Point Clouds – Gaussian Splatting
“Points essentially become ellipsoids with learnable size, orientation, and visual appearance”

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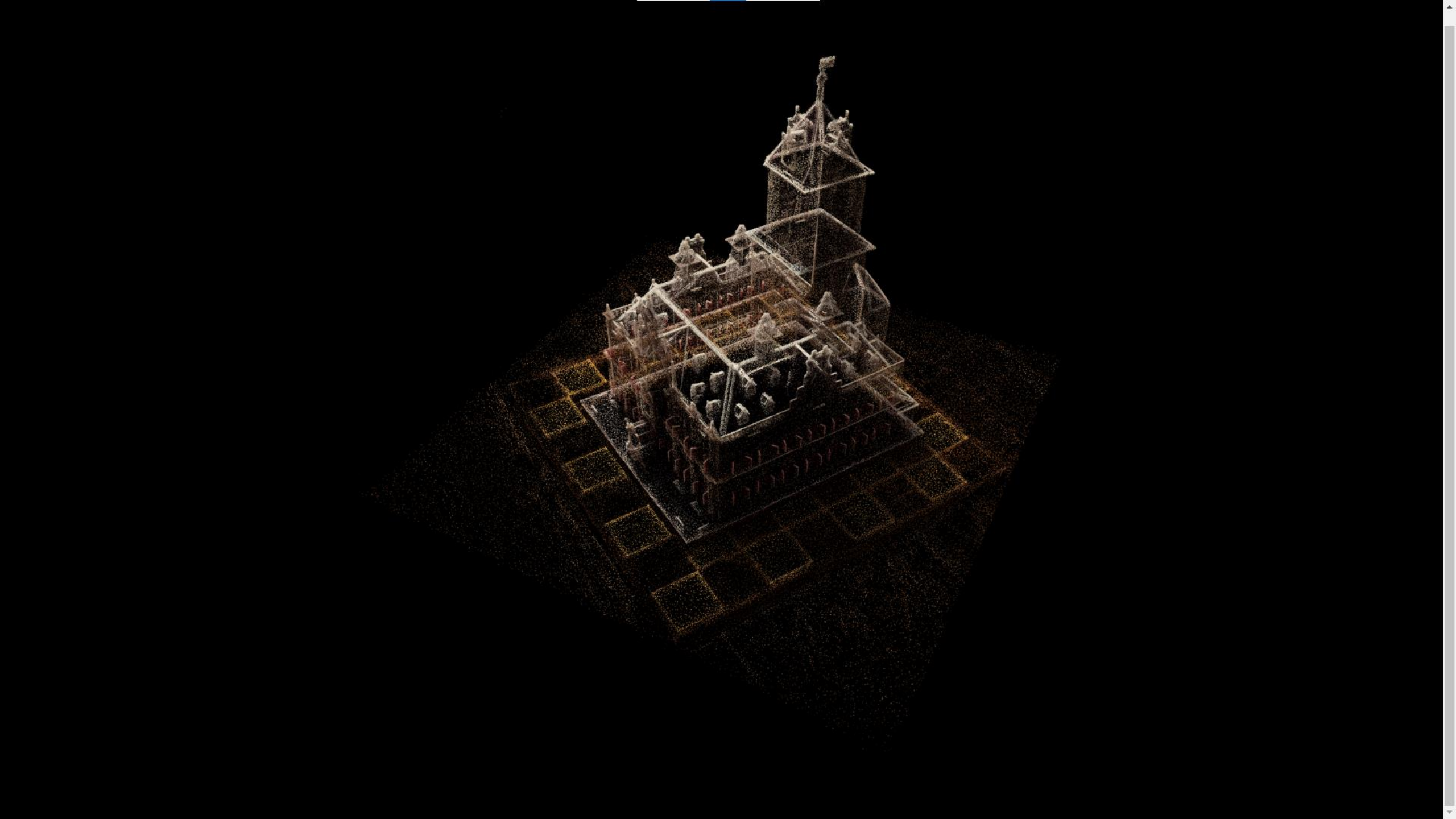
TU Delft



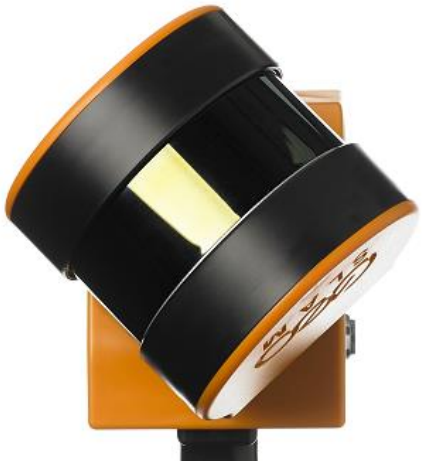
Rutger Kopland
De Landmeter (1982)

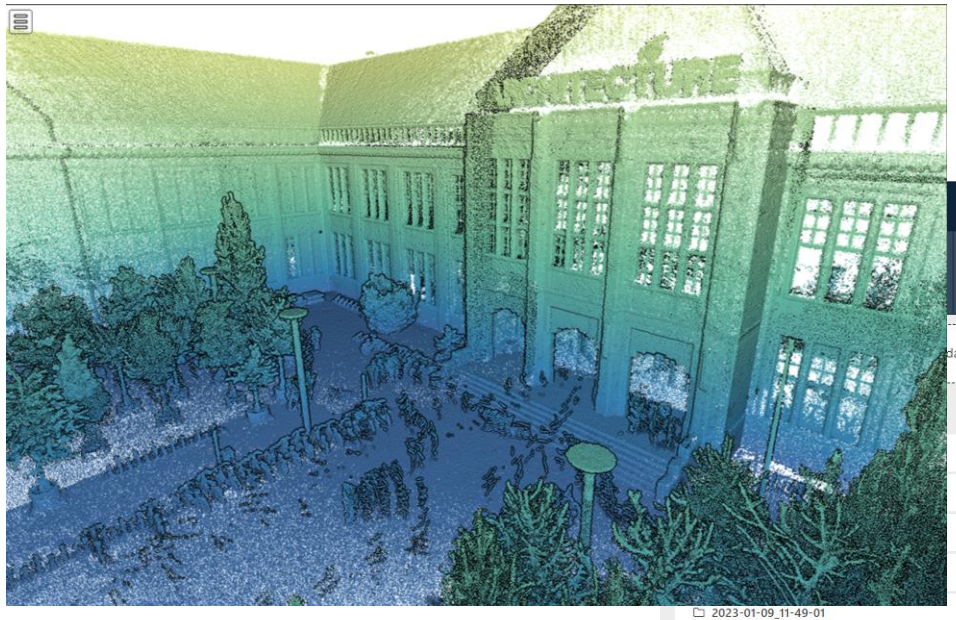
- Het is niet alleen onverschilligheid, in zekere zin
  is het misschien zelfs wel liefde die hem dwingt,
  er is geen paradijs zonder rentmeester.
- Hij is gelukkig met het landschap, maar gelukkig
  met het zoeken, coördinaten wijzen hem zijn onzichtbare
  plek, zijn utopie is de kaart, niet de wereld.
- Hij wil weten waar hij is, maar zijn troost is
  te weten dat de plek waar hij is niet anders bestaat
  dan als zijn eigen formule, hij is een gat in de vorm van
- een man in het landschap. **Met de grenzen die hij
  trekt, scherper en duidelijker, vervagen het gras
  en de bomen en alles wat daar leeft, lijdt en sterft.**
- **Het is heel helder om hem heen, alles is waargenomen**.

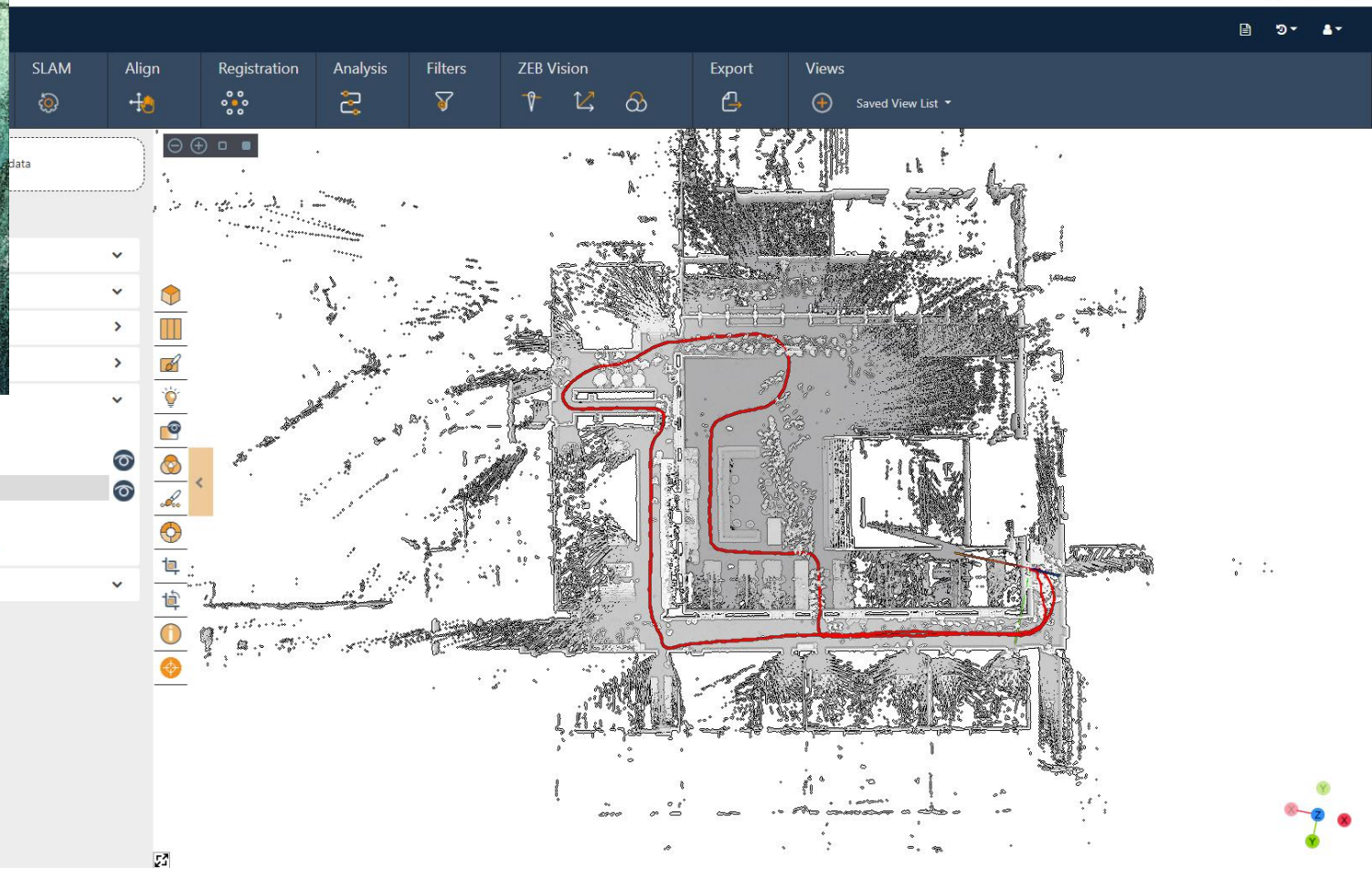
Rutger Kopland
The Surveyor (Translation: James Brockway, 2001)

