

# Visual Computing

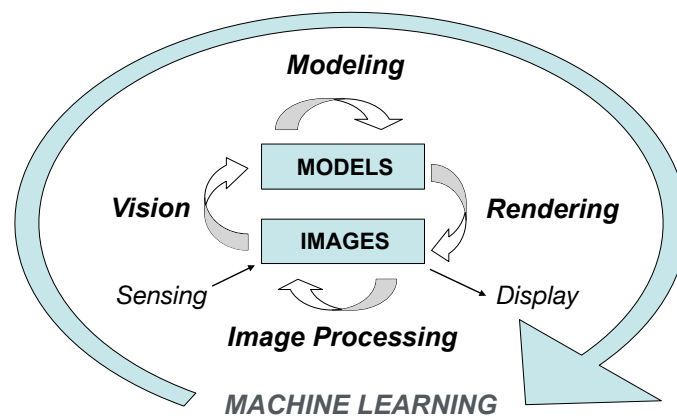
@ IMPA / Visgraf Lab

Luiz Velho  
(IMPA)

Applied Math Day - 2026

## What We Do ?

Computational Applied Mathematics for (New) Media



- Conceptual Framework

# New Frontier

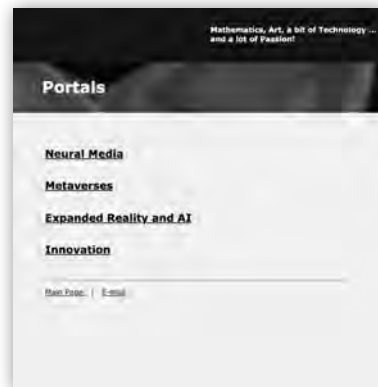
- Cognitive Mathematics
  - Human Perception
  - Machine Learning
- Intelligent Mediation
  - Human / Computer
  - Robotics

