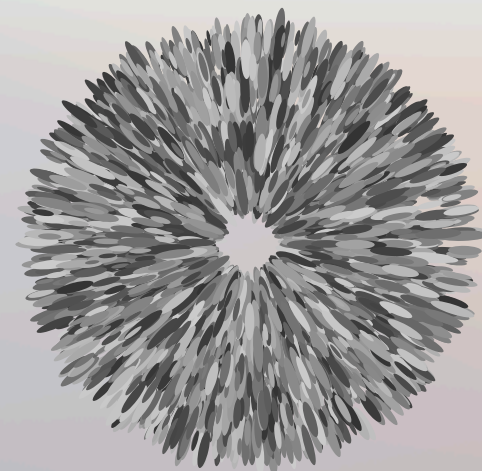


MRD: METAMERS RENDERED DIFFERENTIABLY

Benjamin Beilharz & Thomas S. A. Wallis
Perception Lab – Technical University Darmstadt



Perception
Lab



Centre for
Cognitive
Science



Funded by
the European Union



European Research Council
Established by the European Commission

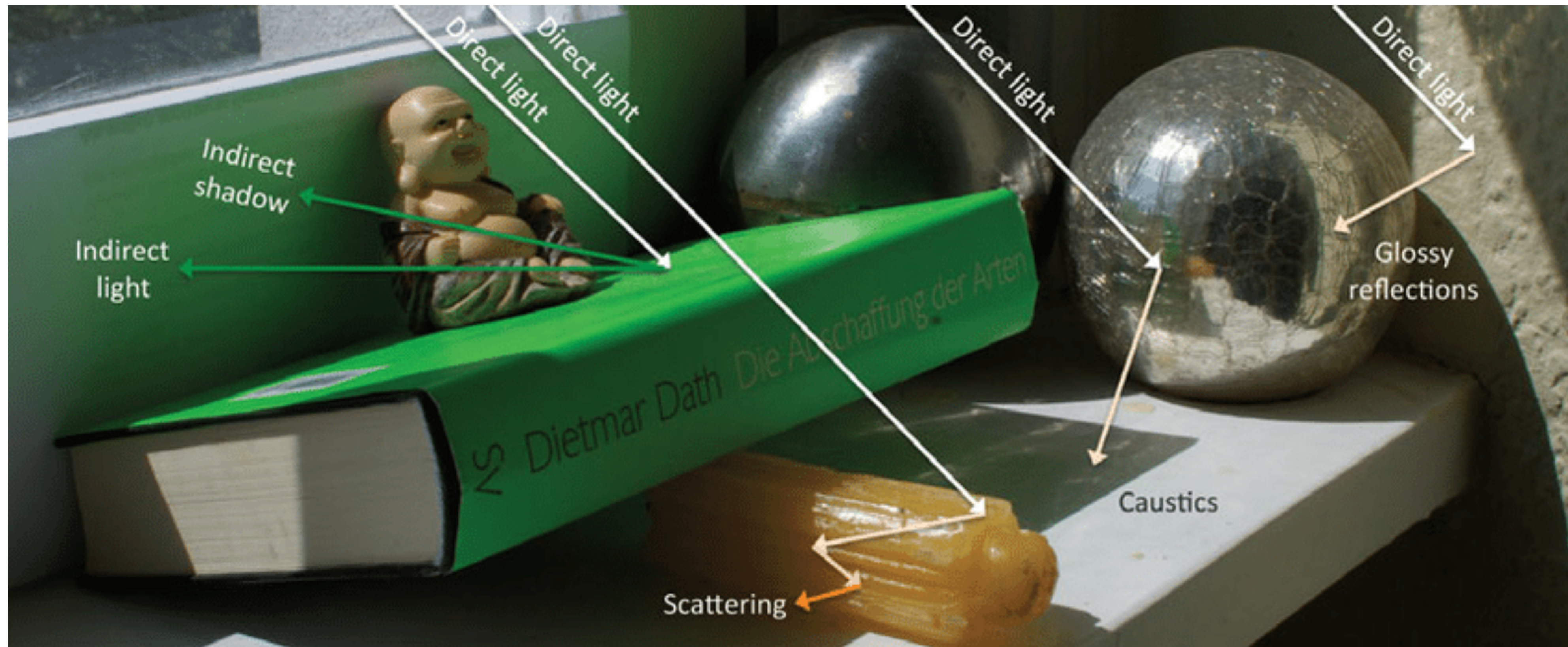
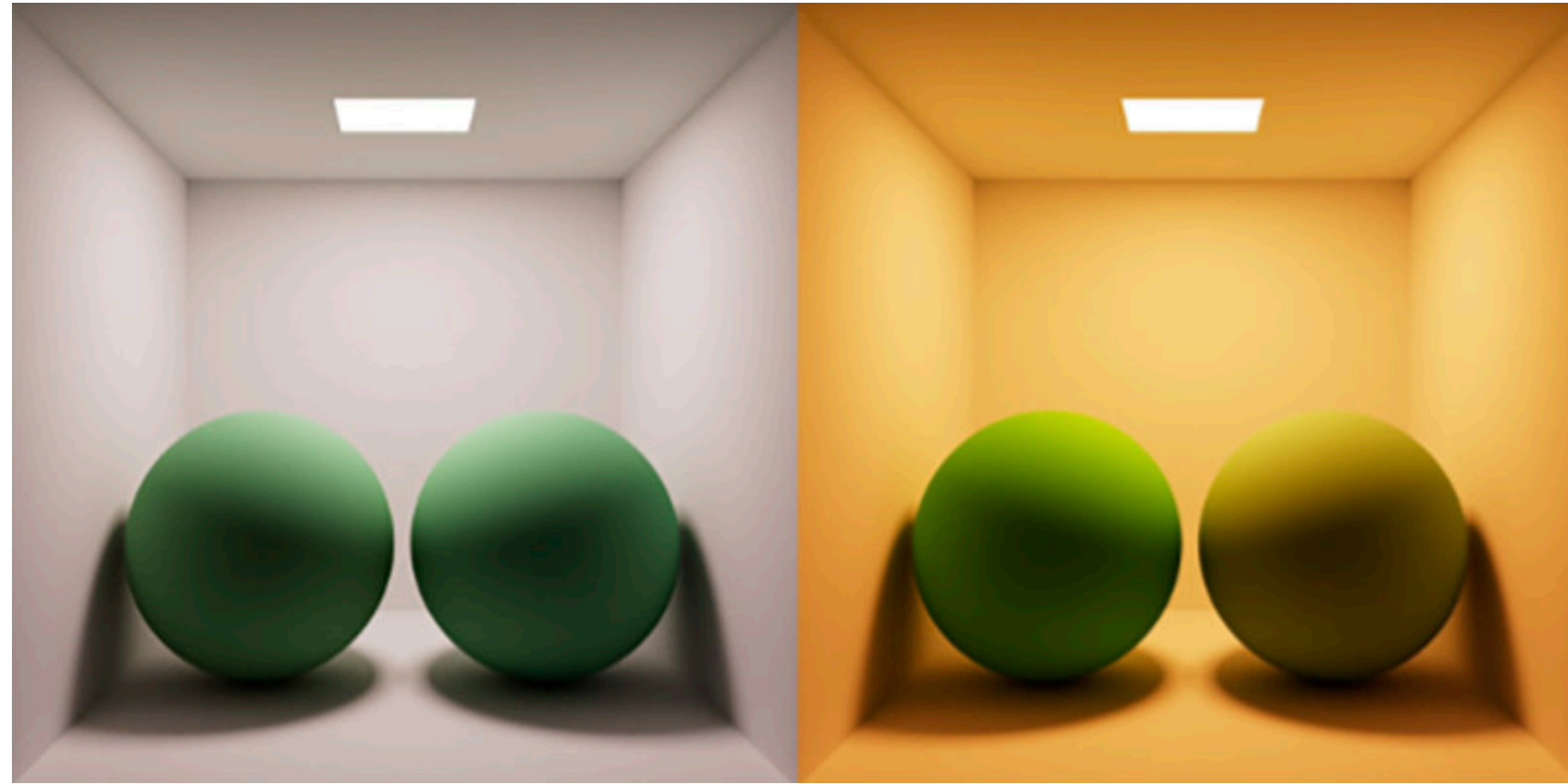