- It isn't mere indifference, in a certain sense
  it is perhaps even love that drives him on,
  there's no paradise without its steward.
- He is happy with his landscape, but even happier
  with searching, co-ordinates point him to his invisible
  spot, the map, not the world, is his Utopia.
- He wants to know where he is, but it's his consolation
  to know that the spot where he is standing exists only
  as his private formula, he is a hole in the shape of
- a man in the landscape. **With the boundaries that he draws,**
  sharper, more distinct, the grass and the trees grow
  vaguer and everything that lives, declines and dies.
- **The world around him is perfectly clear, everything has been observed.**

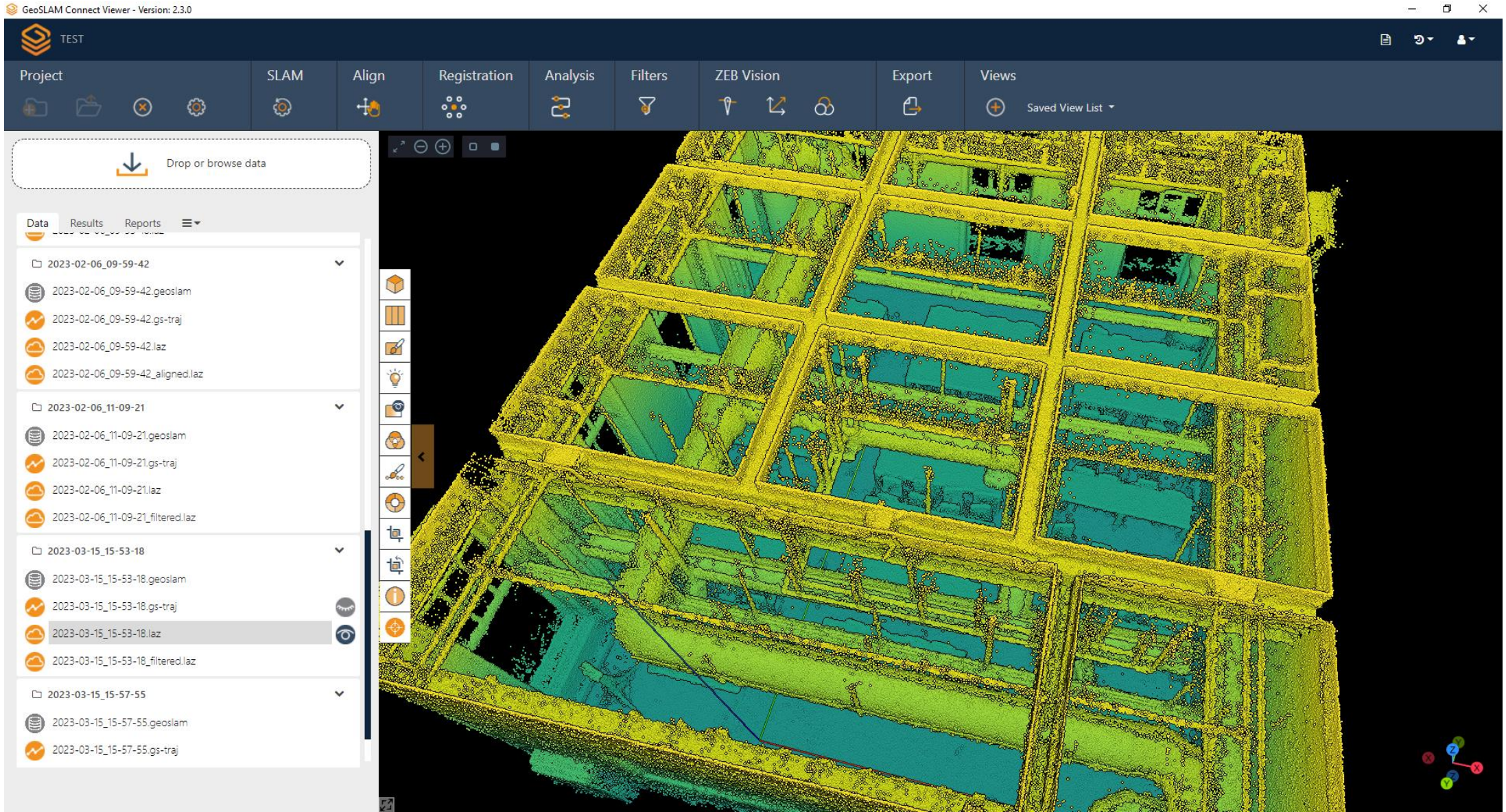
Point Cloud Hardware in Education
GeoSLAM Zeb Horizon



