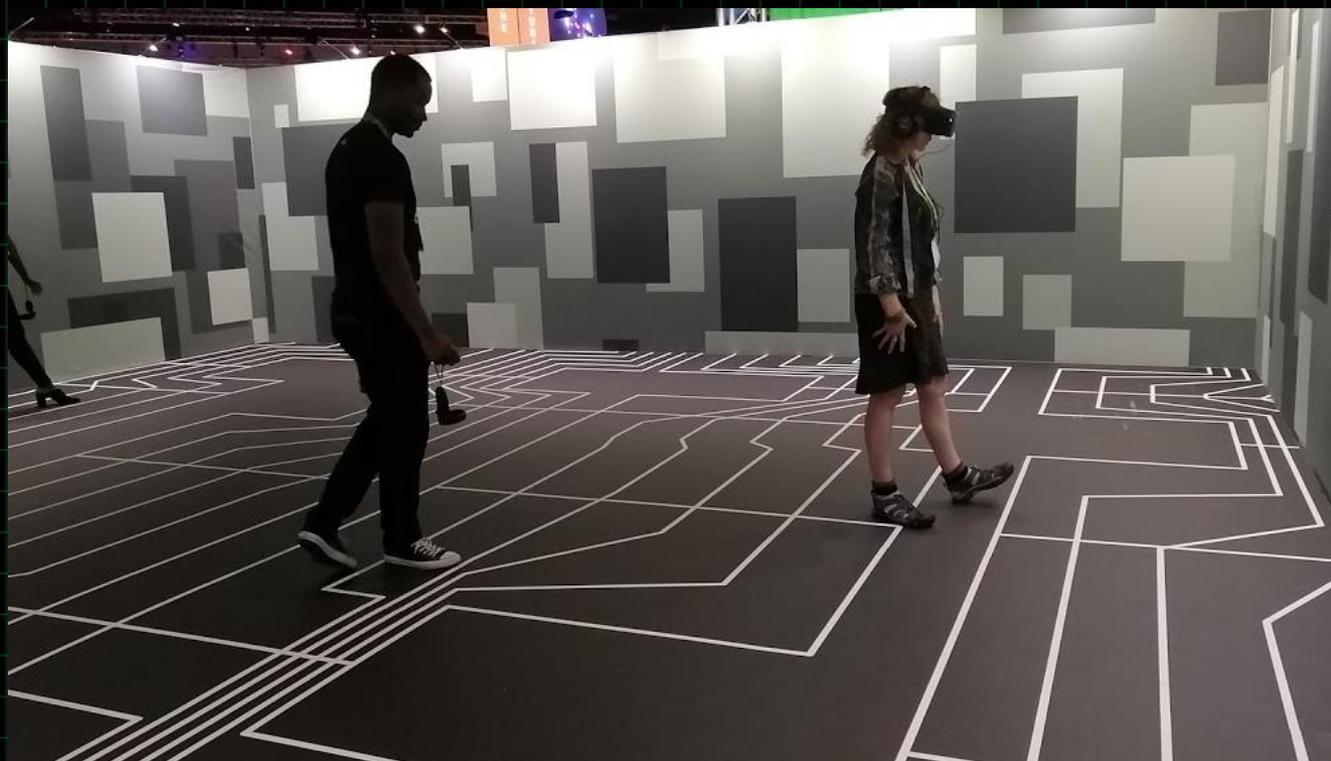
Race and flight game potential-cause score ranking along with different exposure moments for the P6 subjects.