Image courtesy of Tobias Ritschel

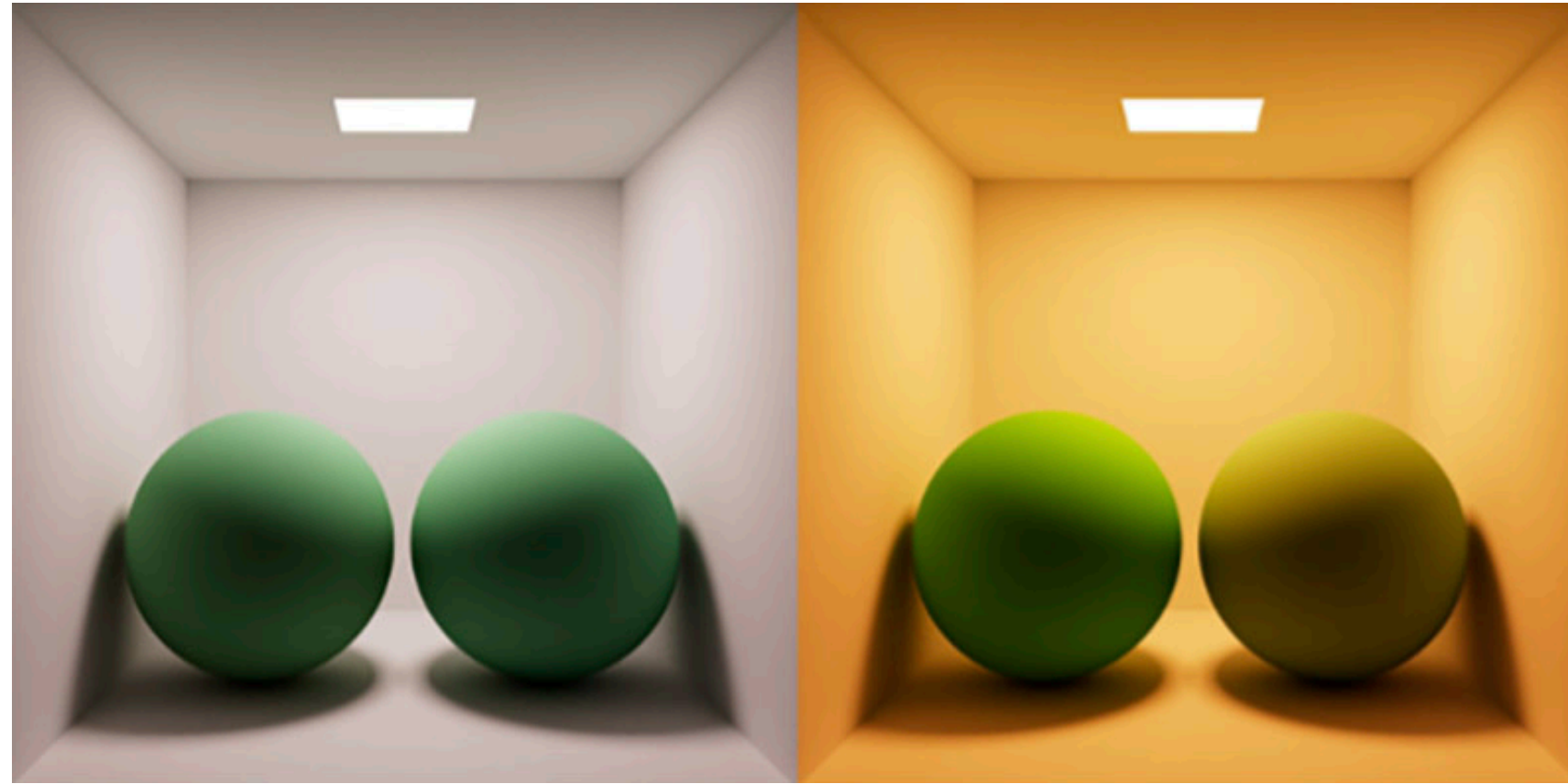
Metamers

Metamers



Colour metamer