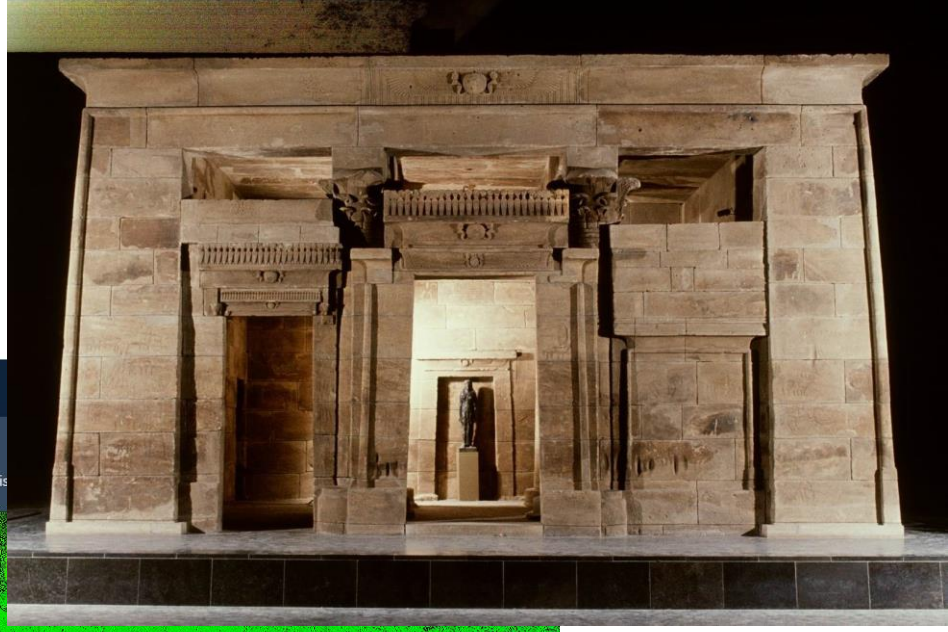


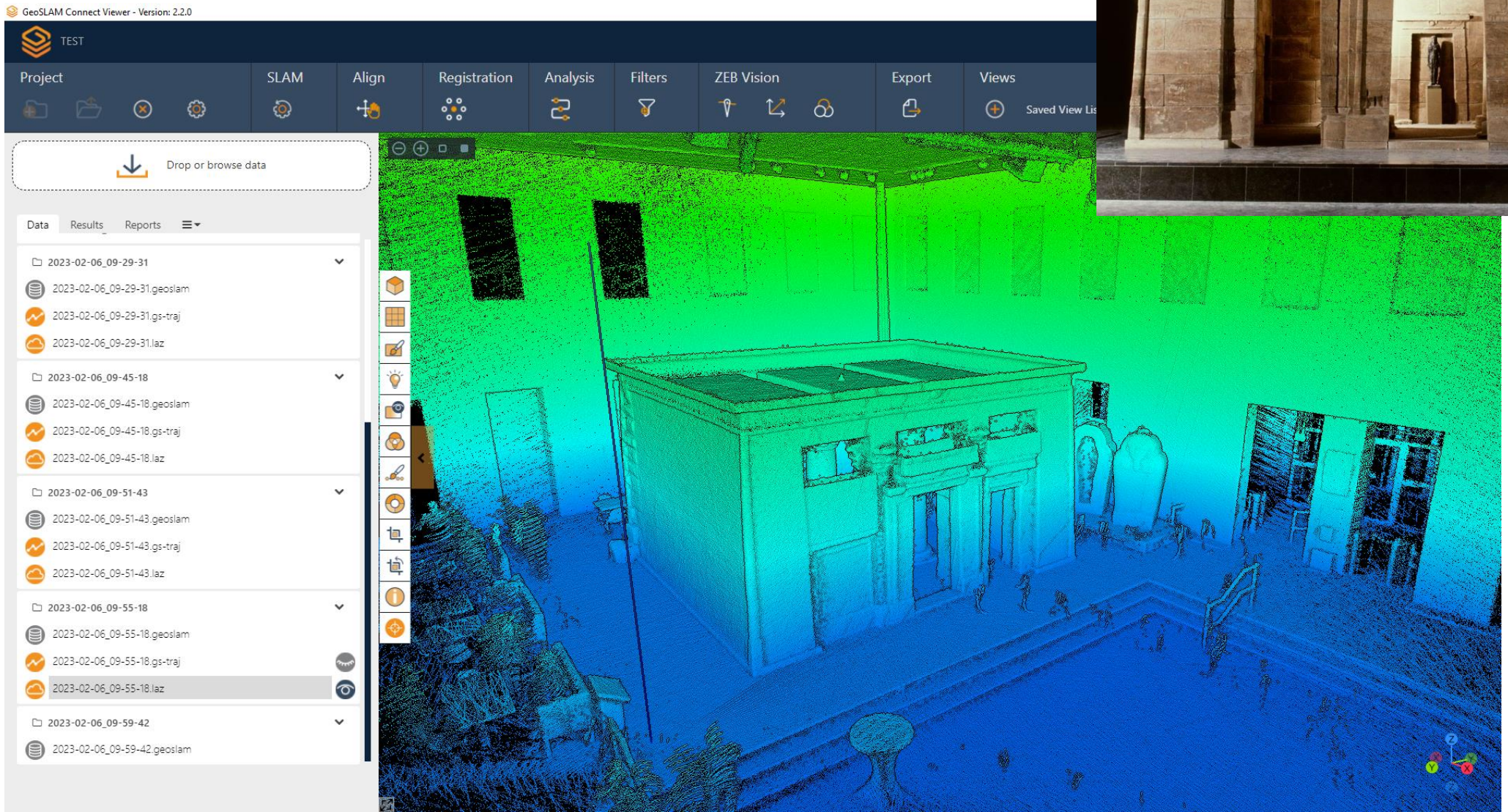


Architecture – Room F – Scanning time 3 minutes

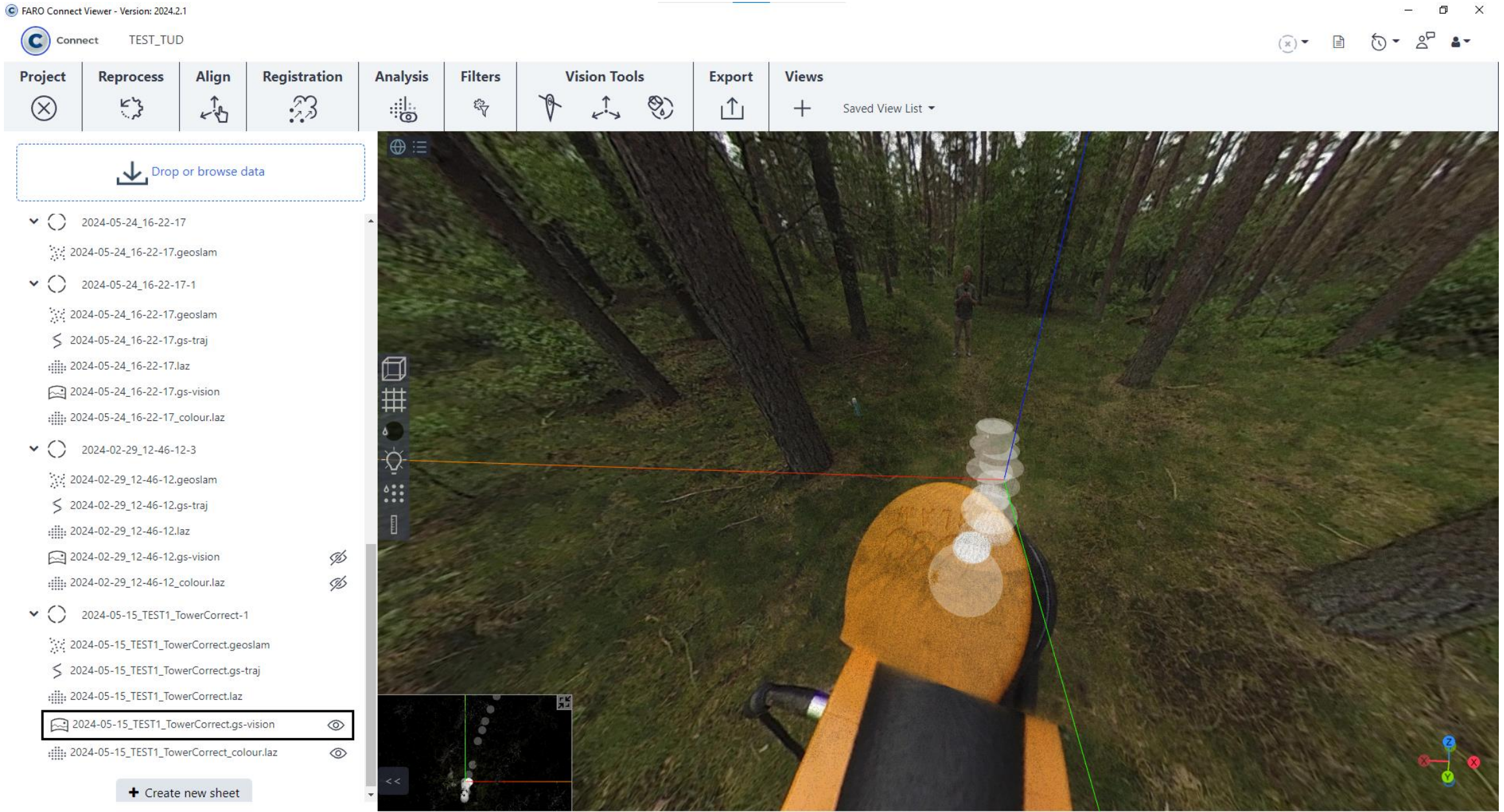


Rijksmuseum van Oudheden, Leiden
Tempel van Taffeh

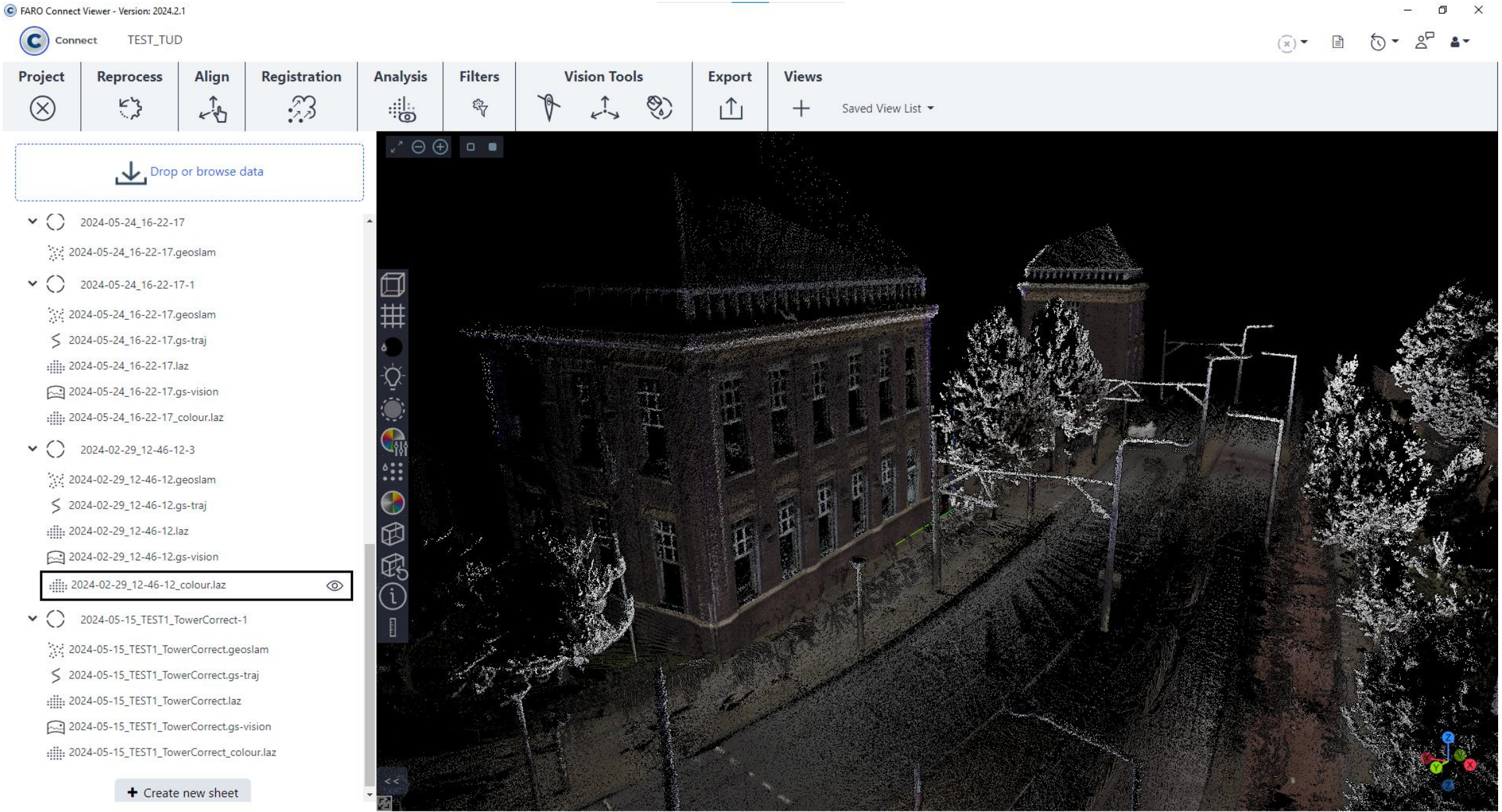




ZEB Horizon Vision



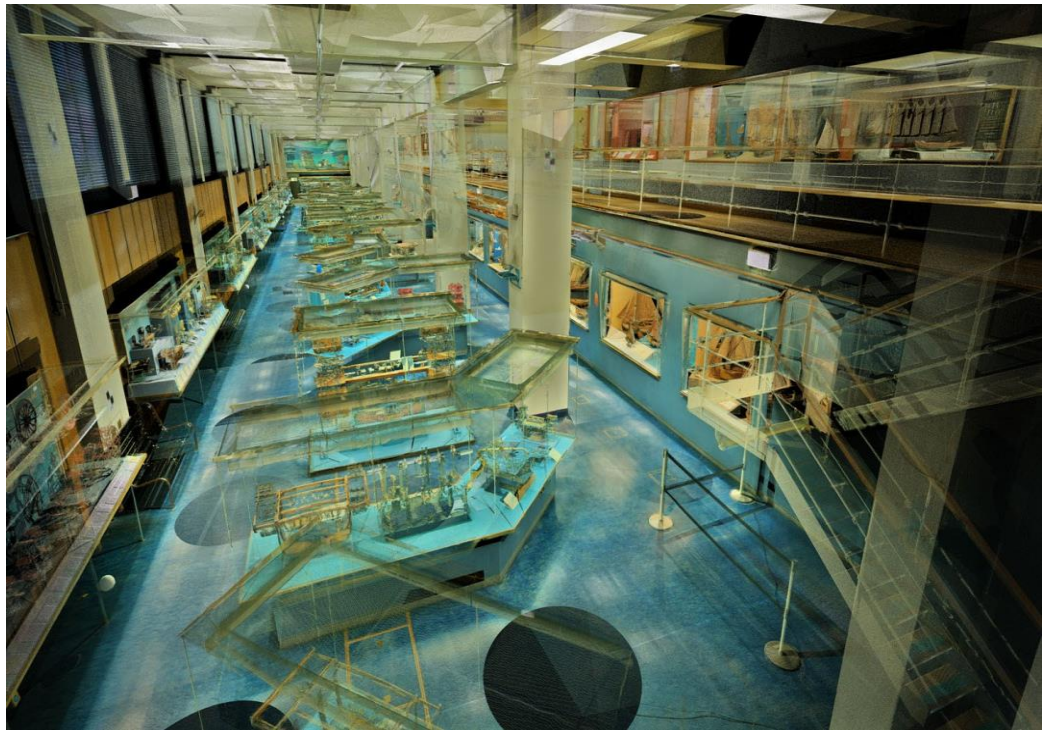
ZEB Horizon Vision



Science Museum - The Shipping Galleries

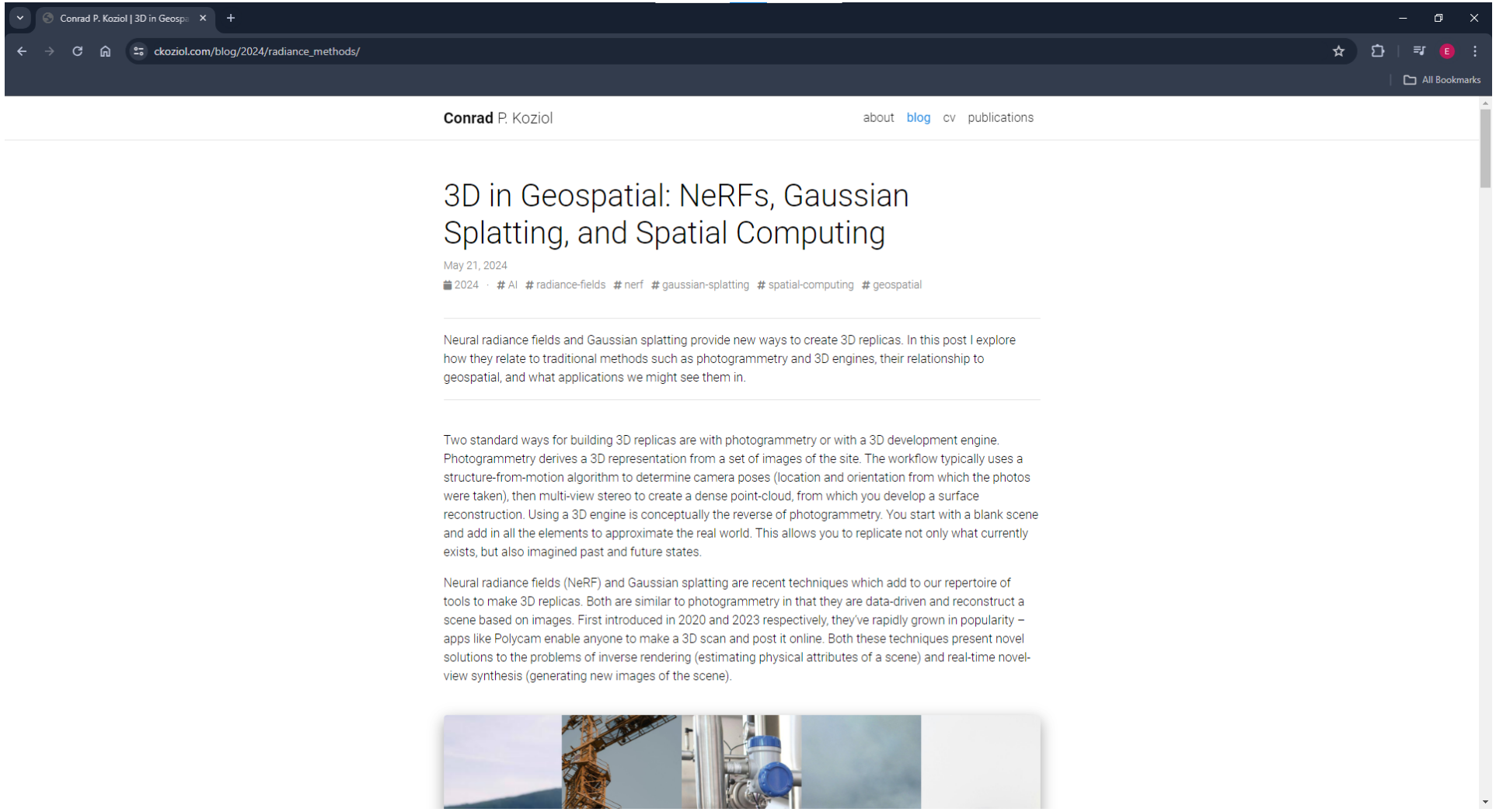
http://youtu.be/gDTbFhFZl9I

- “Every time I walked through, I found something I have not seen before”
- These guys have made a time machine...”
- “Who did ever imagine in 1963 that we could make a virtual shipping gallery out of lasers and computers [...] I can't wait to see how this technology develops”



I can't wait to see how this technology develops …
… Gaussian Splatting

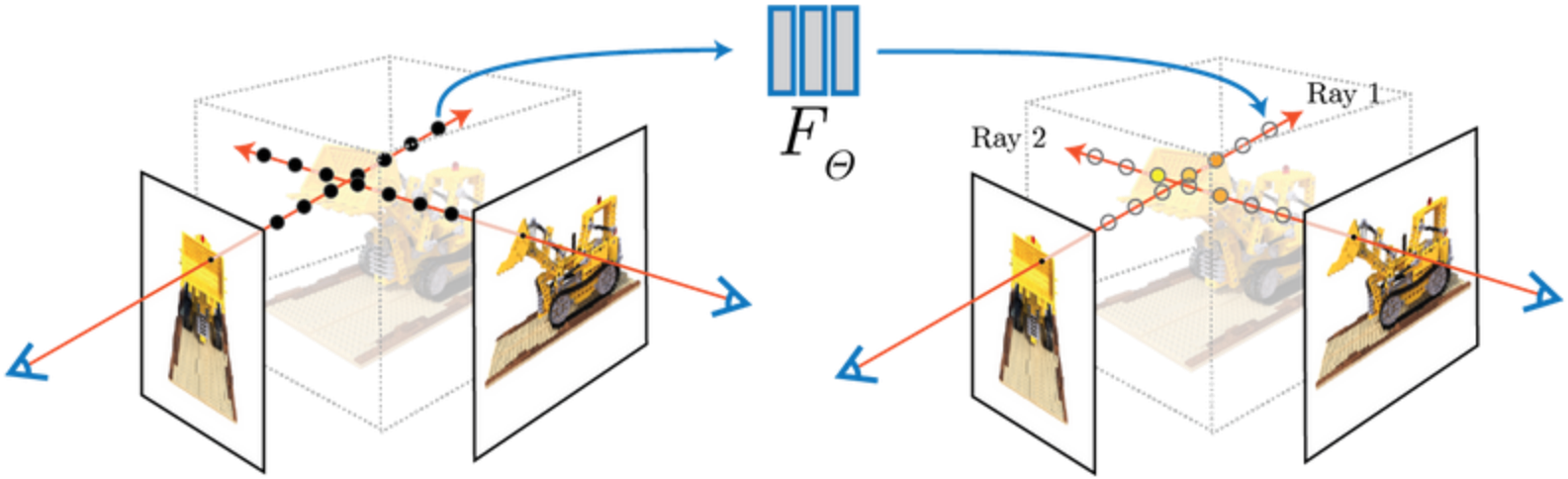
Conrad P. Koziol
NeRFs and Gaussian Splatting
https://ckoziol.com/blog/2024/radiance_methods



Neural Radiance Fields (NeRFs)

Neural Radiance Fields

NeRFs represent 3D scenes using a neural network, rather than an underlying mesh or point cloud. The inputs to the neural network are spatial location (x, y, z) and viewing direction (θ, ϕ). The outputs are volume density (σ) and emitted radiance (R, G, B). To synthesize a view, points sampled along camera rays are input to the neural network and an image is generated from the outputs using volume rendering techniques. The network learns to represent the scene from a set of training images and camera poses, and is optimized using gradient descent. Once trained, new views are synthesized by repeating the process of querying points along the camera ray and rendering the output of the network.