# The Nest Past / Present / Future

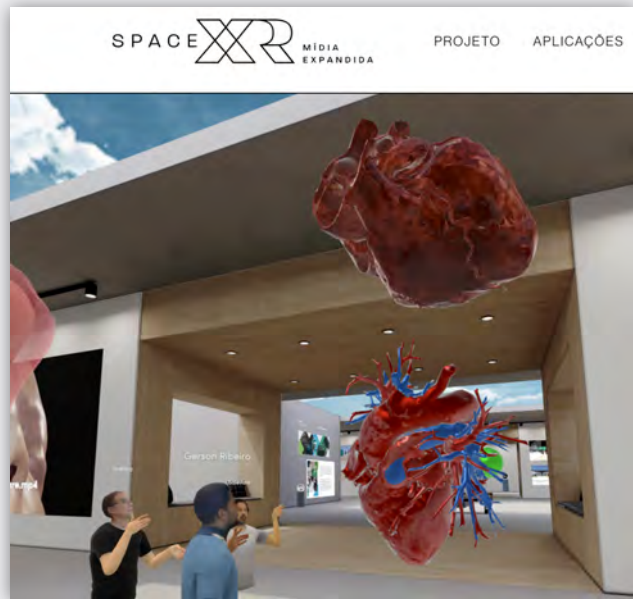
- Lab Website



- Portals to Current Research

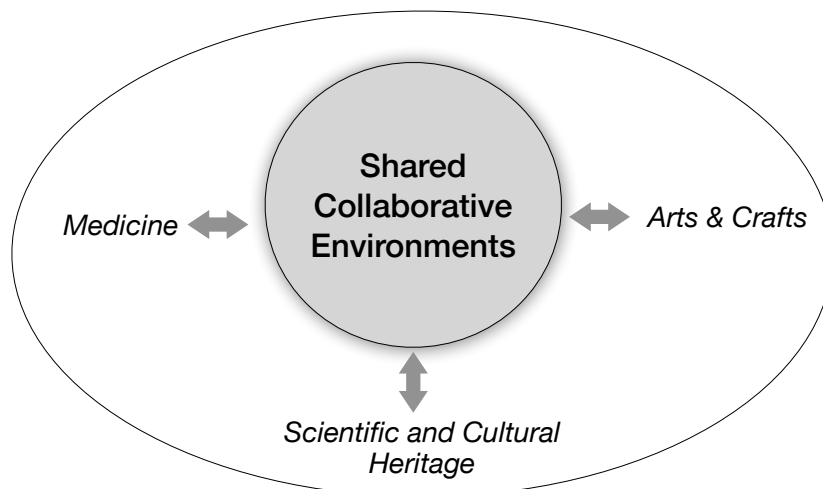


# Metaverses



## Expanded Reality :

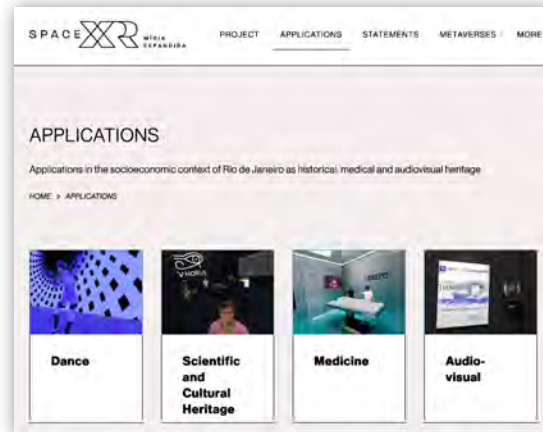
*New Media and AI*



# Highlights

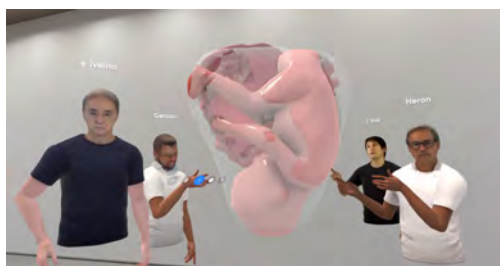
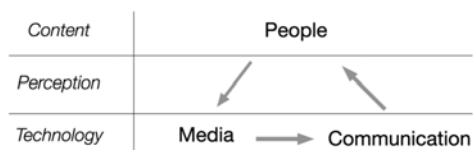
2020 - 2024

- Metaverses
  - Fetal Medicine
- BioDesign
  - Assisted Surgery
- Dance
  - Ocean Dance
- Cinema 3D
  - Egypt XR
- ★ *The Book*



