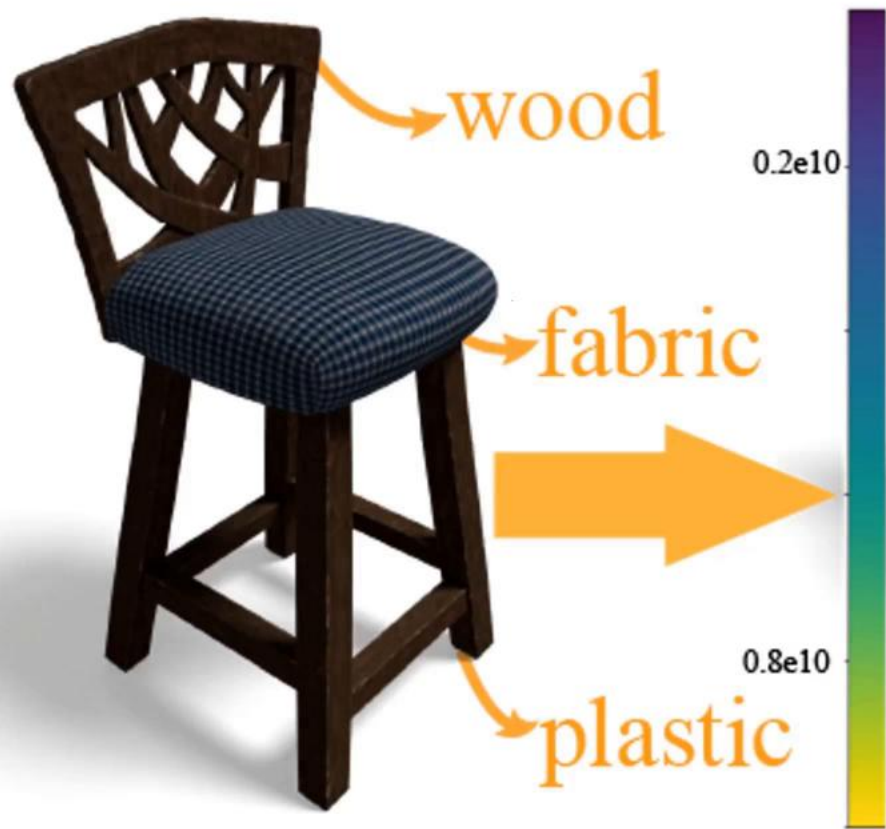


VoMP: Predicting Volumetric Mechanical Property Fields

Rishit Dagli, Donglai Xiang, Vismay Modi, Charles Loop, Clement Fuji Tsang

Anka He Chen, Anita Hu, Gavriel State, David I.W. Levin, Maria Shugrina





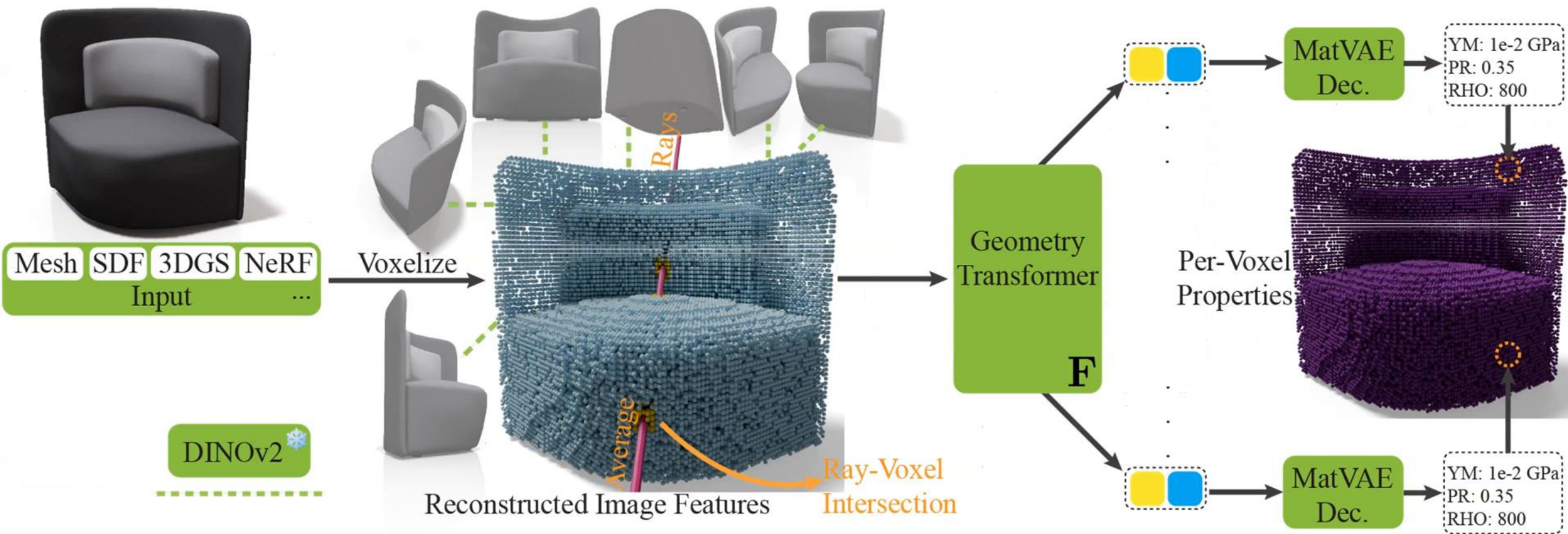
Young's Modulus



Poisson's Ratio



Density





high quality assets

leather, body

leather, handle

metal, legs

aluminium, rivets

plastic, feet

metal, body

detailed volumetric parts (+ material names)