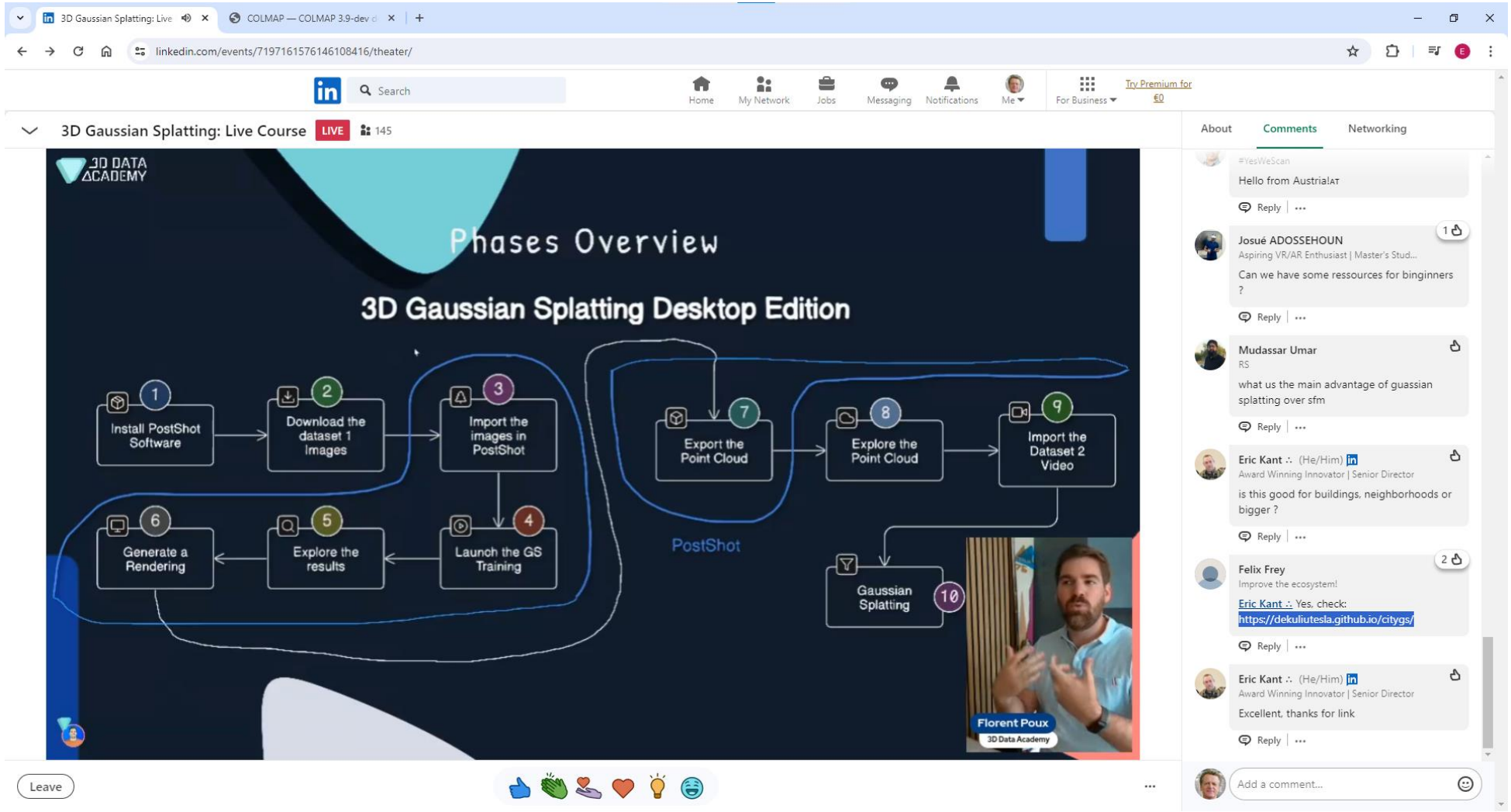
Gaussian Splatting

Gaussian splatting represents 3D scenes similar to point clouds. Points are extended to have a 3D Gaussian distribution in space, opacity (so translucent objects can be represented and for composition of overlapping Gaussians), and spherical harmonics (allowing points to change color as view direction changes). These modifications make Gaussian splats more expressive and better able to reconstruct scenes. Points essentially become ellipsoids with learnable size, orientation, and visual appearance.

An initial (maybe surprising!) observation is that Gaussians can be arranged such that they form an excellent representation of an image. Efficiently going from 3D Gaussian splats to a 2D image for a given camera pose is enabled by a differentiable renderer. The differentiable part is key, because it allows using gradient descent for optimization in tandem with heuristics for adding, splitting, and removing existing Gaussians.

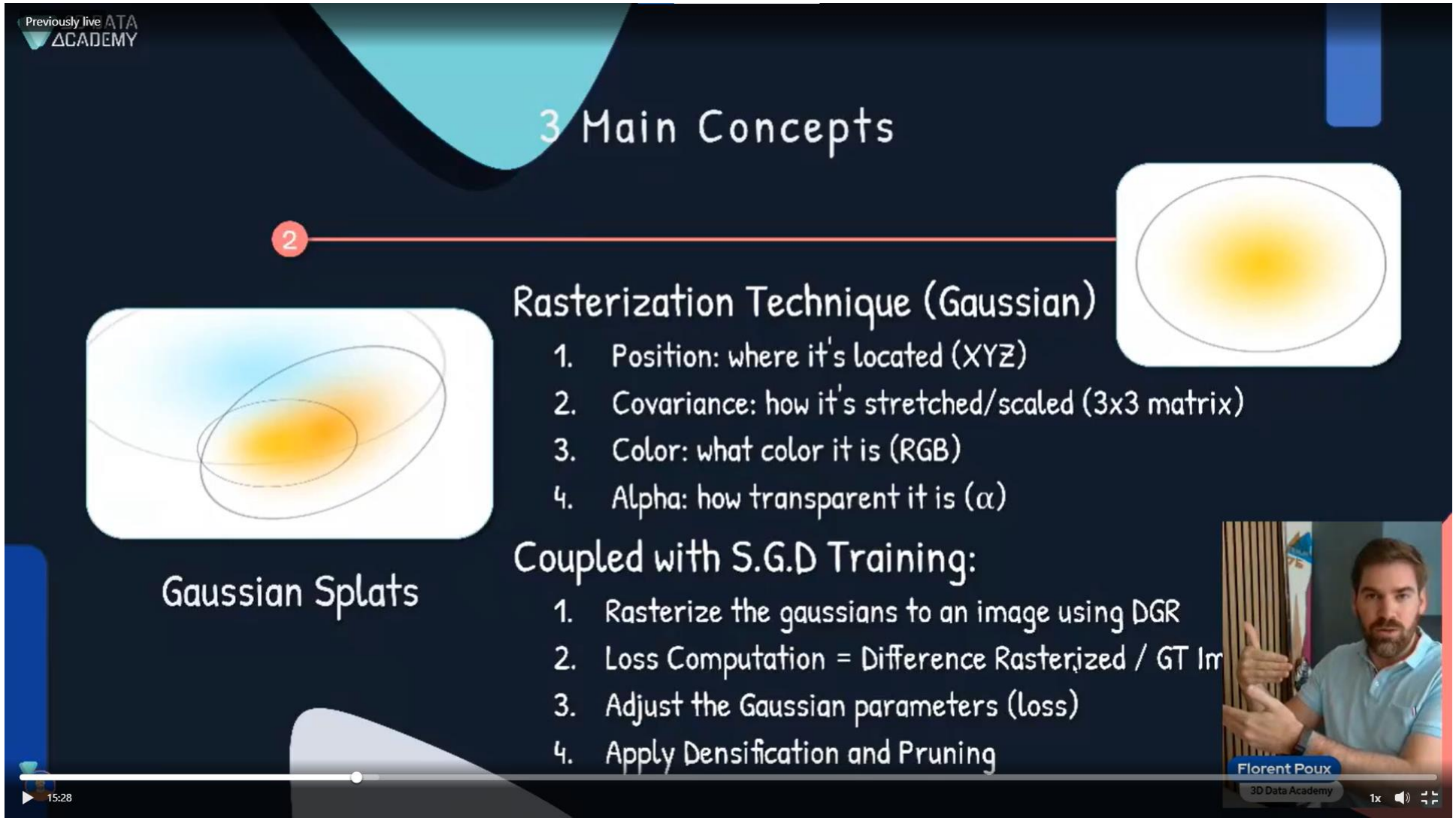
Florant Poux

https://www.linkedin.com/events/3dgaussiansplatting-livecourse7197161576146108416/theater



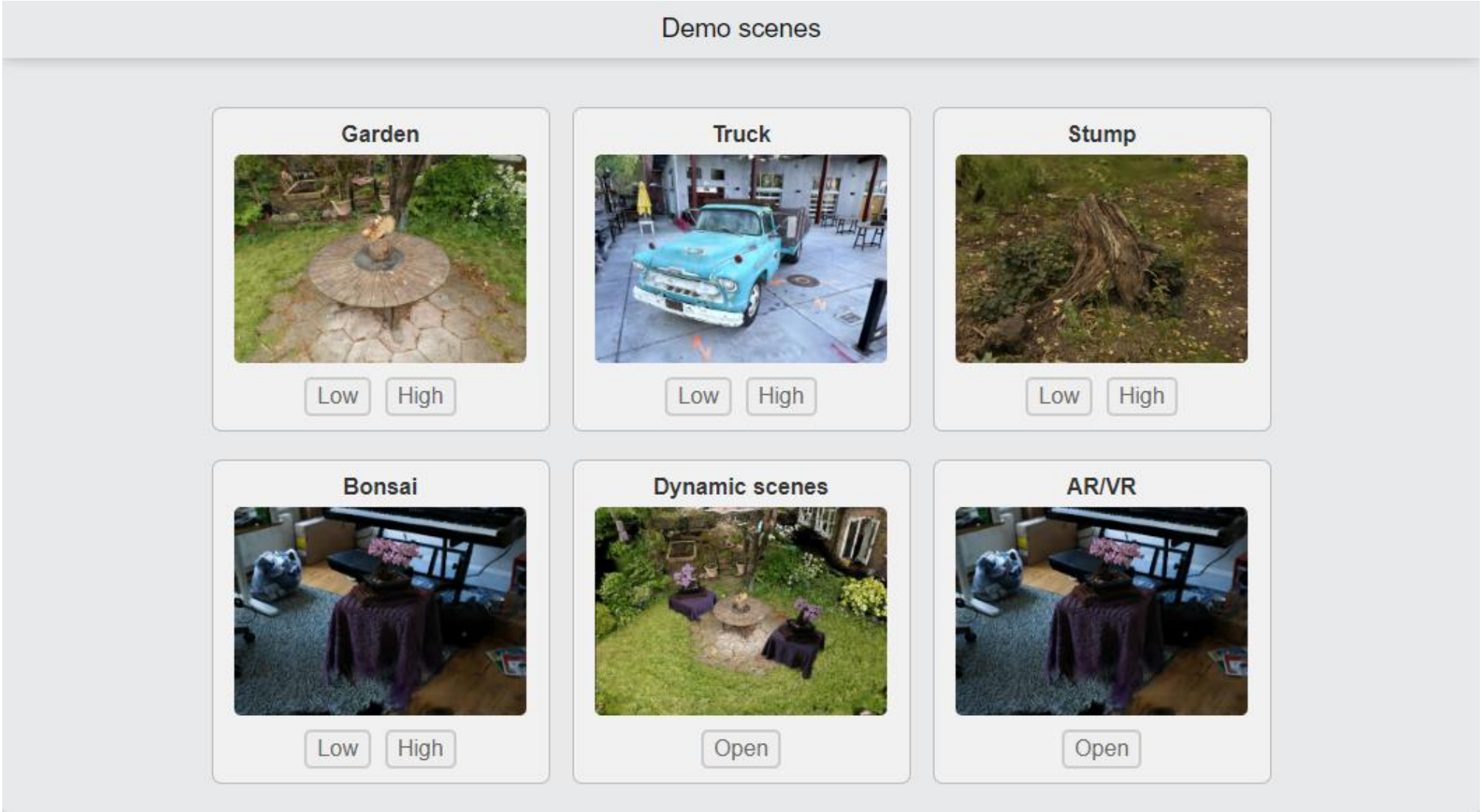
Florant Poux

https://www.linkedin.com/events/3dgaussiansplatting-livecourse7197161576146108416/theater