# Metaverses

- *The Use of Metaverse in Fetal Medicine*



# Seminar Medicine in the Metaverse 2022



Live Streaming



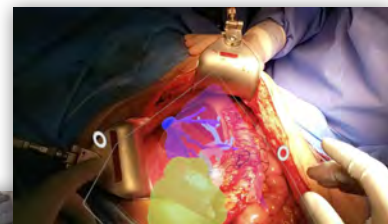
Virtual Operating Room



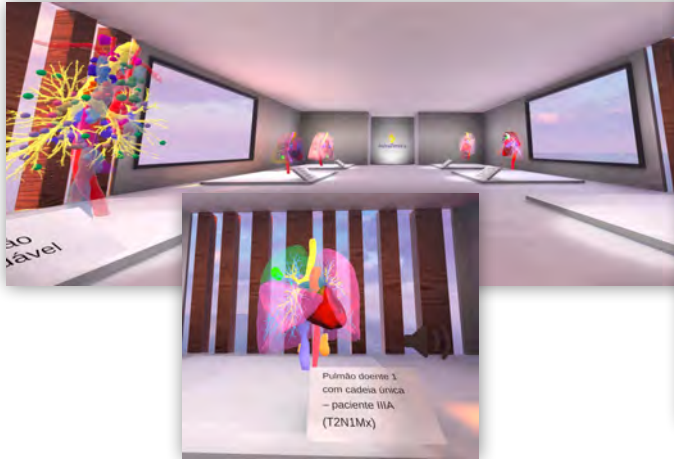
Interactive Exploration Space

## BioDesign

- *From Virtual Planning to Real Incision*

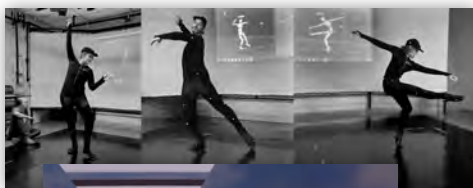


# Astrazeneca Demonstration 2023



## Dance

- Ocean Dance Process Record

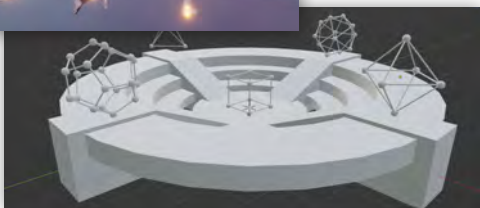


*Motion Capture*

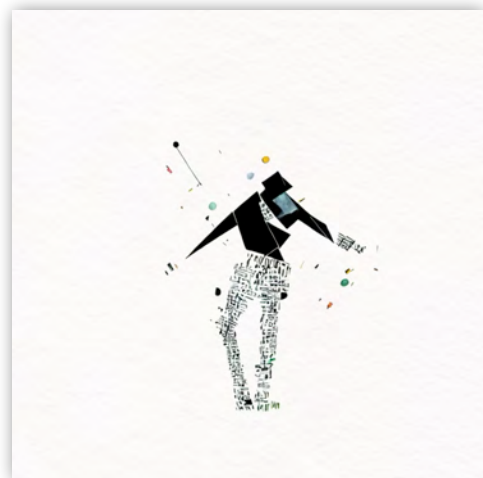


*Animation  
+  
Rendering*

*3D Modeling*



- AI, Images & Dance



*AI, Watercolor Rotoscoping*

# XR Dance 2024 / DANC3&T3CH 2024



## Cinema 3D

- Neferhotep Project: A Digital Experience