Aluminum Bronze
YM: 110 - 120 GPa
PR: 0.33 - 0.35
RHO: 7700 - 7900 kg/m³

material ranges database



extracted textures

VLM ❄️

part-wise mechanical properties





Youngs Modulus



Poissons Ratio



Density





Youngs Modulus



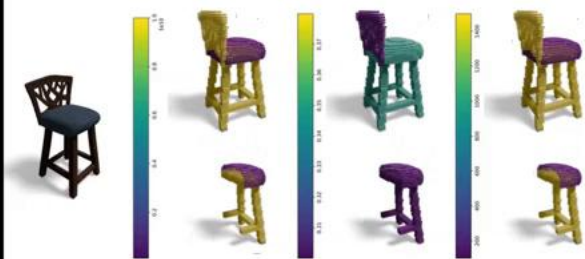
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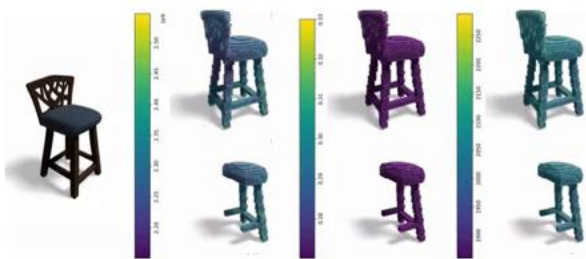
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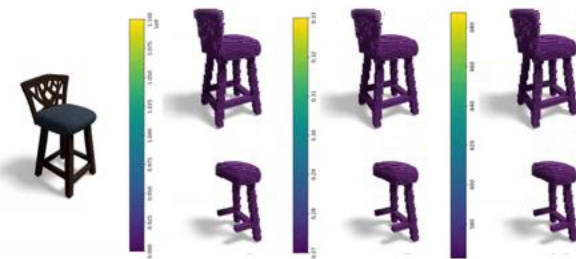
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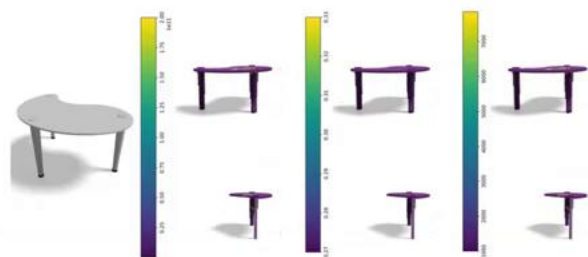
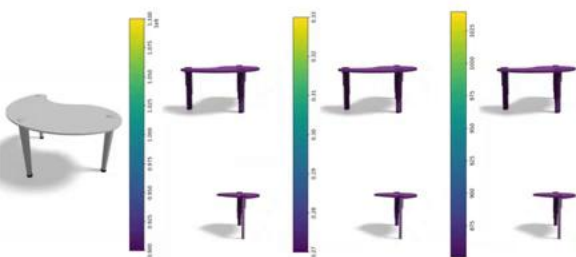
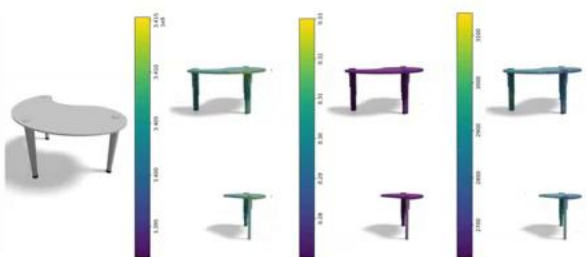
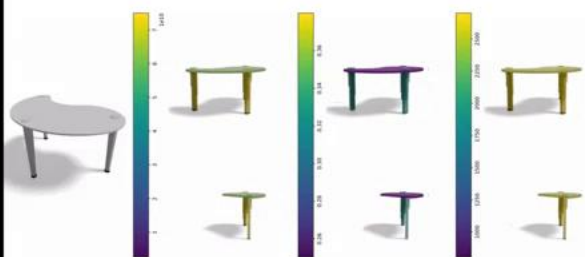
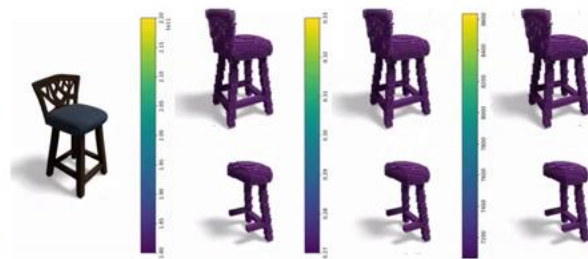
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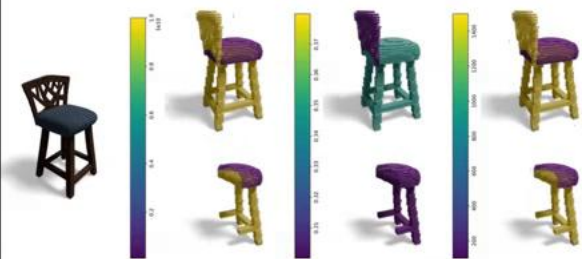
PUGS



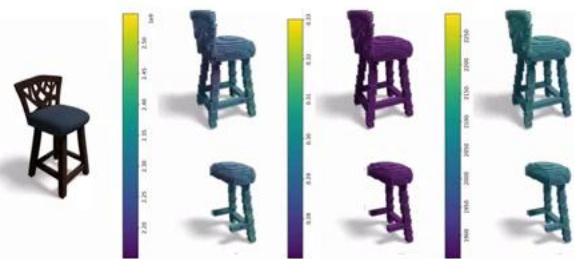
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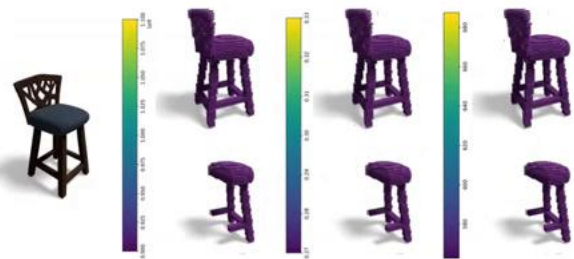
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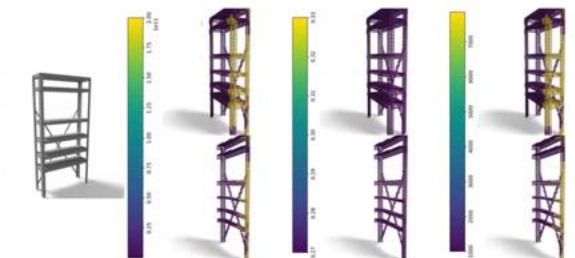
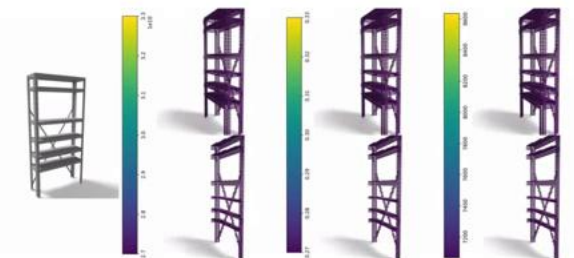
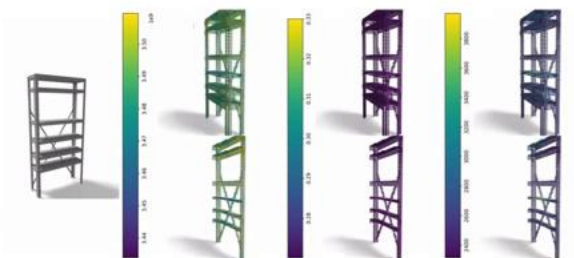
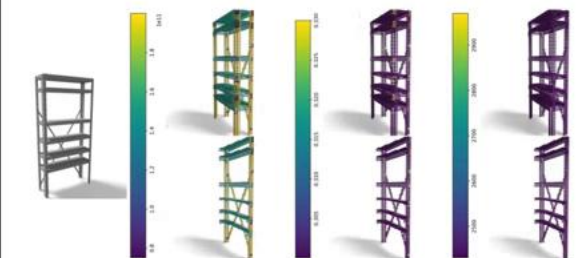
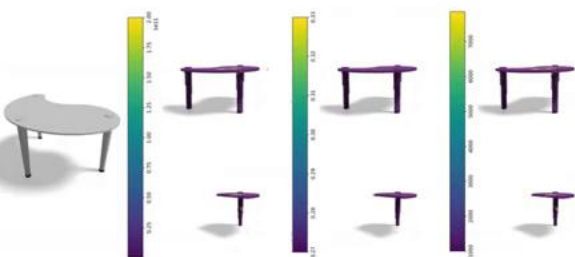
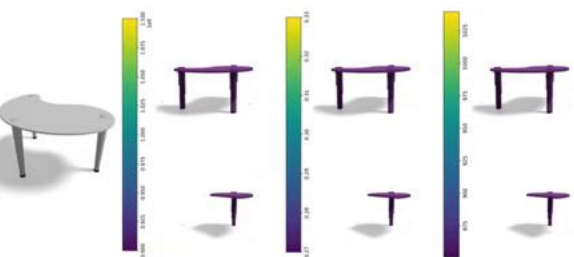
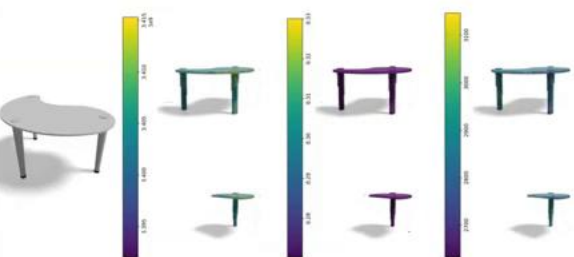
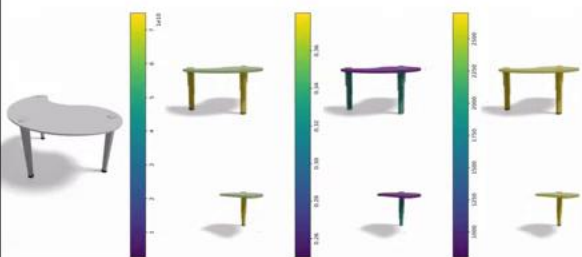
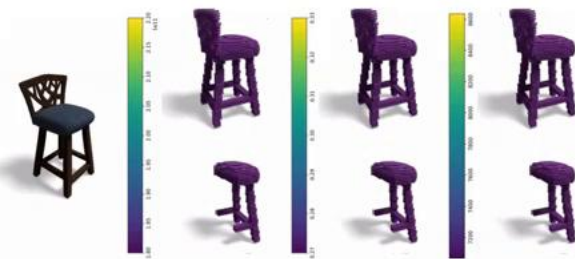
NeRF2Physics