Gaussion Splatting

https://projects.markkellogg.org/threejs/demo_gaussian_splats_3d.php



Olli Huttunen – Road map of Gaussian Spatting possibilities

https://www.youtube.com/watch?v=TB4AjE0w5Xc
https://www.youtube.com/watch?v=DQGtimwfpIo
https://my.spline.design/untitled-67883b1a43e3efc52206ba2bc4a49956
https://www.youtube.com/watch?v=TGZIKPdFZQY

Road map of Gaussian Splatting possibilities

Olli Huttunen
11,7K abonnees
Geabonneerd
450
Delen
Downloaden
Fragment


Gaussian Splatting Ghost Wall FX Web Demo
A tiny Interactive
Gaussian Splatting
DEMO
0:10 / 1:00

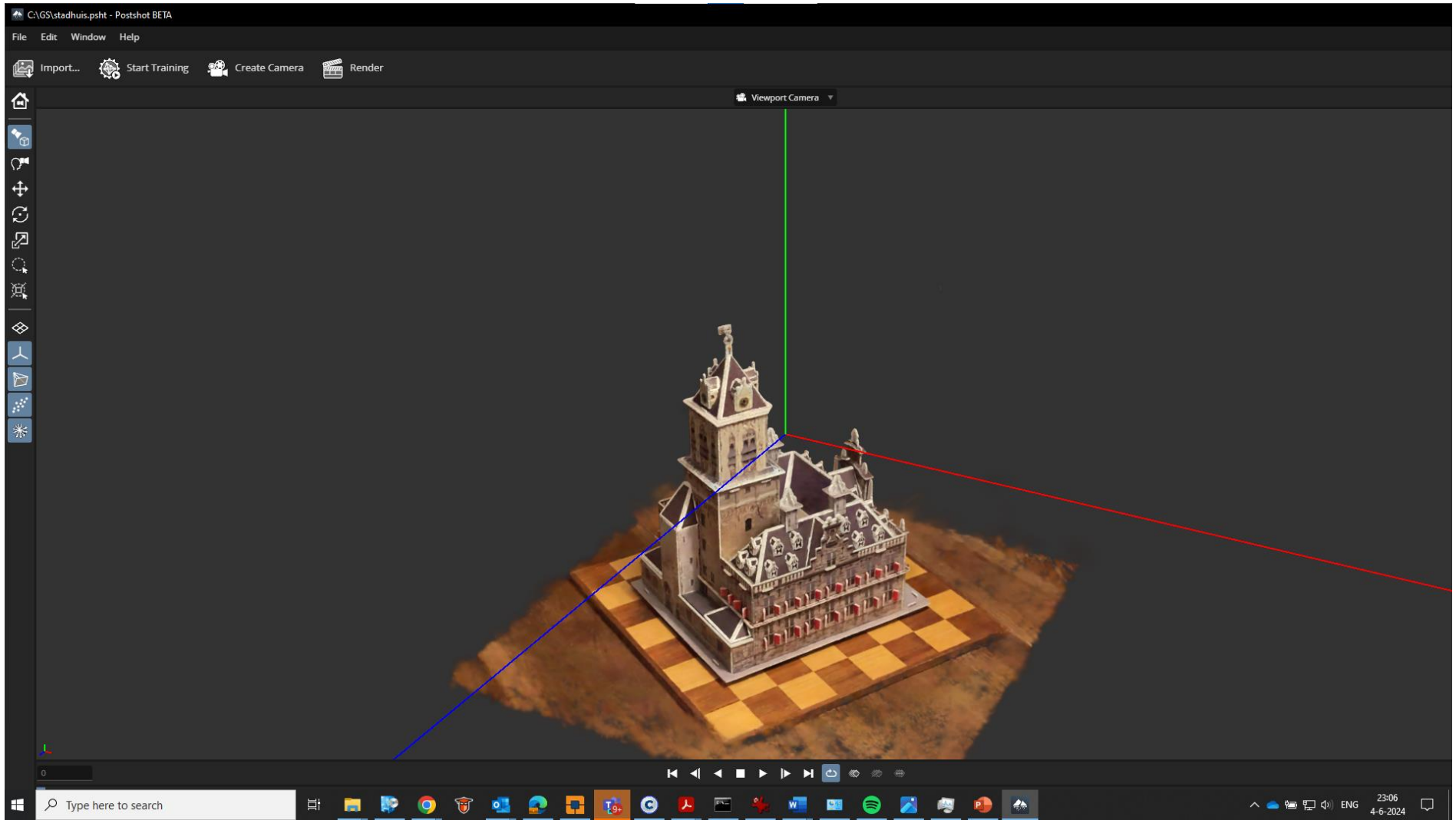

Built with Spline


Built with Spline


Gaussian Splatting Art - Ghost Wall FX - imaginary opening title sequence
THE
Ghost Wall
0:50 / 1:35