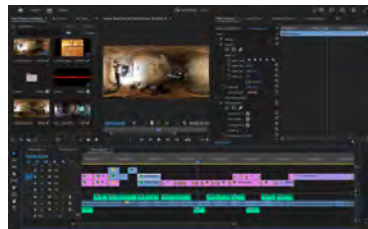
The Site



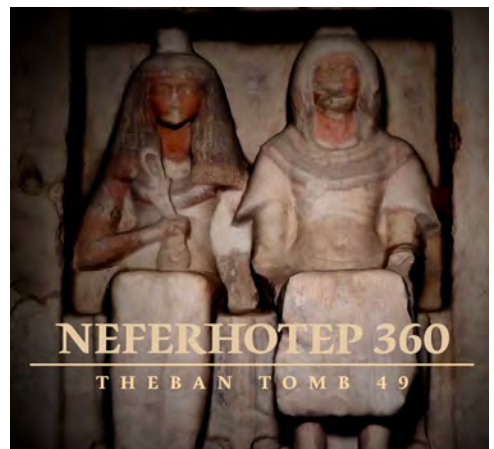
360 Video



TT29



Adobe Premiere + Mantra VR



The Movie

# SEMNA 2024 / FestMat 2025

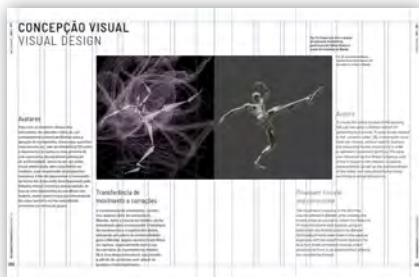


## The Book

- *Weaving Virtual Networks:  
Interactive Design as a Catalyst For Publication*



Web Portal



Book Layout

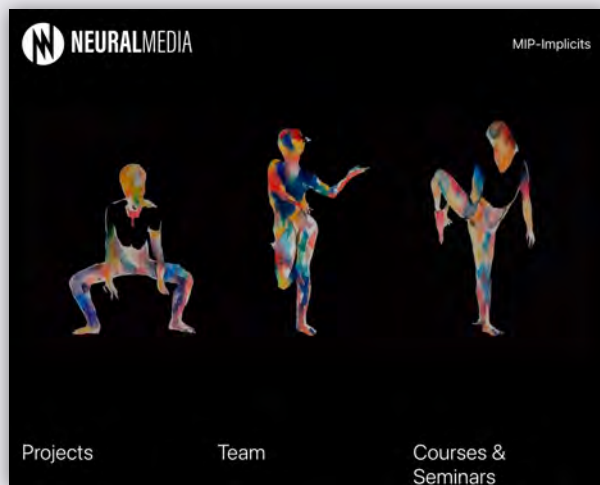


# Book Signing - 07/08/2025

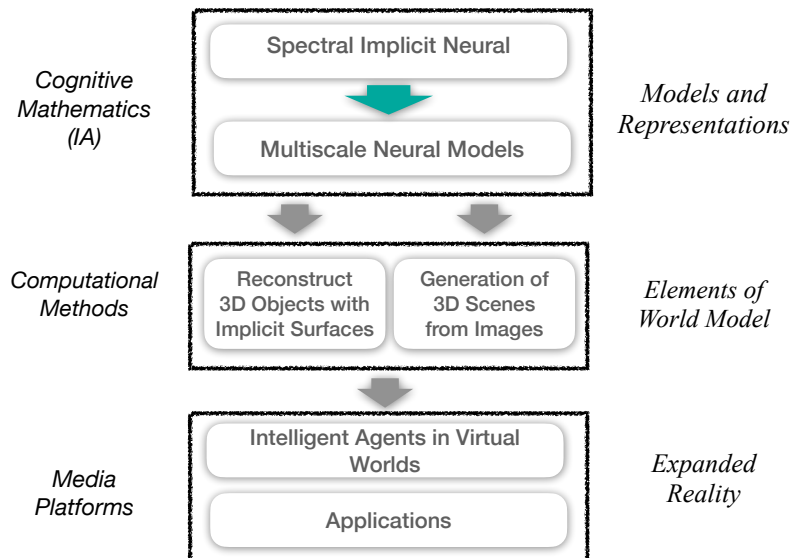
Auditorio do Alta Botafogo



## Neural Media



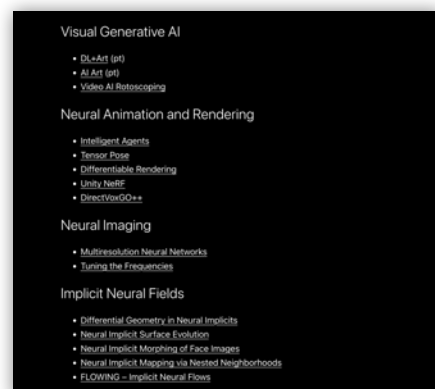
## World Models with AI



## Highlights

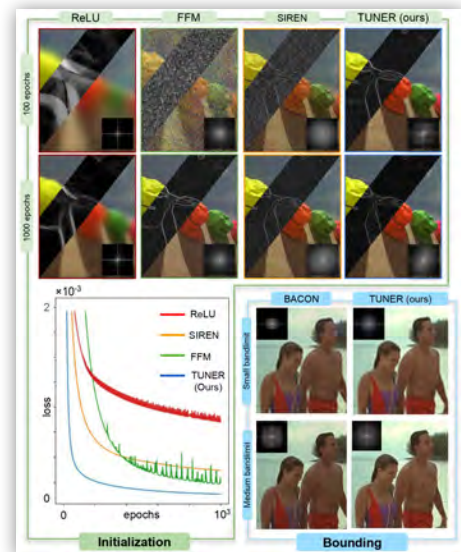
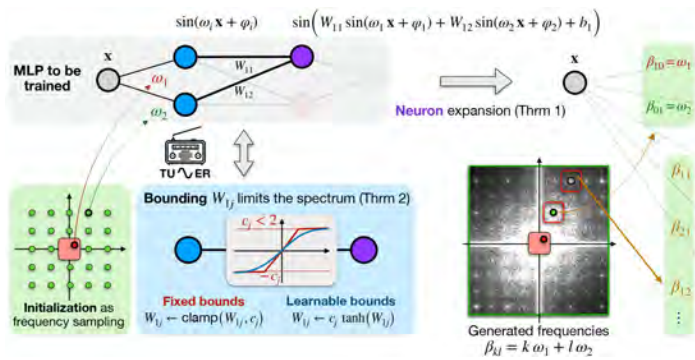
2022 - 2025