PUGS



Phys4DGen



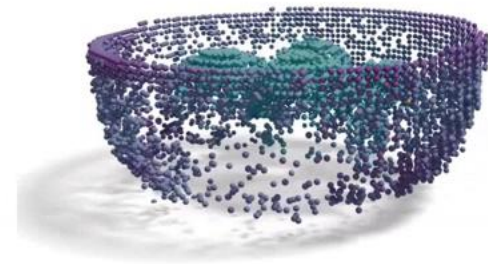
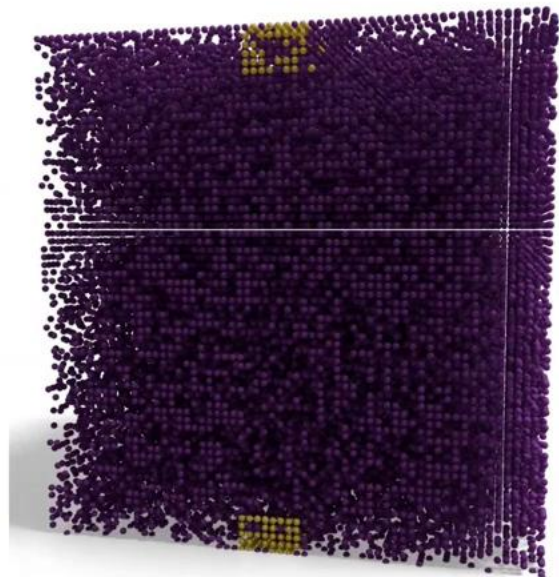
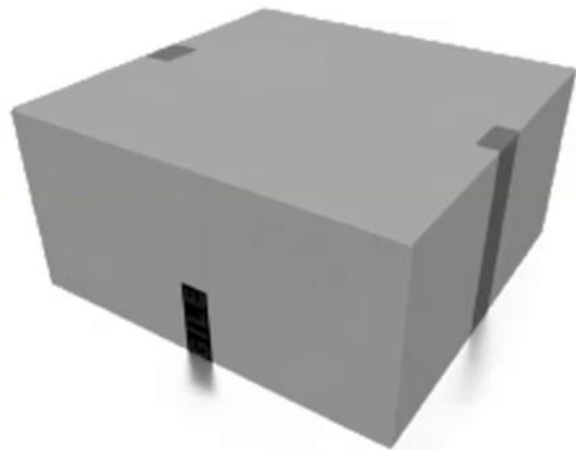
Ours

NeRF2Physics

PUGS

Phys4DGen



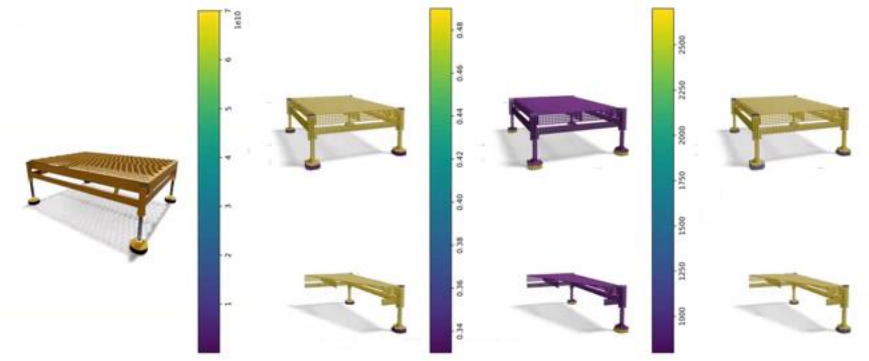
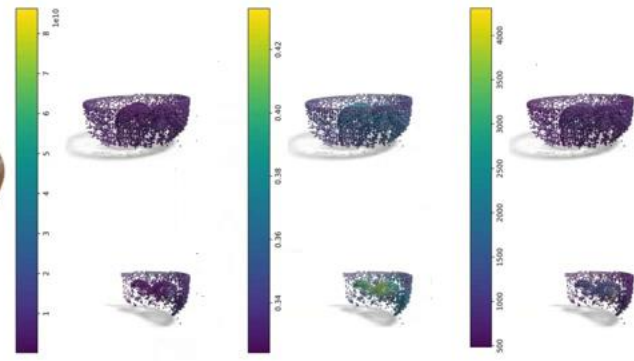
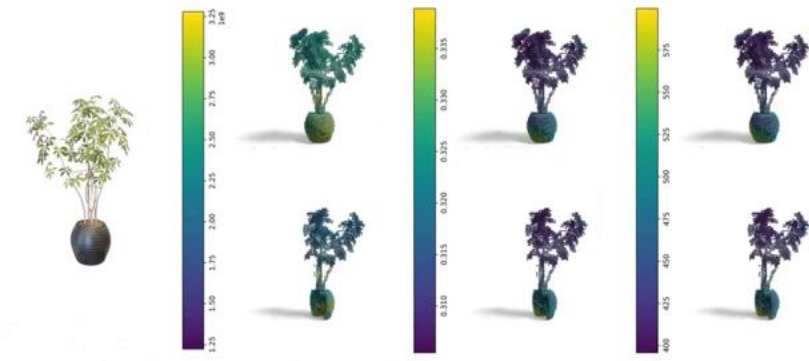
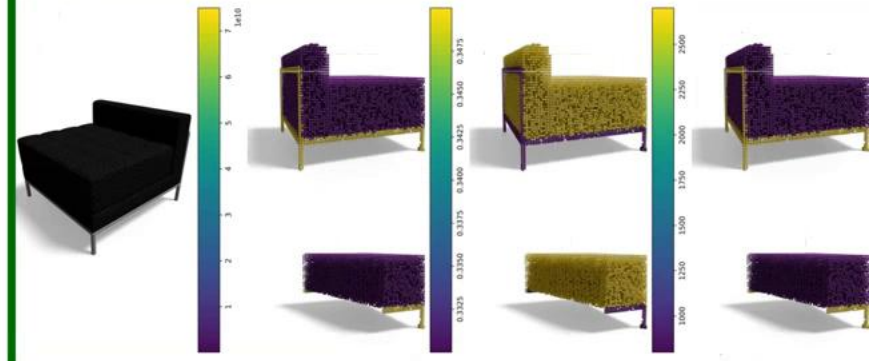
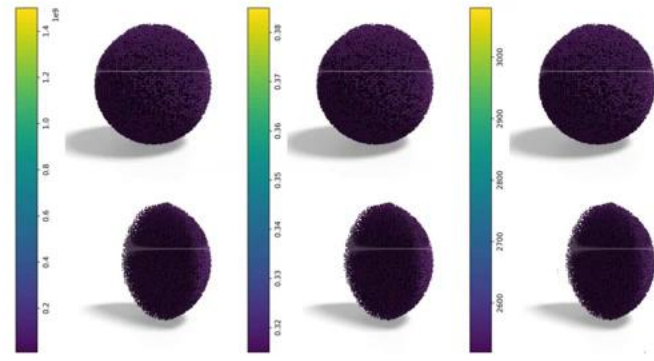
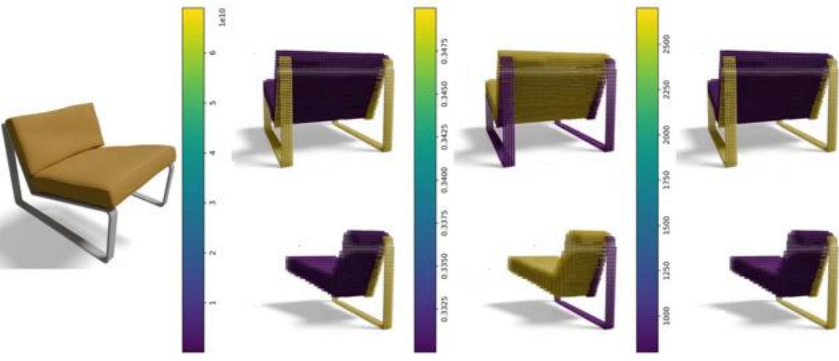