# Tracking



# Endless Walk

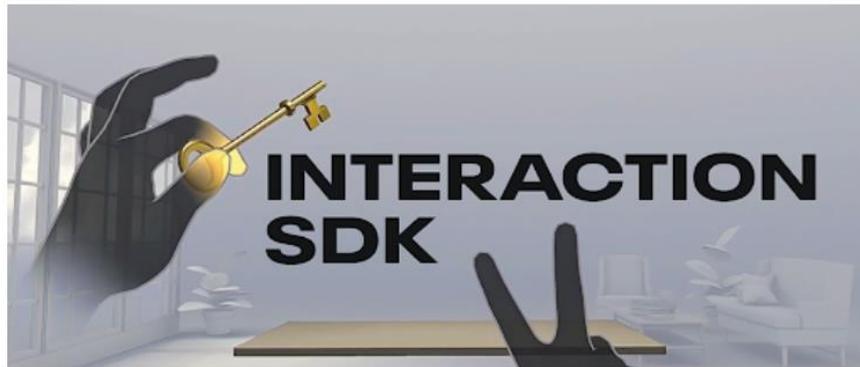


# Presence Platform Interaction SDK and Tracked Keyboard Now Available

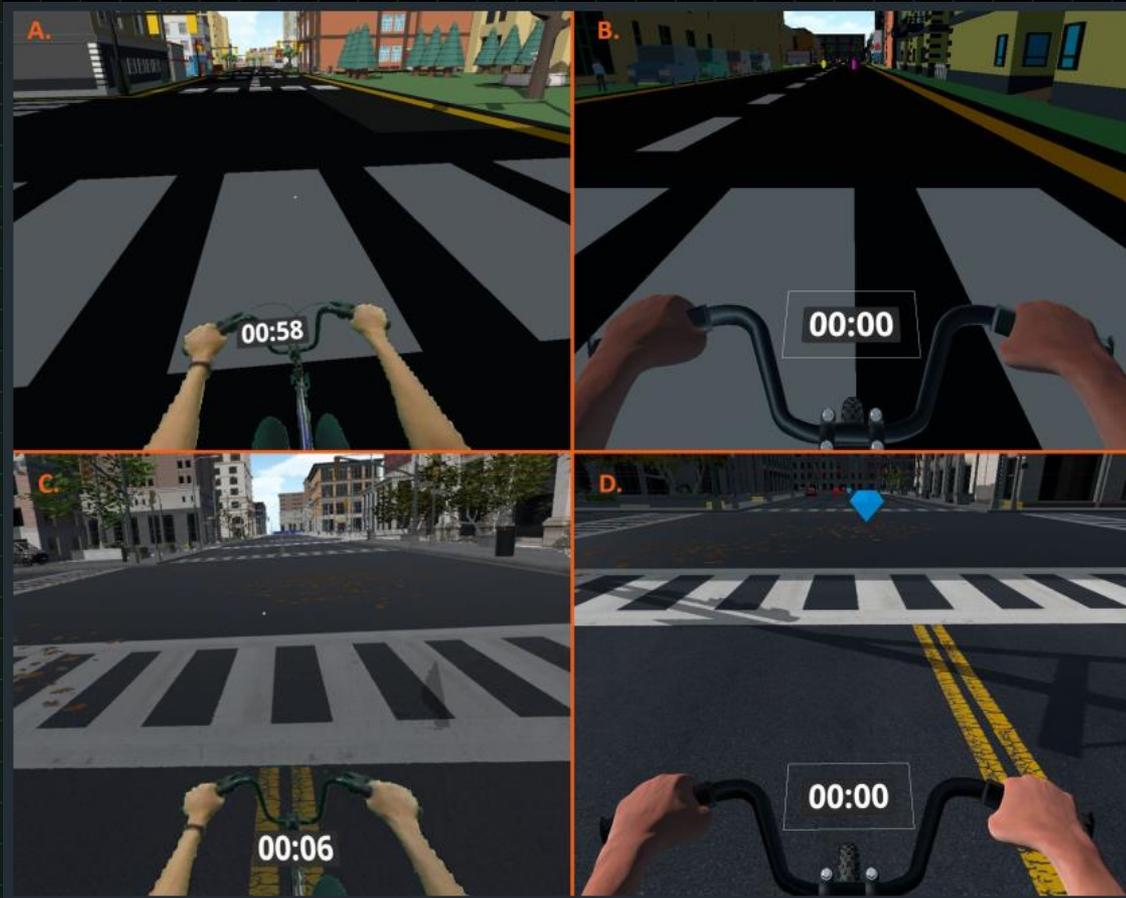
Written by: Oculus VR • Feb 1, 2022

At Connect 2021, [we introduced Presence Platform](#)—a broad range of machine perception and AI capabilities that allow you to build more realistic mixed reality, interaction, and voice experiences that seamlessly blend virtual content in a user's physical world. Since then, we've followed that introduction with releases of [Spatial Anchors Experimental](#), [Voice SDK](#), and [Passthrough](#), and we're now excited to add to our growing list of mixed reality capabilities with [Interaction SDK Experimental](#).