- Spectral INRs (*Tuner*)
- Multiscale Neural Models (*MR-Net*)
- Implicit 3D Reconstruction (*i3D / i4D*)
- Scene Generation from Images (*xGS*)
- Intelligent Agents for XR (*MMSW*)

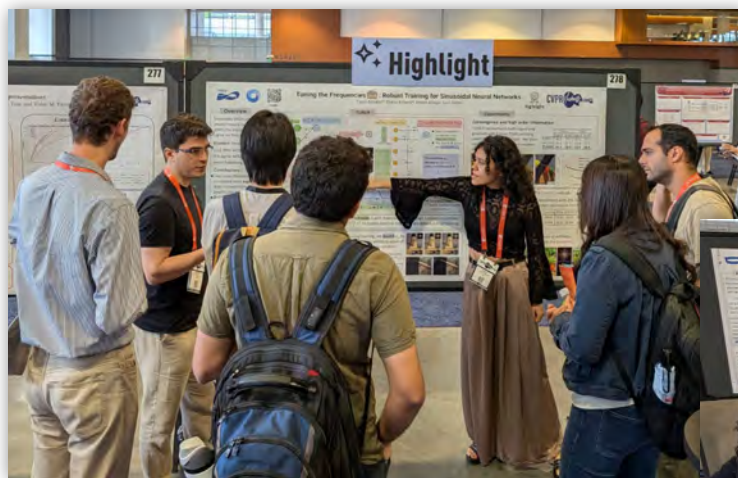


# Spectral INRs

- *TUNER - Tuning the Frequencies: Robust Training for Sinusoidal Neural Networks*



## CVPR 2025

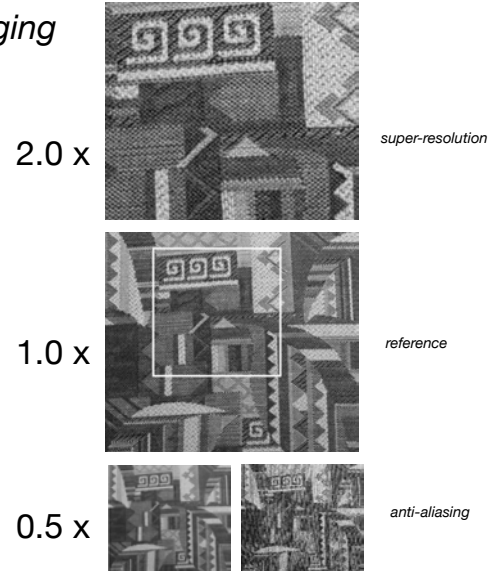
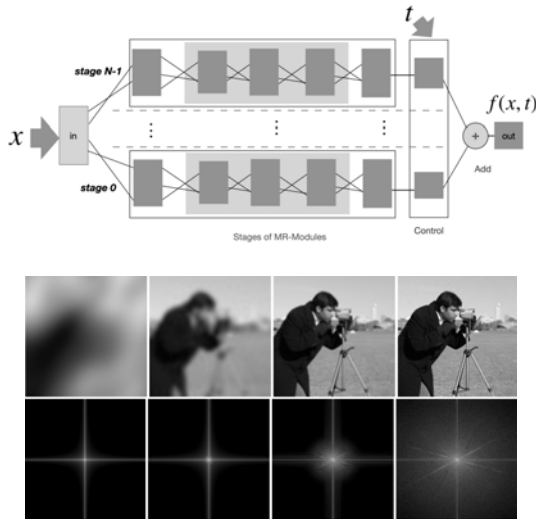