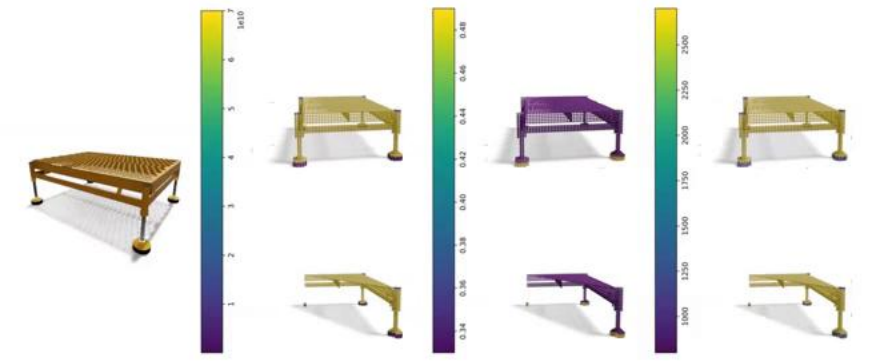
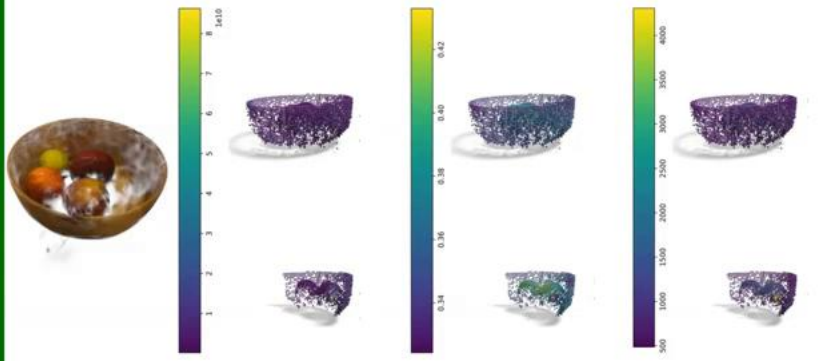
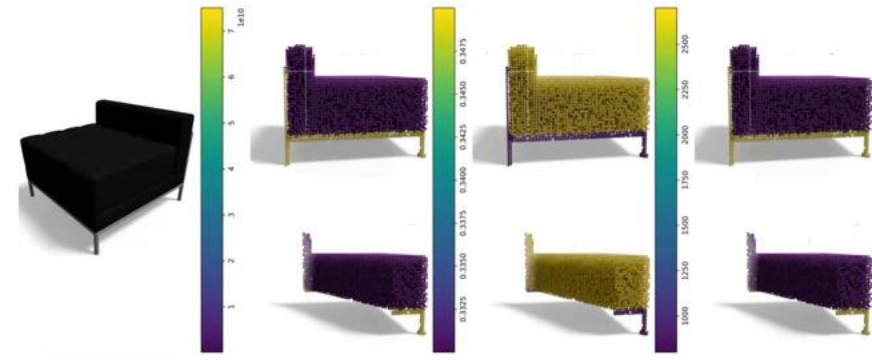
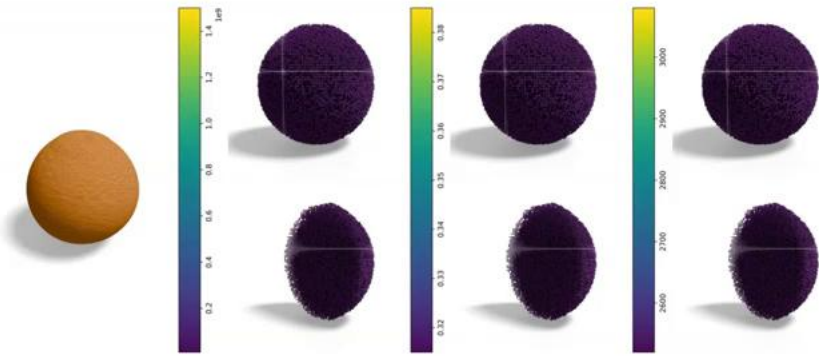
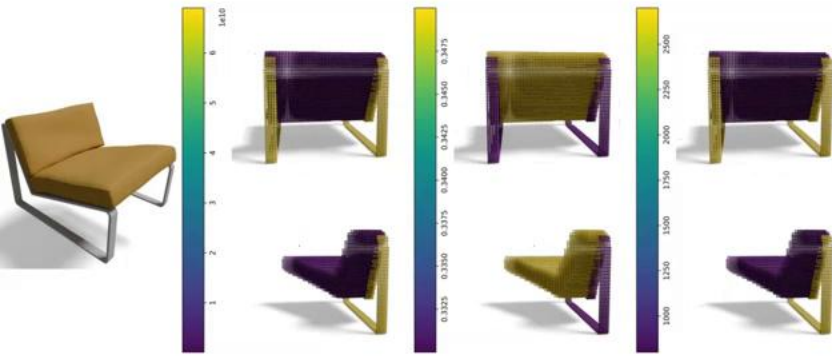
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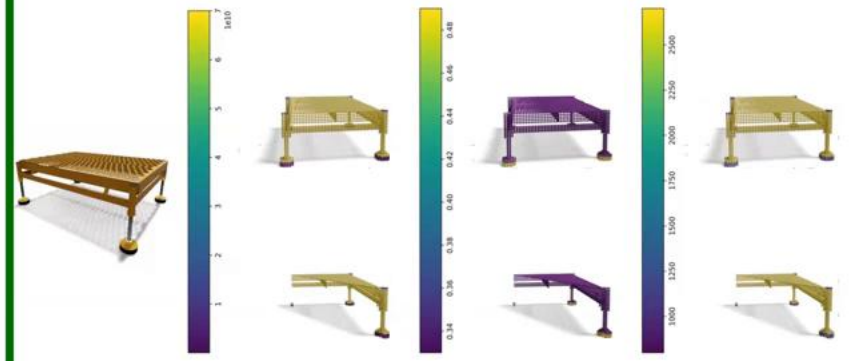
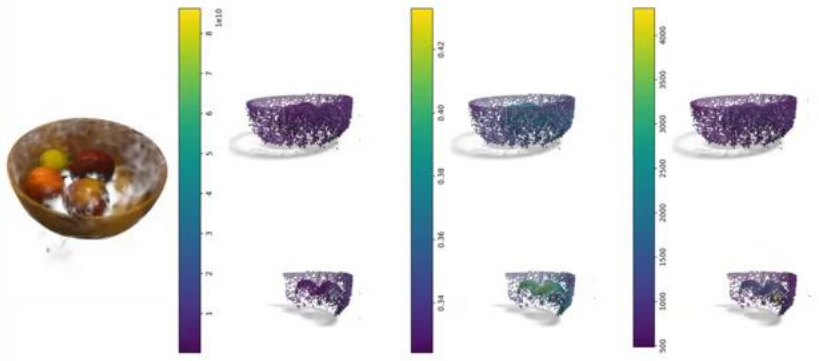
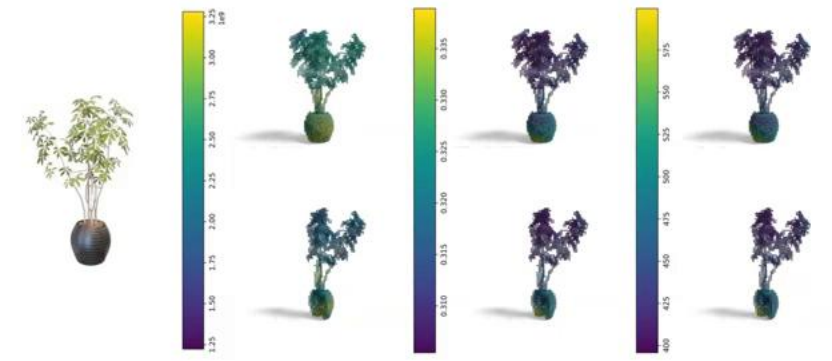
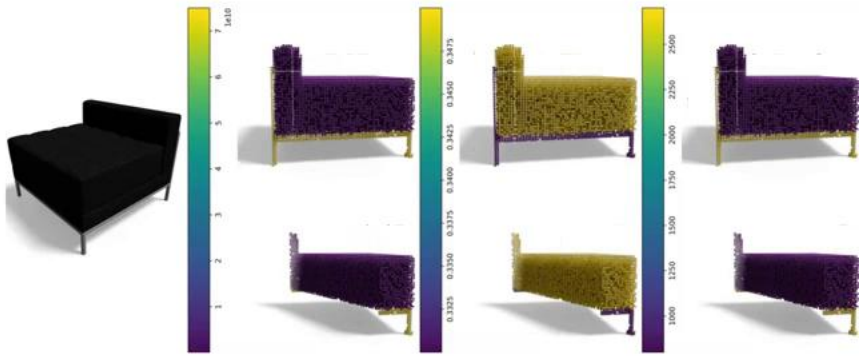
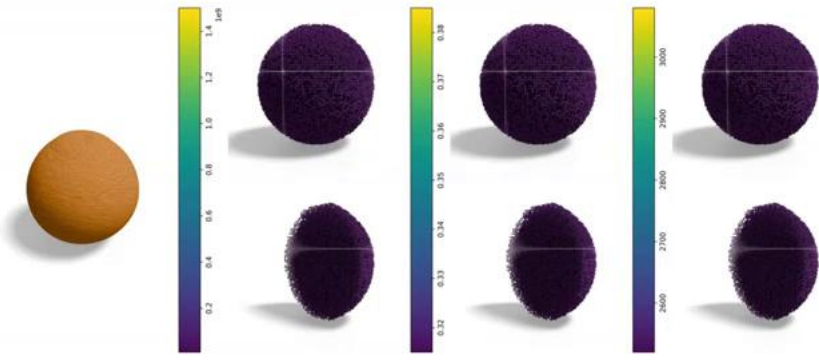
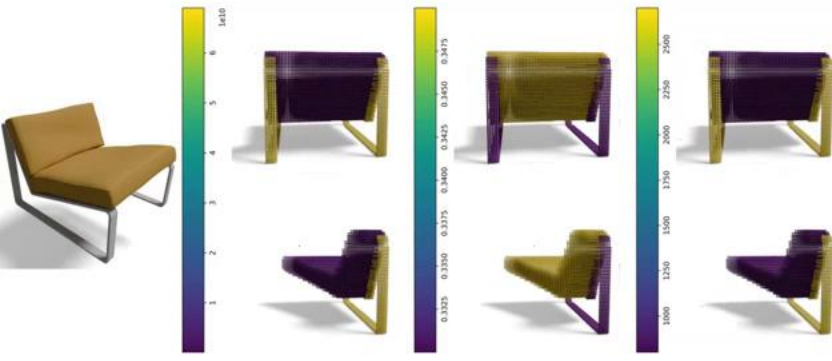
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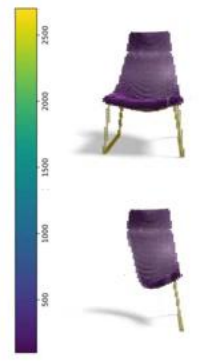
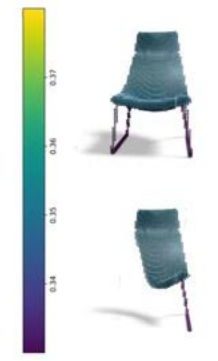
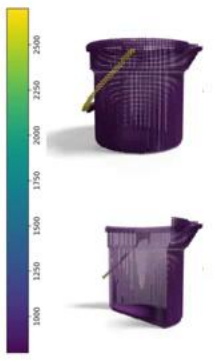
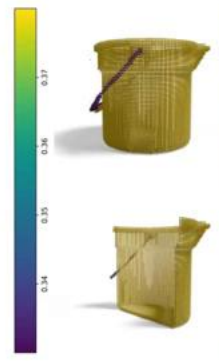
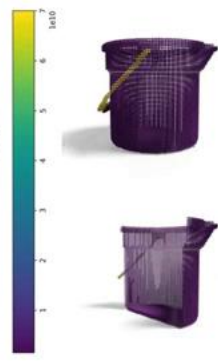
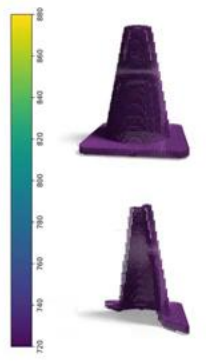
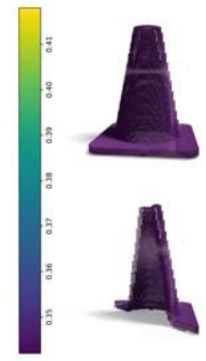
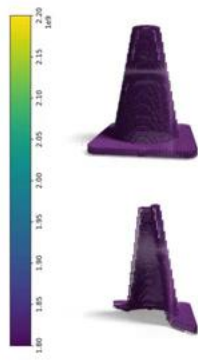
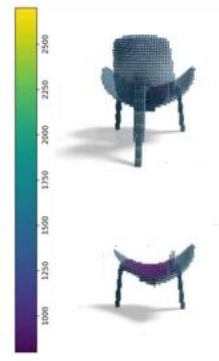
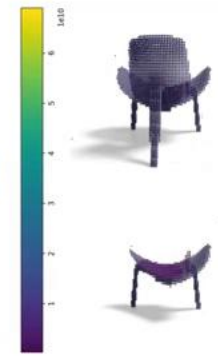
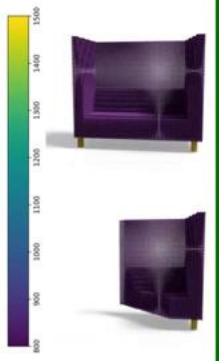
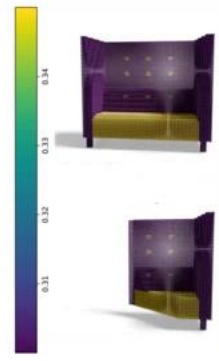
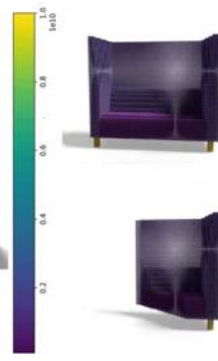
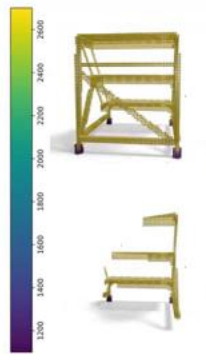
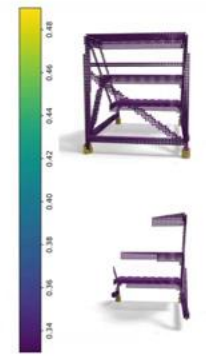
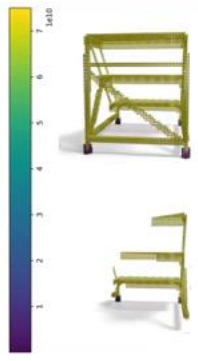
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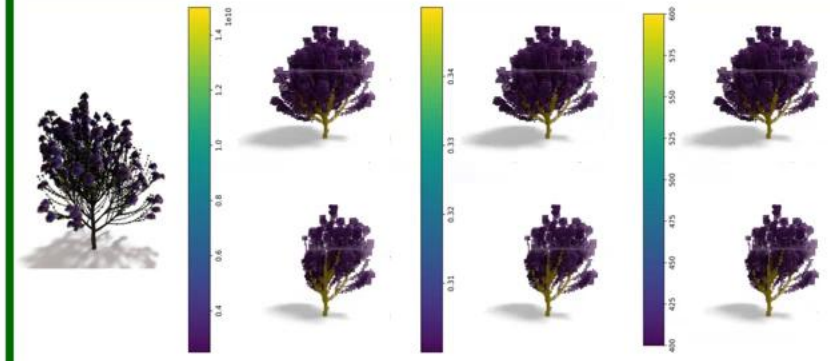
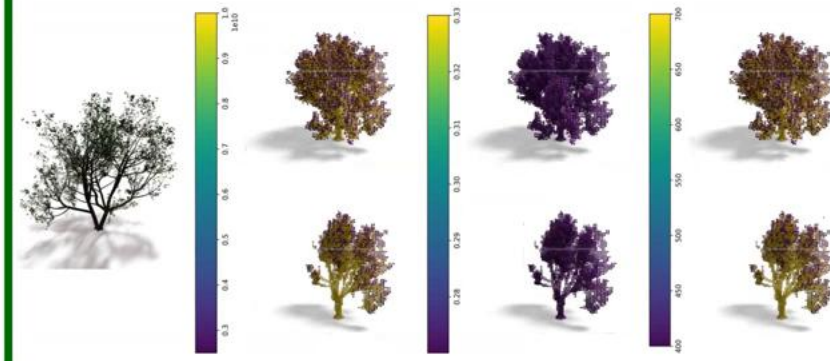
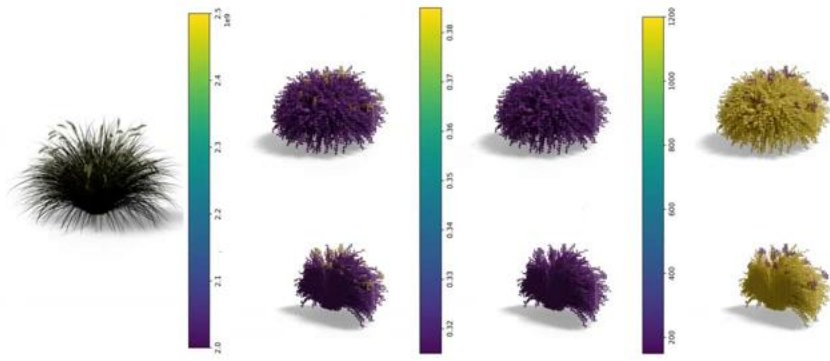
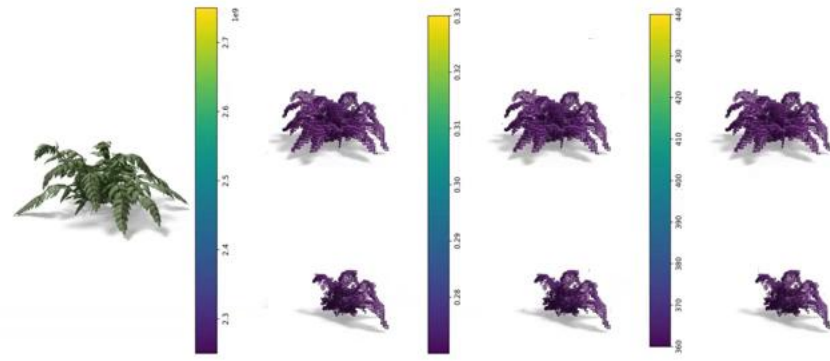
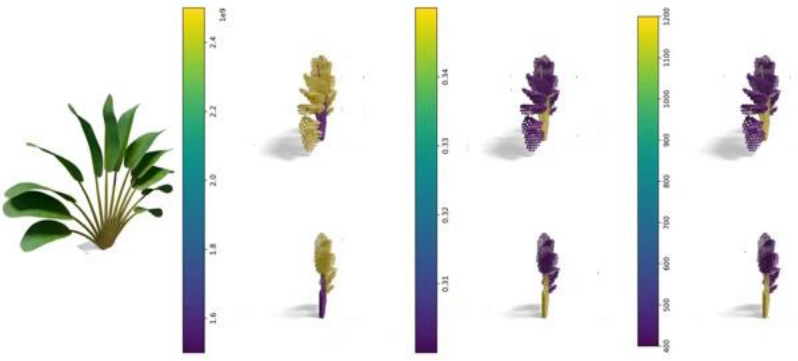
Gaussian Splat