## Interaction SDK



# Hand Tracking



OLIVEIRA, W. ; TIZUKA, M. ; Clua, Esteban ; SALGADO, L. ; TREVISAN, D. Virtual and Real Body Representation in Mixed Reality: An Analysis of Self-presence and Immersive Environments. Proceedings of the XVIII International Conference on Entertainment Computing (ICEC 2019), 2019. p. 42-54

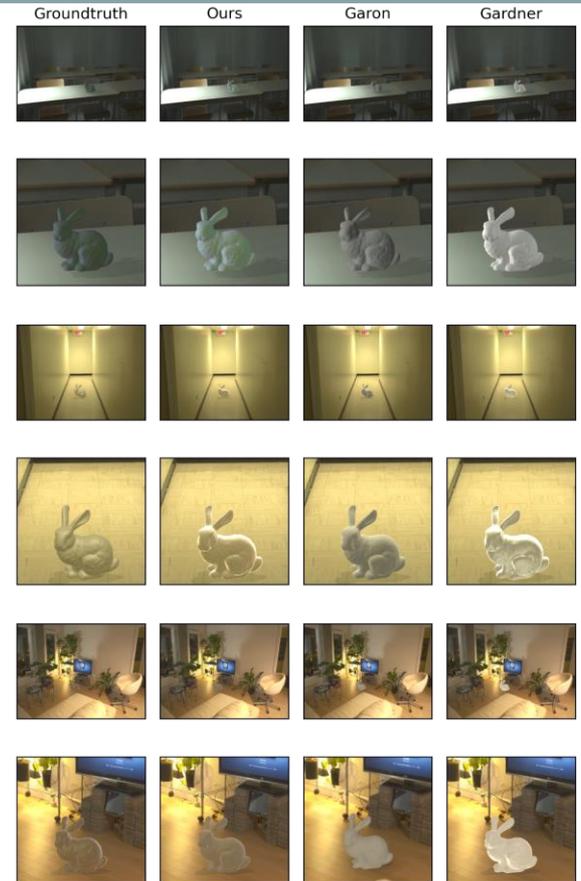
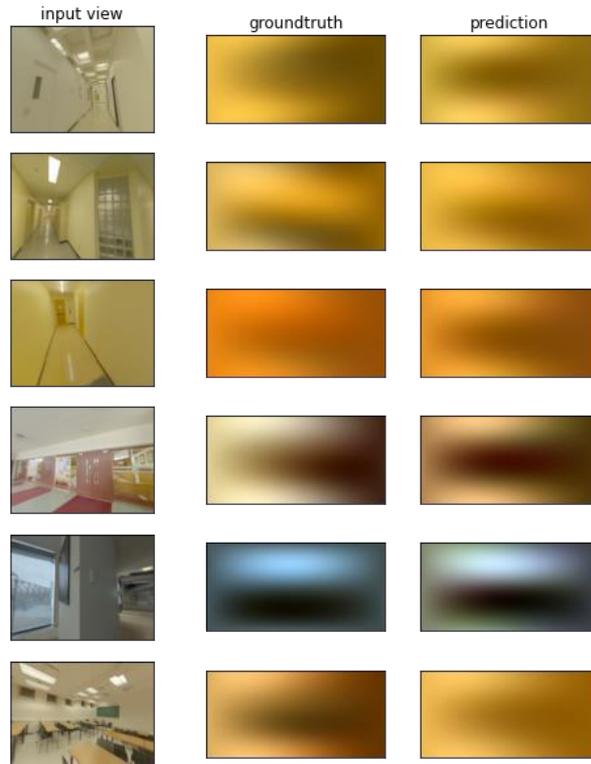


# ***Illumination Matching***



# Deep Learning Environment Lighting

- High quality lighting
- Fast (real time)
- Low estimation error
- Easy to use (9 SH lighting coefficients)
- One AI model for all applications
- Does not require scene setup
- Does not require user's intervention

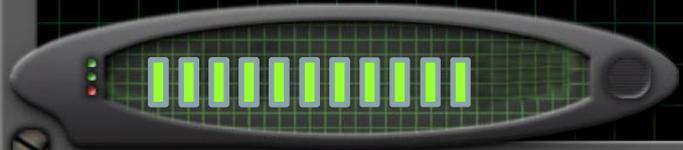


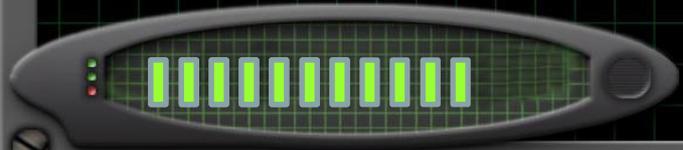
MARQUES, Bruno Augusto Dorta; CLUA, Esteban Walter Gonzalez Clua; VASCONCELOS, Cristina Nader. Deep spherical harmonics light probe estimator for mixed reality games. **Computers & Graphics**, v. 76, p. 96-106, 2018.