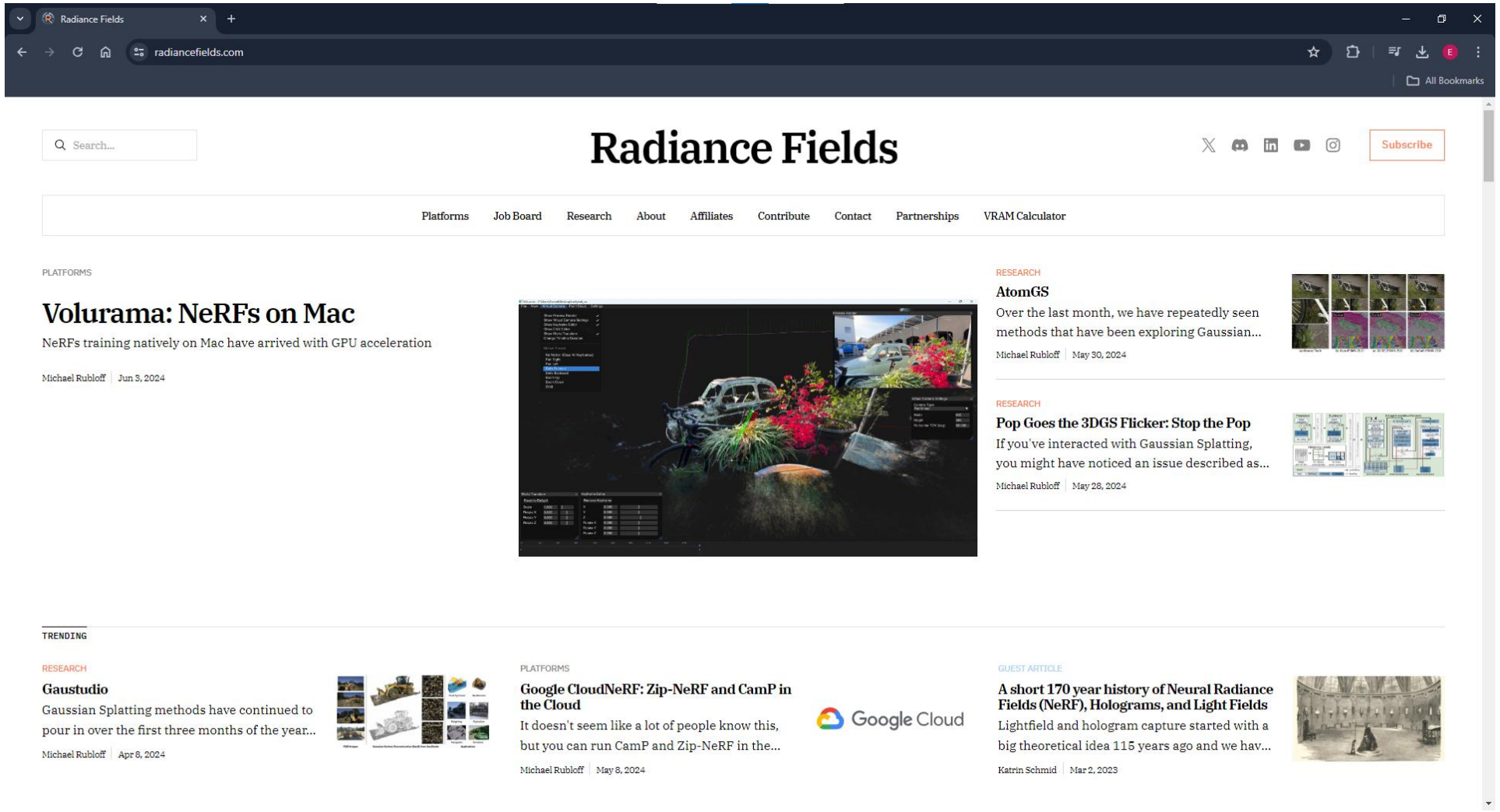
Postshot

https://www.jawset.com



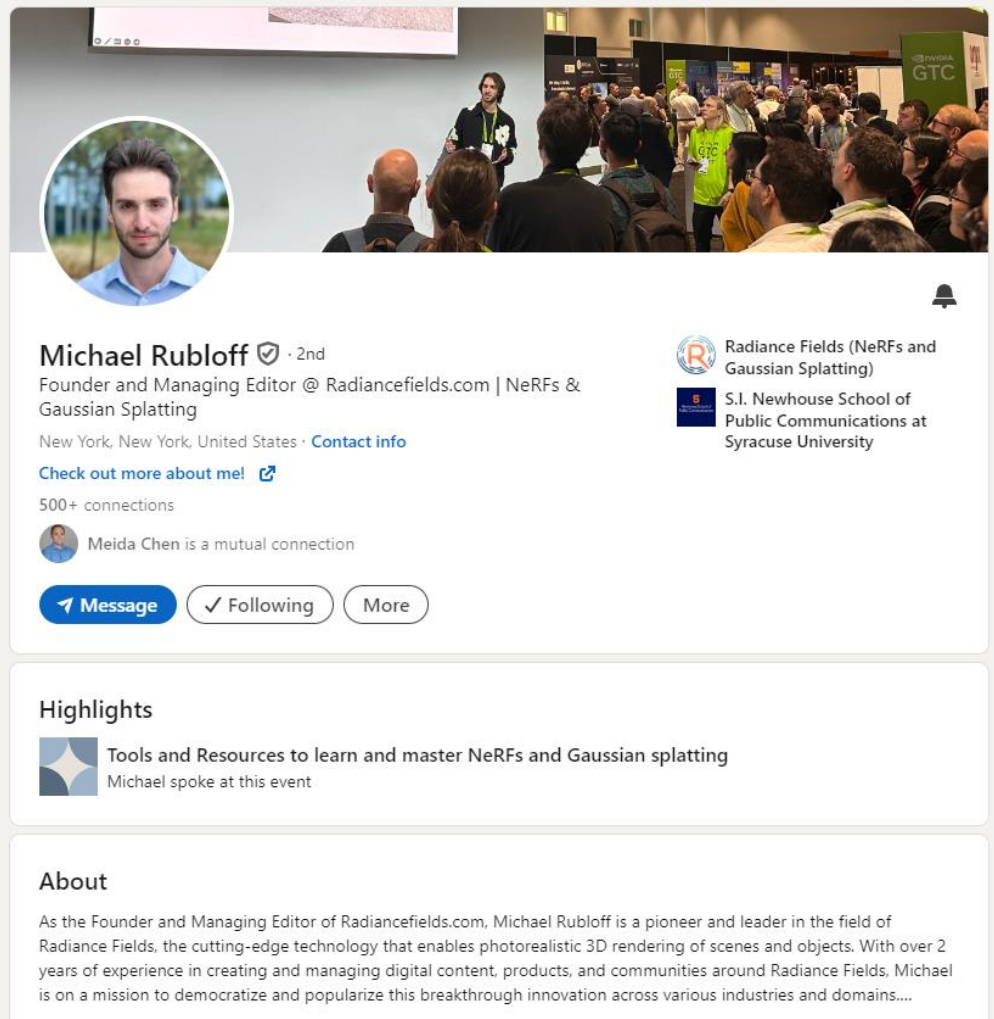
Radiance Fields - Michael Rubloff

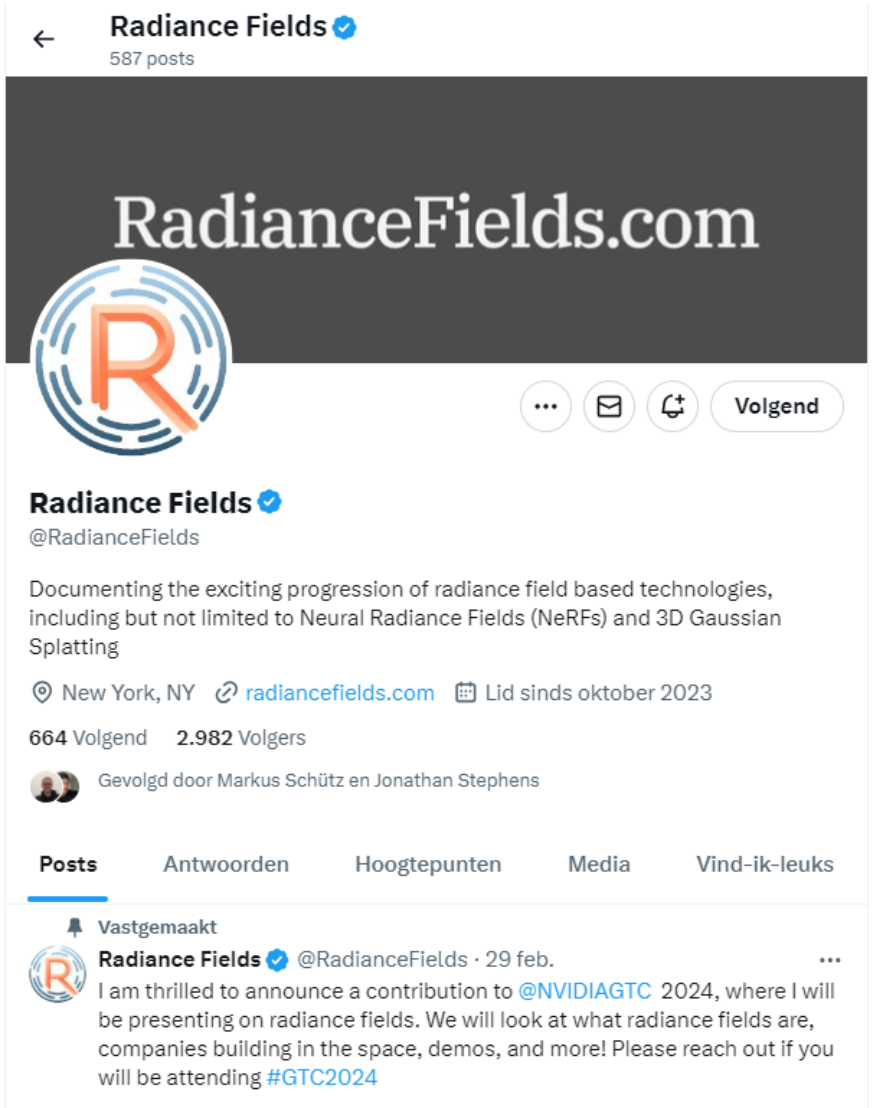
https://radiancefields.com
https://antimatter15.com/splaTV



Radiance Fields - Michael Rubloff

LinkedIn / Twitter(X)