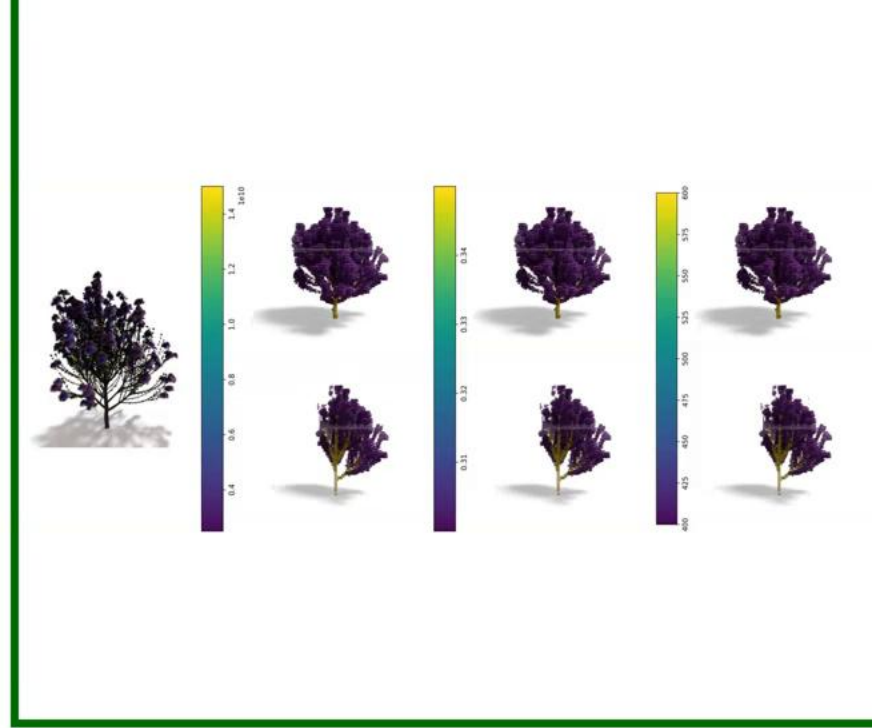
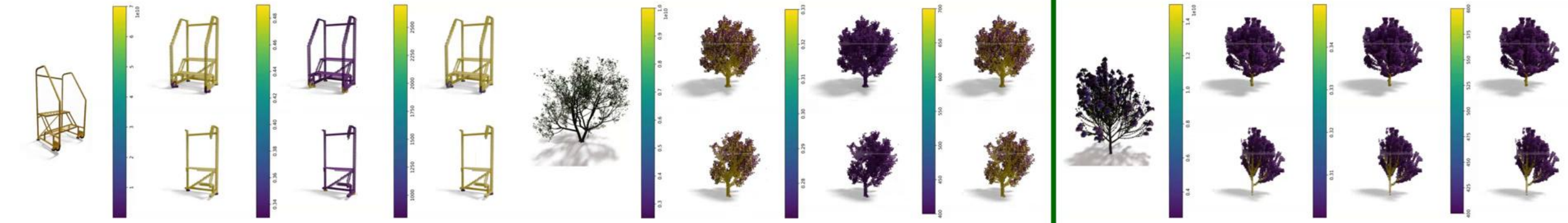
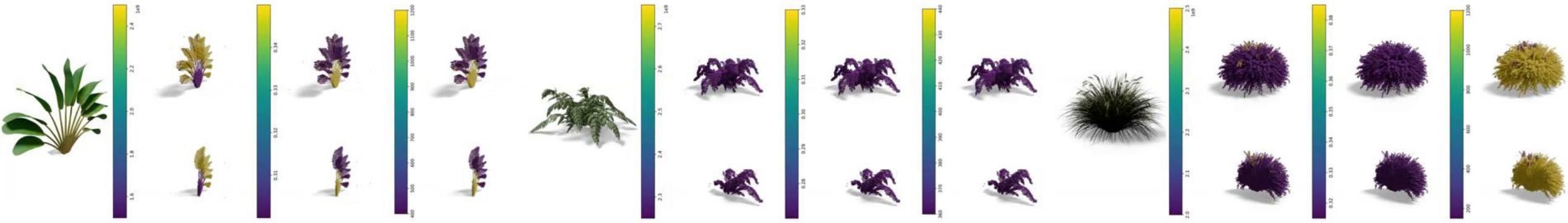