- Highlight Paper



# Multiscale Neural Models

- *MR-Net: Multiresolution Neural Networks for Imaging*



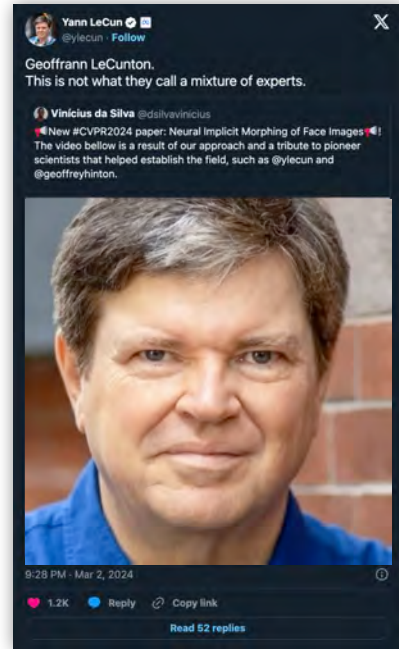
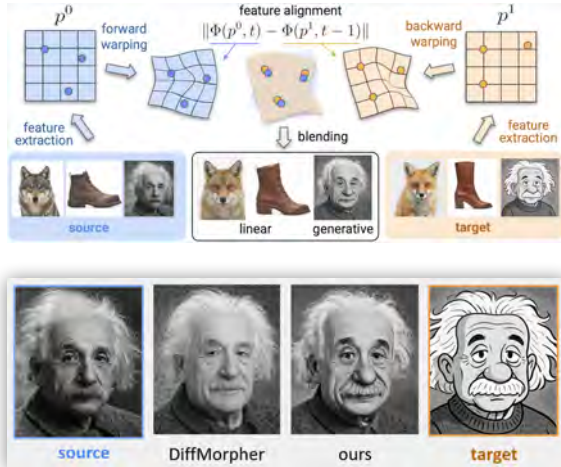
# SIGGRAPH 2024

- Significant New Researcher Award  
(Adriana Schulz - IMPA alumni)



# Implicit Neural Flow

- *FLOWING* : Implicit Neural Flows for Structure-Preserving Morphing



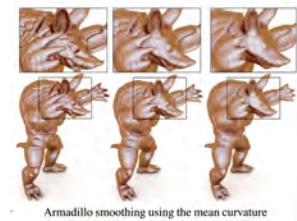
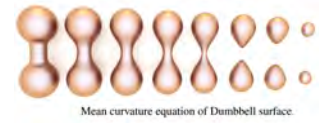
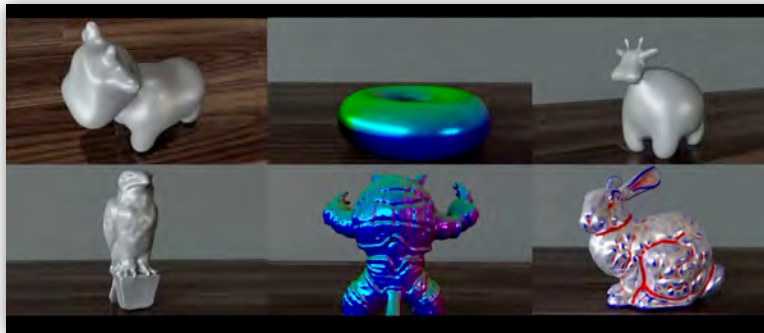
## CVPR 2024 / NeurIPS 2025



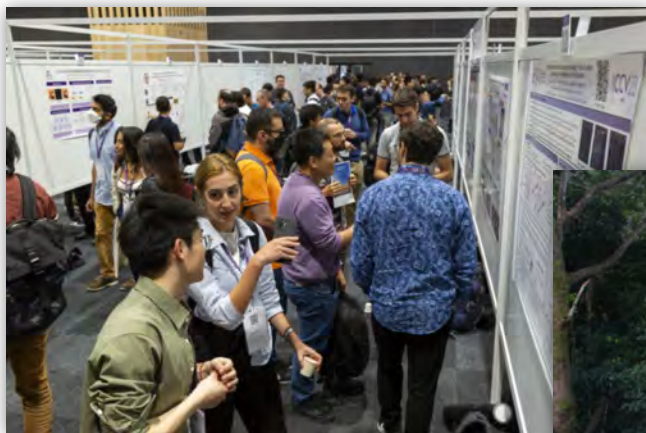
# Implicit 3D Reconstruction

- *Neural Implicit Surface Evolution*

Level-Set Equation: 
$$L(\theta) = \int_{\mathbb{R}^3 \times 0} (f_0 - g)^2 dx + \int_{\mathbb{R}^3 \times (a,b)} \left( \frac{\partial f_0}{\partial t} - v |\nabla f_0| \right)^2 dx dt.$$