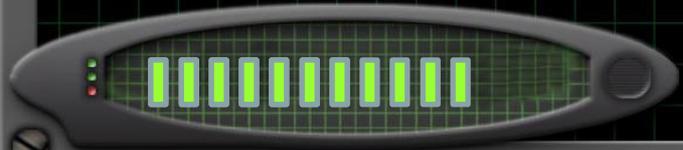
# *Wearables*









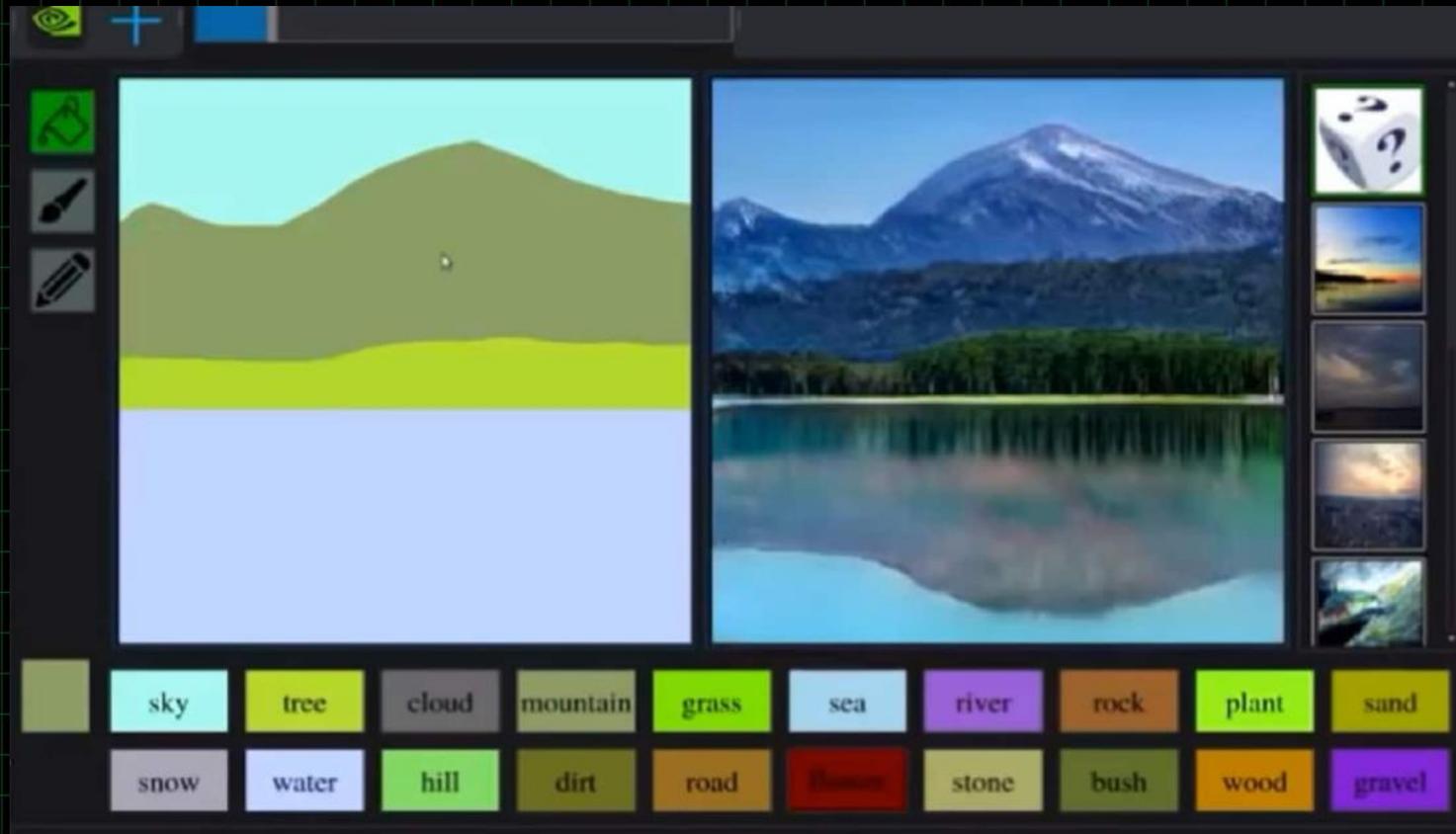


# Inclusive devices



# Deep Learning and World creation

<https://www.nvidia.com/en-us/research/ai-playground/>



# Deep Learning and Characters Creation



ARTOMATIX

ARTENGINE

INDUSTRIES

ARTIST SHOWCASE

CAREERS

CONTACT

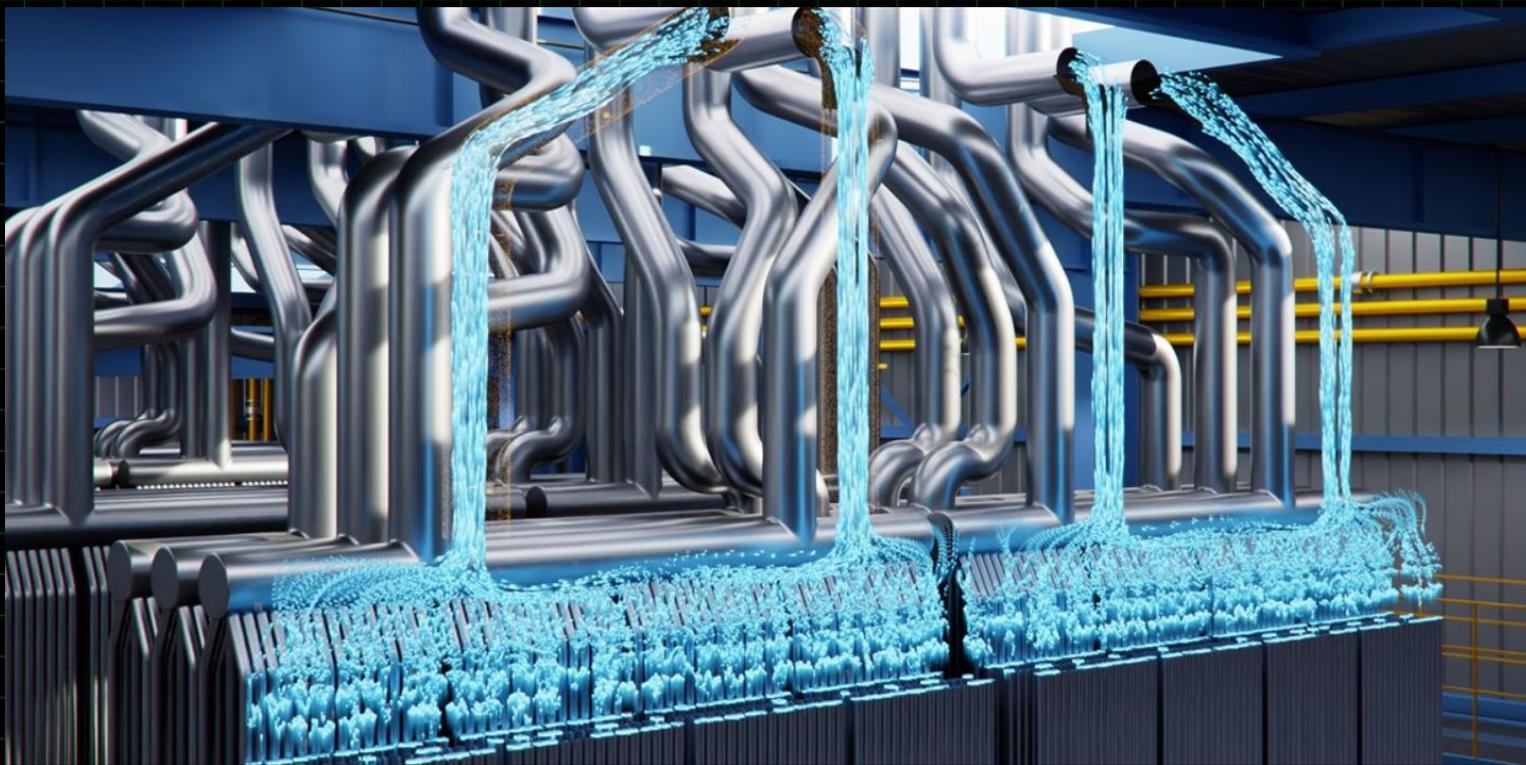
## GREAT ART TAKES TIME MAKE MORE OF IT

ArtEngine helps studios create 3D content quicker than ever before. The solution learns from examples provided by artists and imagines many more in real time.

FREE TRIAL



# *Physics & ML*



<https://developer.nvidia.com/modulus>



# *Analytics*



MELO, SIDNEY ARAUJO ; PAES, ALINE ; Clua, Esteban ;  
KOHWALTER, TROY C. ; Murta, Leonardo . Detecting long-  
range cause-effect relationships in game provenance graphs with  
graph-based representation learning. ENTERTAINMENT  
COMPUTING, v. 32, p. 100318-100337, 2019