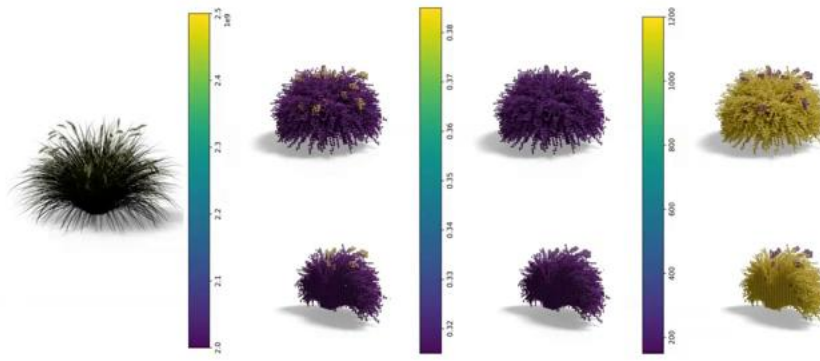
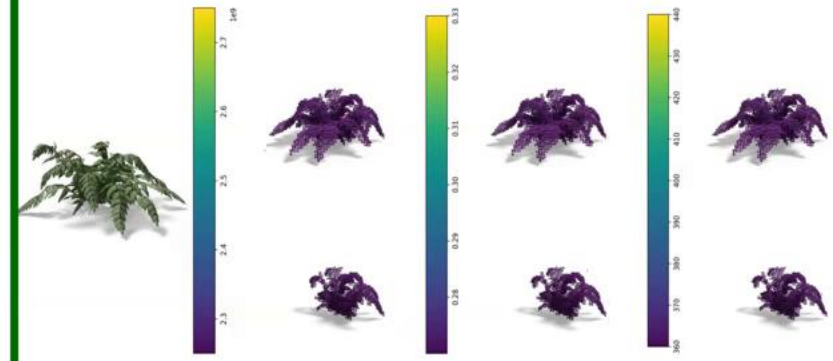
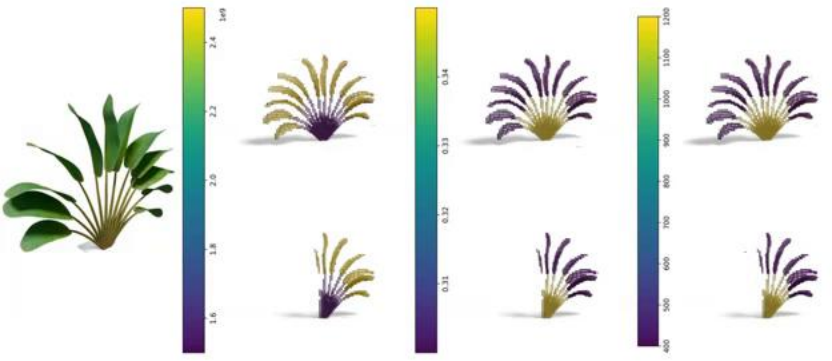
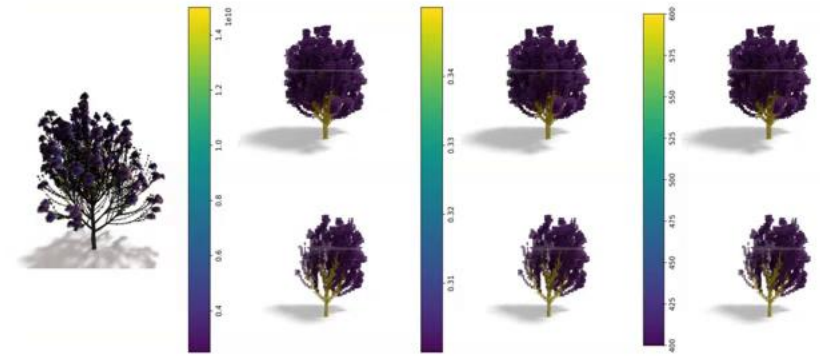
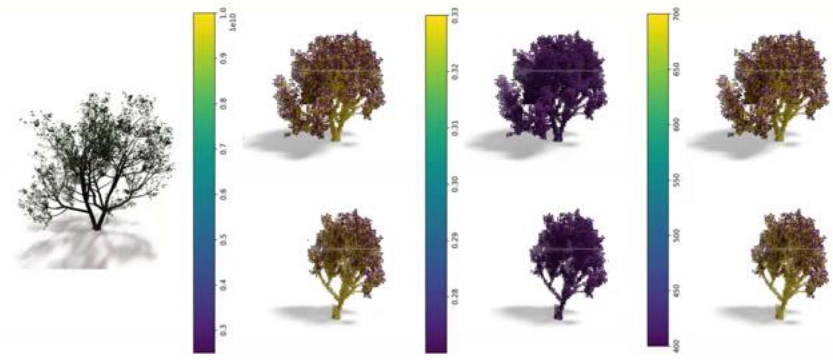
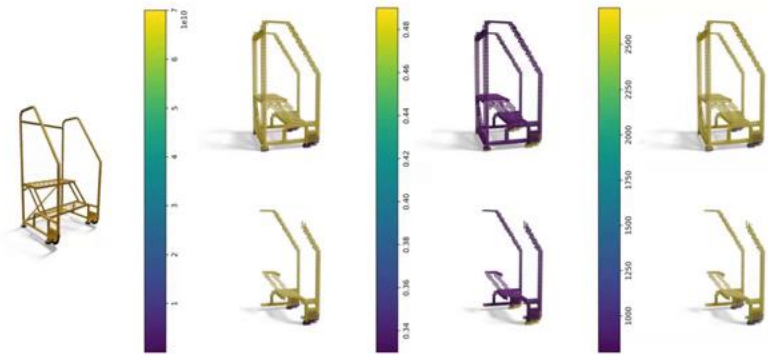