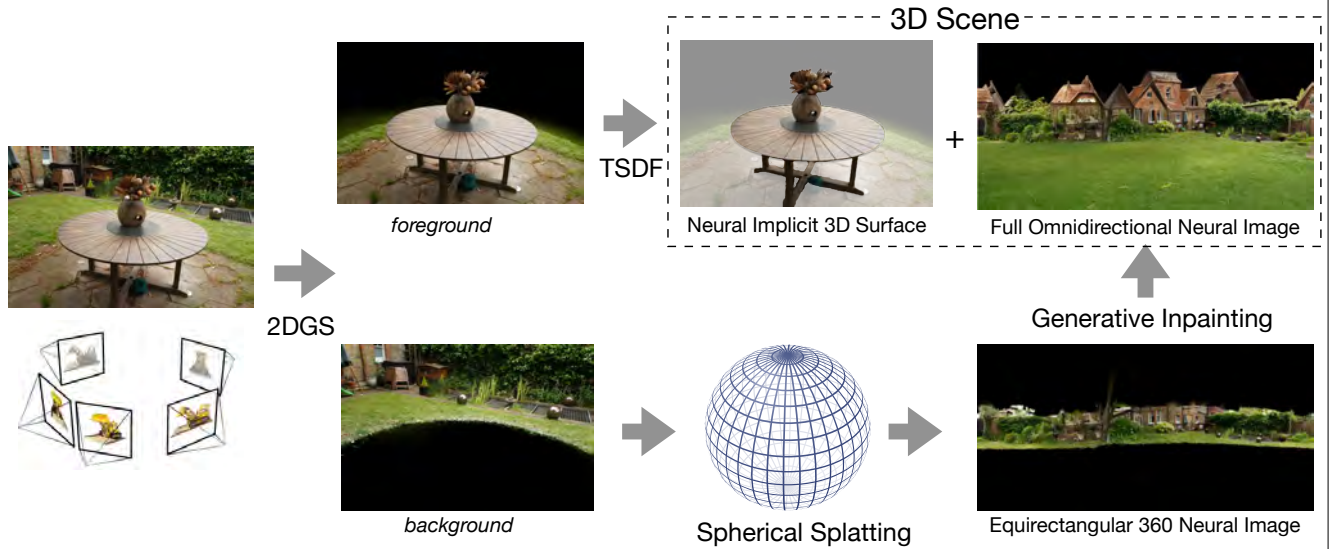


## ICCV 2023



# Scene Generation from Images

- *A Study on Gaussian Splatting and Neural Fields*



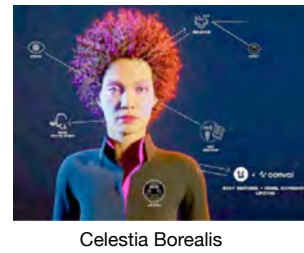
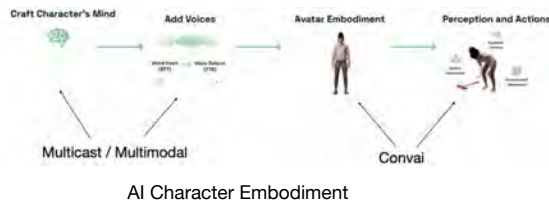
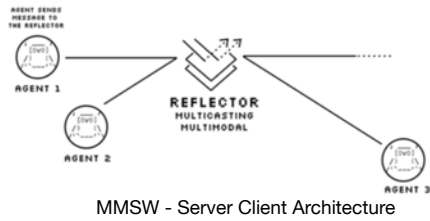
## SIBGRAPI 2025

- Best Ms Dissertation Prize



# Intelligent Agents for XR

- *Gen.AI Playground: Multicast-Multimodal AI Platform*



## IMPA Graphics Seminar 2024



**A Multicasting Multimodal Production  
Presents**

**Q&A**