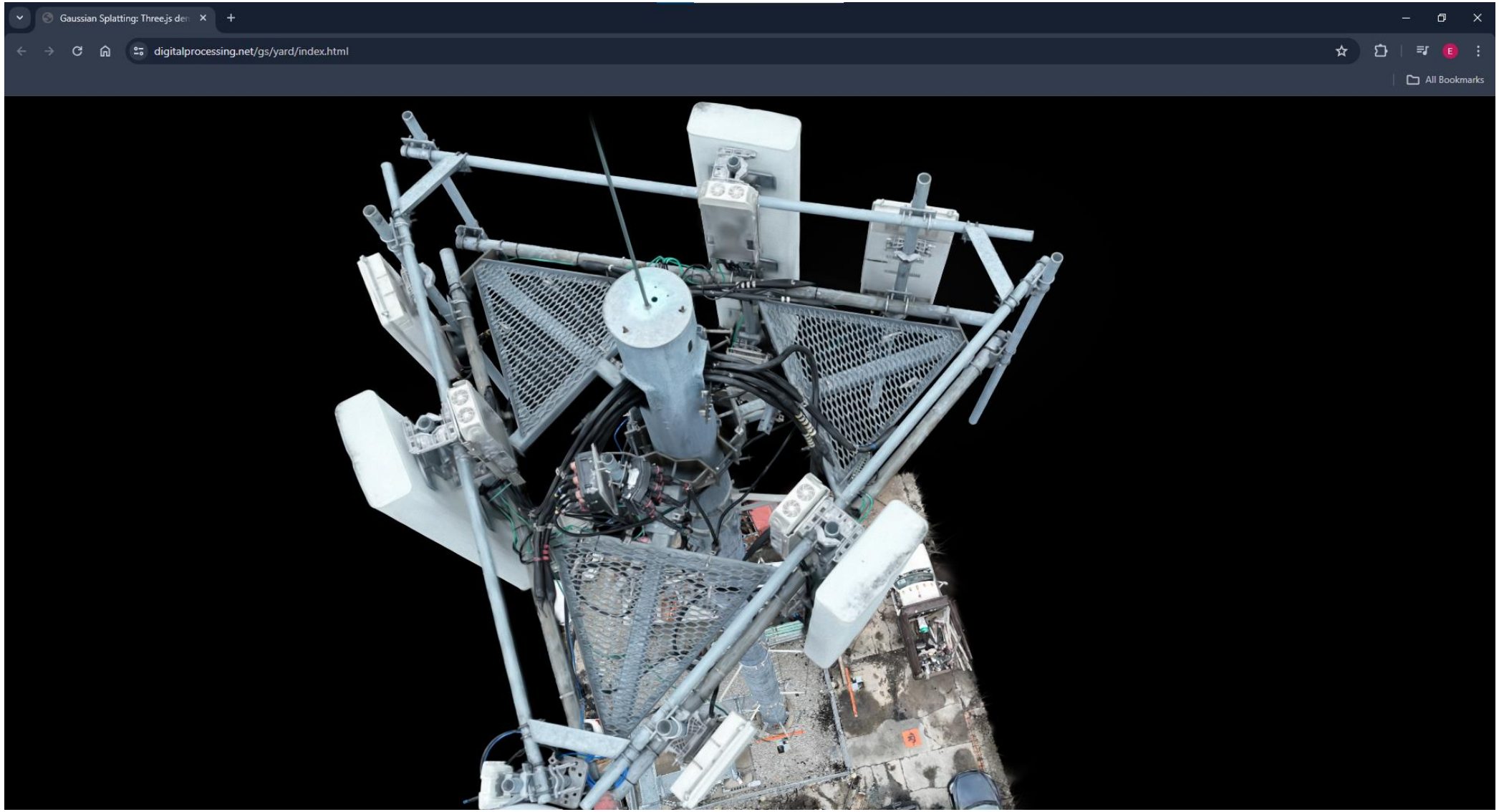





60 fps

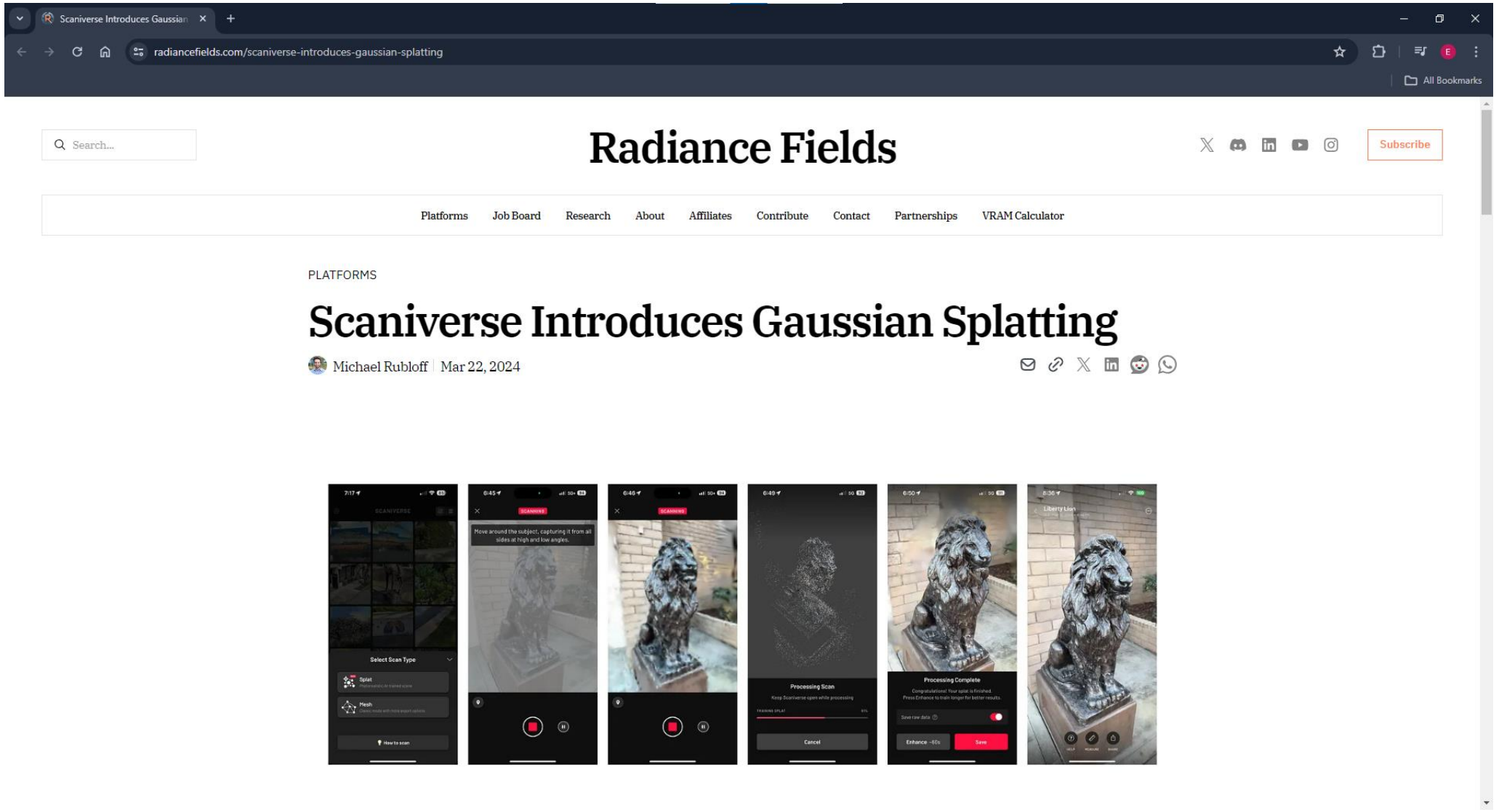
Striking demo

https://digitalprocessing.net/gs/yard/index.html

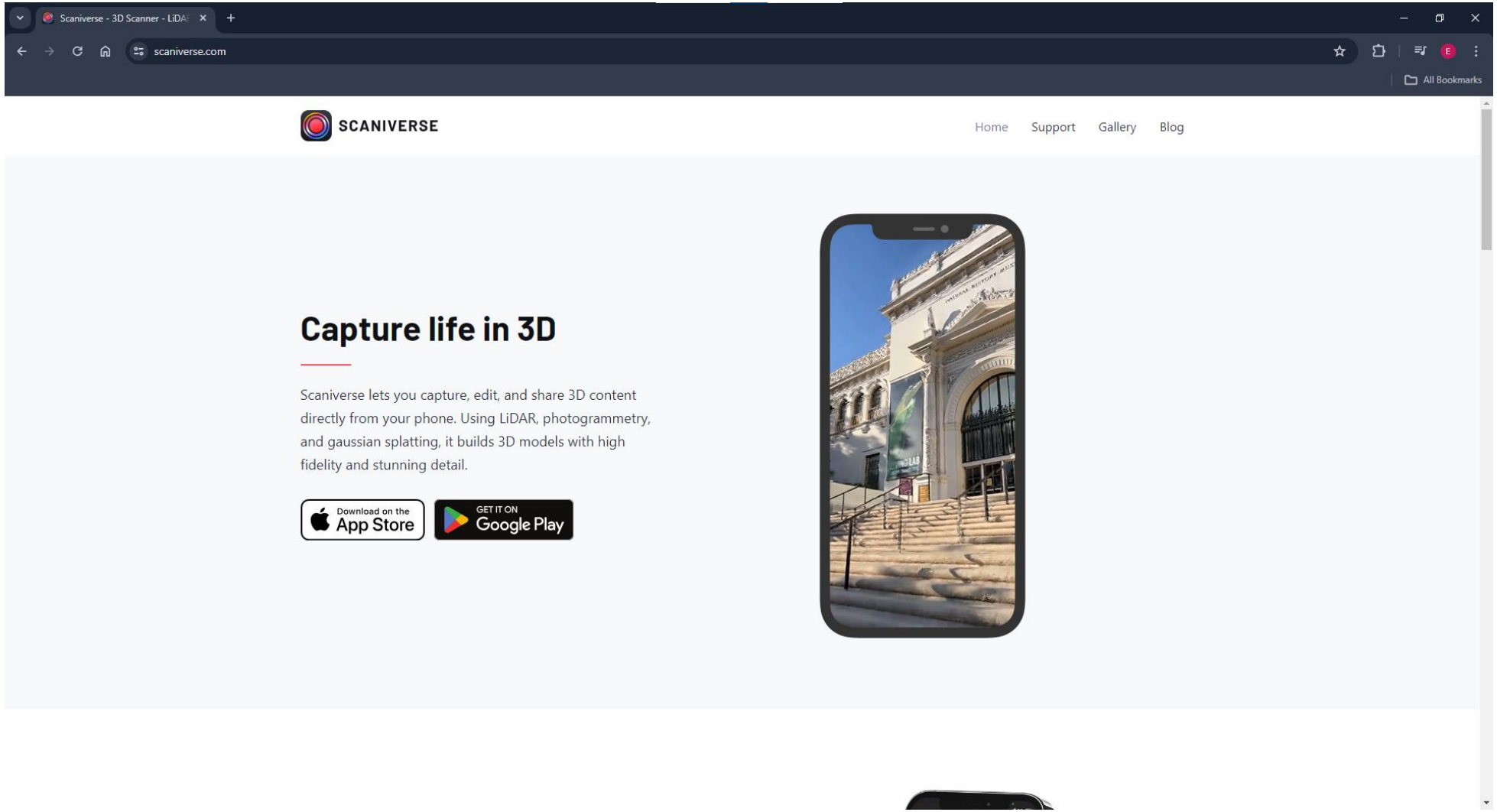


Scaniverse – Capture Life in 3D

http://scaniverse.com



Capture Life in 3D



Zeb Horizon Vision - To do ...

https://arxiv.org/pdf/2402.13255
https://github.com/Lee-JaeWon/2024-Arxiv-Paper-List-Gaussian-Splatting

How NeRFs and 3D Gaussian Splatting are Reshaping SLAM: a Survey

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Stefano Mattoccia[1] Martin R. Oswald[3,4] Matteo Poggi[1]

[1]University of Bologna, Italy [2]Rock Universe, China [3]ETH Zurich, Switzerland [4]University of Amsterdam, Netherlands

Abstract—Over the past two decades, research in the field of Simultaneous Localization and Mapping (SLAM) has undergone a significant evolution, highlighting its critical role in enabling autonomous exploration of unknown environments. This evolution ranges from hand-crafted methods, through the era of deep learning, to more recent developments focused on Neural Radiance Fields (NeRFs) and 3D Gaussian Splatting (3DGS) representations. Recognizing the growing body of research and the absence of a comprehensive survey on the topic, this paper aims to provide the first comprehensive overview of SLAM progress through the lens of the latest advancements in radiance fields. It sheds light on the background, evolutionary path, inherent strengths and limitations, and serves as a fundamental reference to highlight the dynamic progress and specific challenges.

Index Terms—Simultaneous Localization and Mapping, SLAM, Deep Learning, Neural Radiance Field, NeRF, 3D Gaussian Splatting

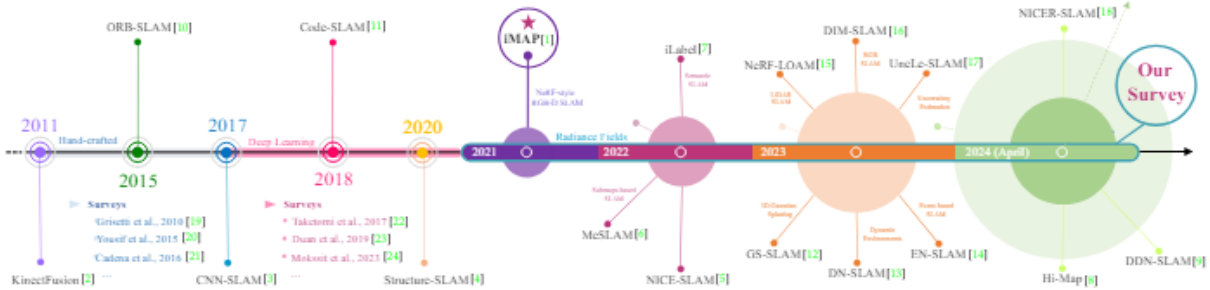

Fig. 1: **Timeline SLAM Evolution.** This timeline begins by illustrating the transition from hand-crafted to deep learning techniques, featuring key surveys from both eras. In 2021, a pivotal shift focuses on radiance-field-based SLAM systems, marked by iMap [1]. The circles on the right side of the figure represent key papers for each year, with size indicating publication volume. The outer circle for 2024 signals a projected surge, highlighting the growing interest in NeRF and 3DGS-inspired SLAM.