Use these outputs in a physics simulator to create realistic 4D worlds



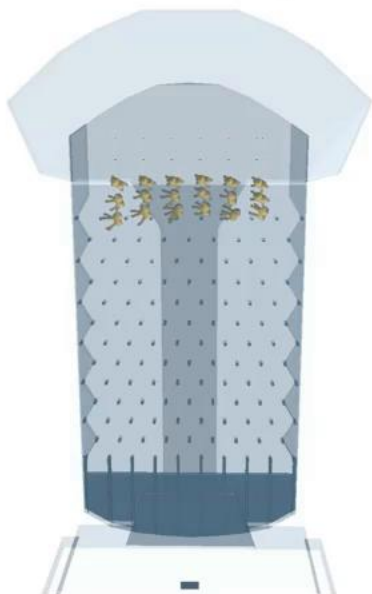
101 Gaussian Splats

(1.5x)



65 Gaussian Splats + Mesh

(1.5x)



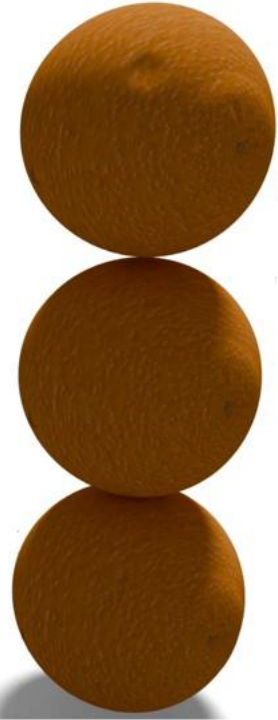
18 Gaussian Splats + Mesh

(2.5x)



Gaussian Scene

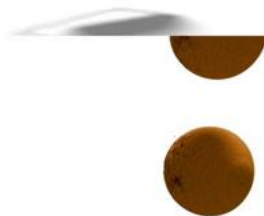
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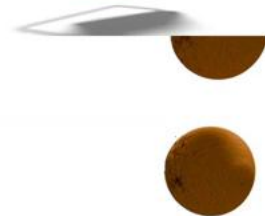
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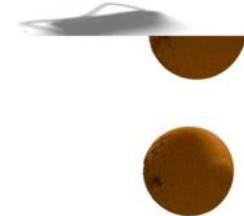
PUGS



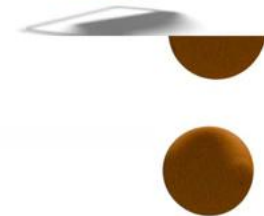
Phys4DGen

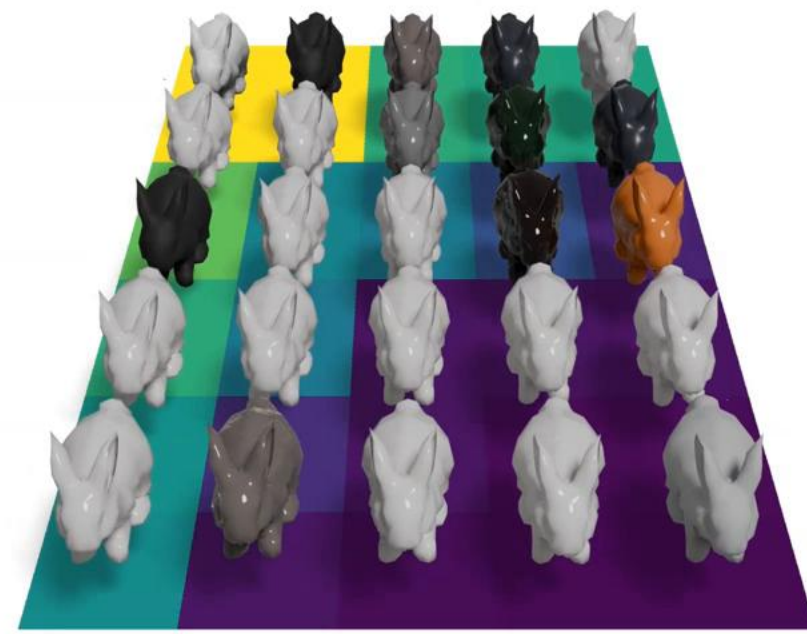
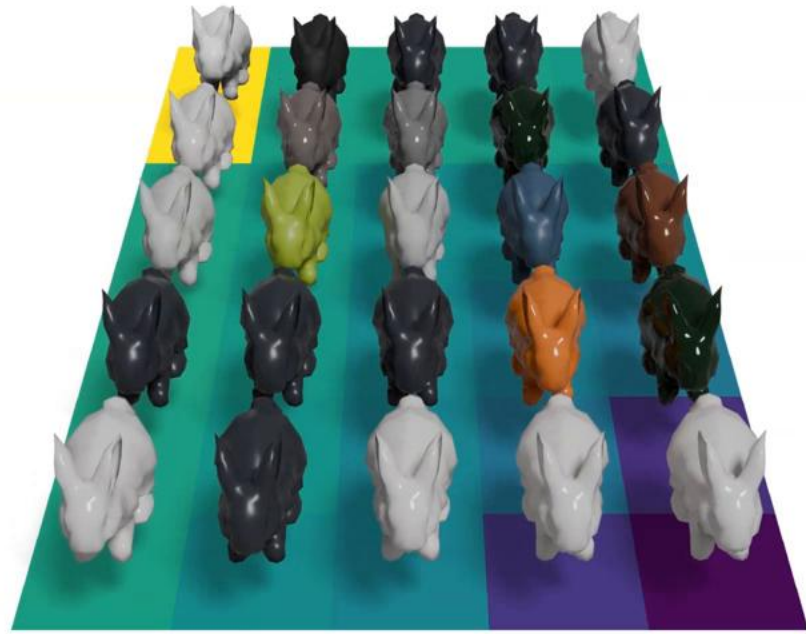
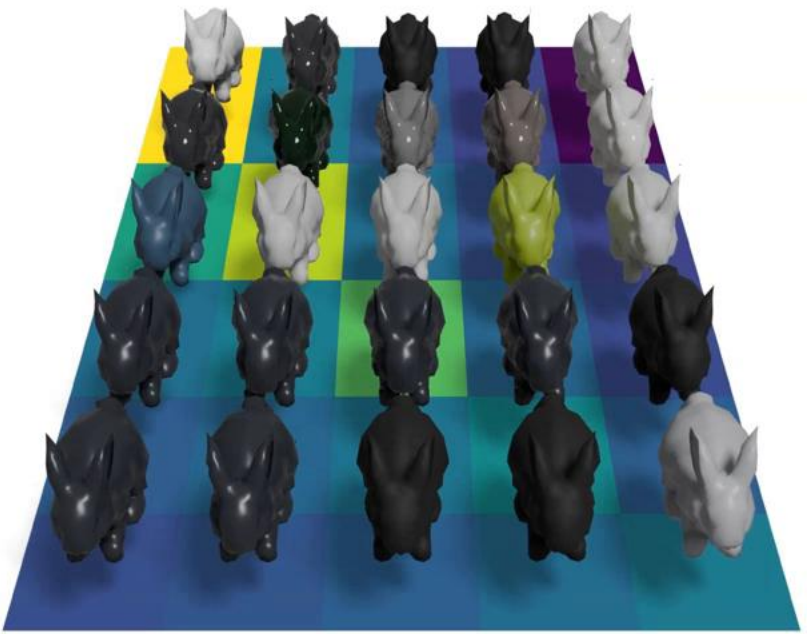


Pixie



VoMP





MatVAE

Aerographite	Carbon Fiber	Carbon Fiber	Carbon Nitride	Diamond
$E = 0.001 \text{ GPa}$, $\nu = 0.25$, $\rho = 0.2$	$E = 235 \text{ GPa}$, $\nu = 0.25$, $\rho = 1775$	$E = 400 \text{ GPa}$, $\nu = 0.25$, $\rho = 1800$	$E = 822 \text{ GPa}$, $\nu = 0.28$, $\rho = 3200$	$E = 1220 \text{ GPa}$, $\nu = 0.2$, $\rho = 3500$

Naive Interpolation

Aerographite	Invalid (X)	Invalid (X)	Invalid (X)	Diamond
$E = 0.001 \text{ GPa}$, $\nu = 0.25$, $\rho = 0.2$	$E = 305 \text{ GPa}$, $\nu = 0.24$, $\rho = 875$	$E = 610 \text{ GPa}$, $\nu = 0.23$, $\rho = 1750$	$E = 915 \text{ GPa}$, $\nu = 0.21$, $\rho = 2625$	$E = 1220 \text{ GPa}$, $\nu = 0.2$, $\rho = 3500$

MatVAE

Styrofoam	Vanadium	Rhodium	Tungsten	Osmium
$E = 0.002 \text{ GPa}$, $\nu = 0.23$, $\rho = 25$	$E = 128 \text{ GPa}$, $\nu = 0.37$, $\rho = 6110$	$E = 275 \text{ GPa}$, $\nu = 0.30$, $\rho = 12450$	$E = 411 \text{ GPa}$, $\nu = 0.28$, $\rho = 19250$	$E = 555 \text{ GPa}$, $\nu = 0.25$, $\rho = 16934$

Naive Interpolation

Styrofoam	Invalid (X)	Invalid (X)	Invalid (X)	Osmium
$E = 0.002 \text{ GPa}$, $\nu = 0.23$, $\rho = 25$	$E = 137.5 \text{ GPa}$, $\nu = 0.31$, $\rho = 5661$	$E = 275 \text{ GPa}$, $\nu = 0.29$, $\rho = 11298$	$E = 412.5 \text{ GPa}$, $\nu = 0.27$, $\rho = 16934$	$E = 555 \text{ GPa}$, $\nu = 0.25$, $\rho = 16934$