Metamers



Colour metamer

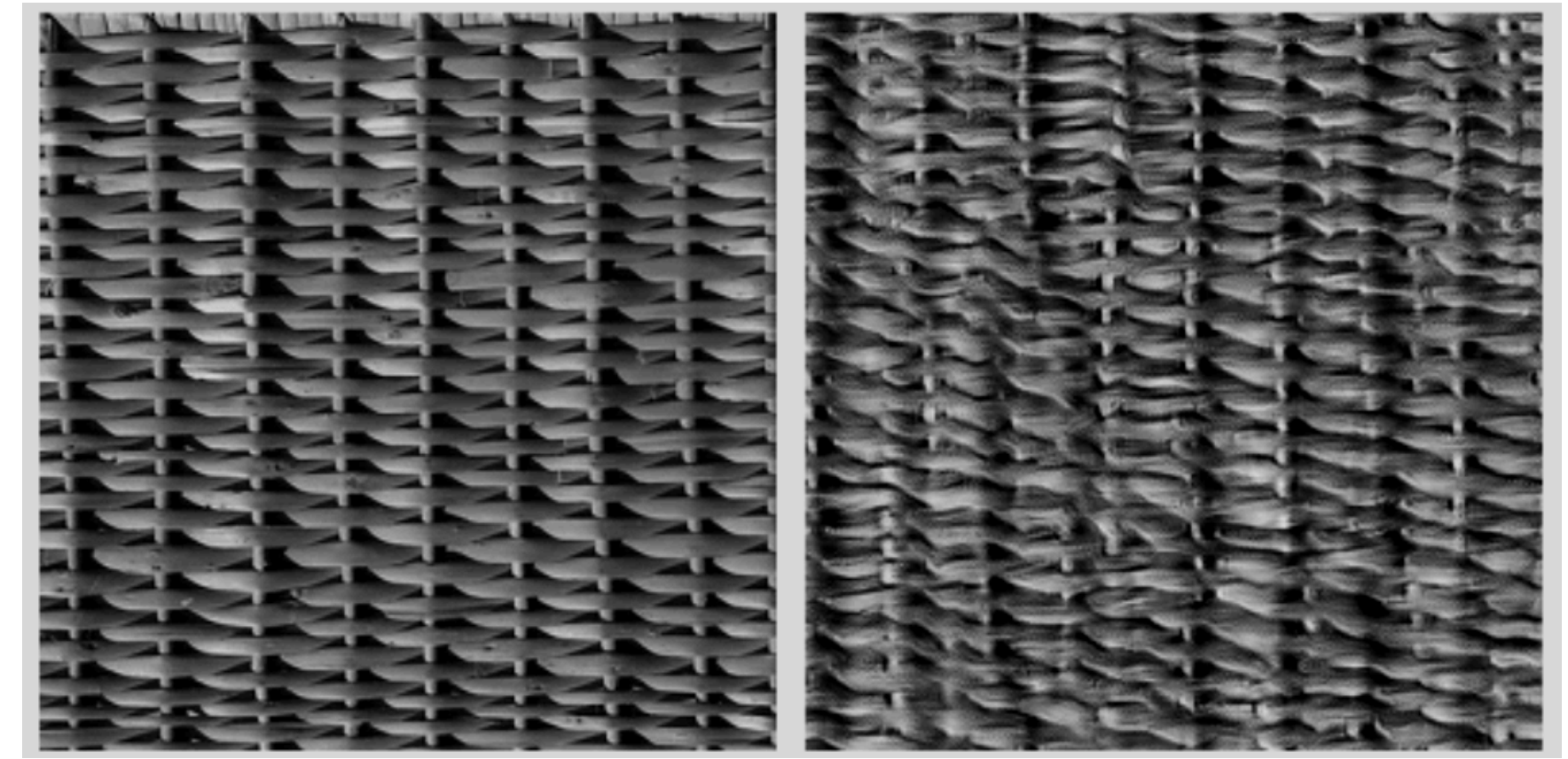
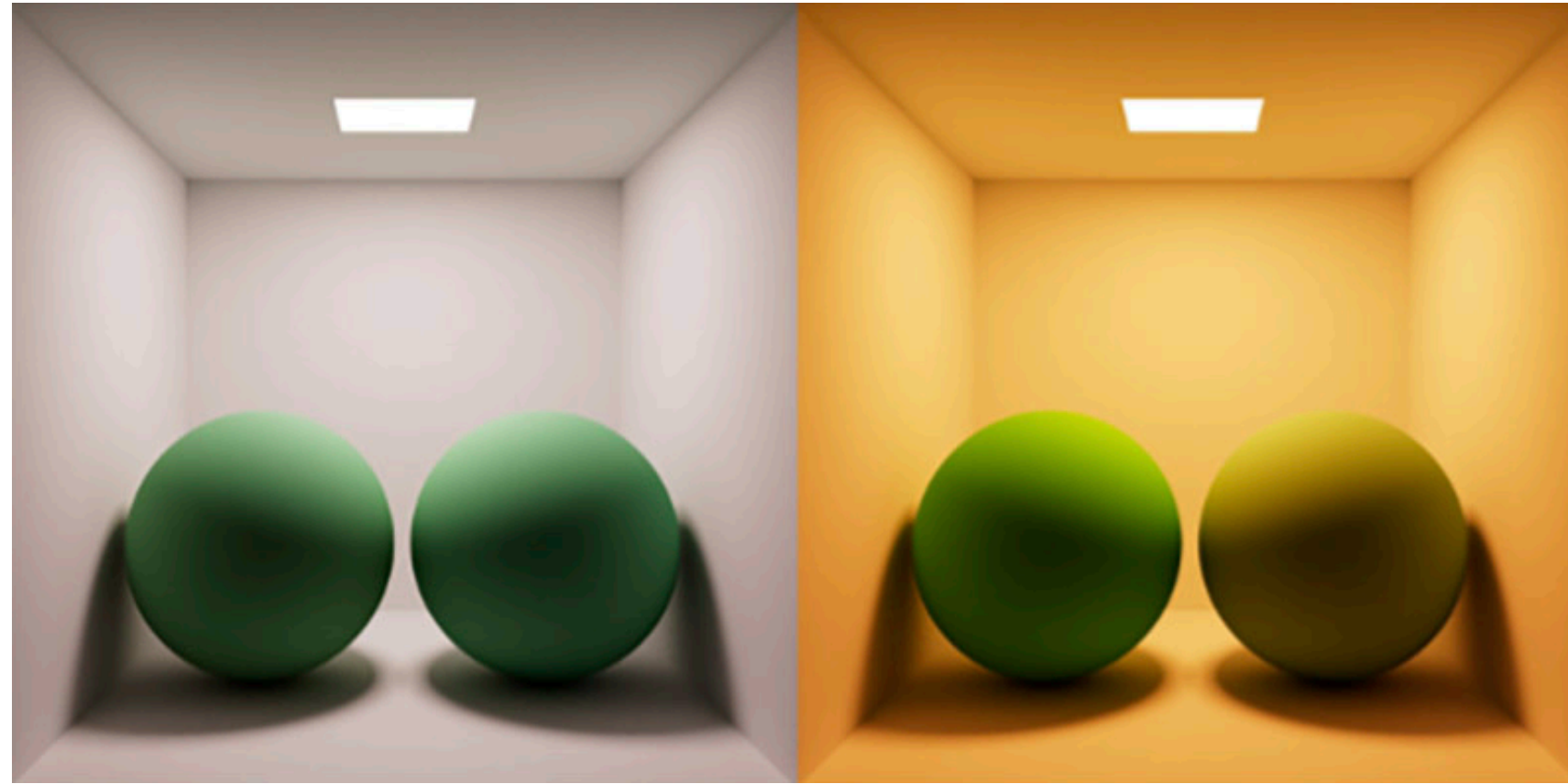


Image statistics metamer (Portilla & Simoncelli 2000,
Freeman & Simoncelli 2011)

Metamers



Colour metamer

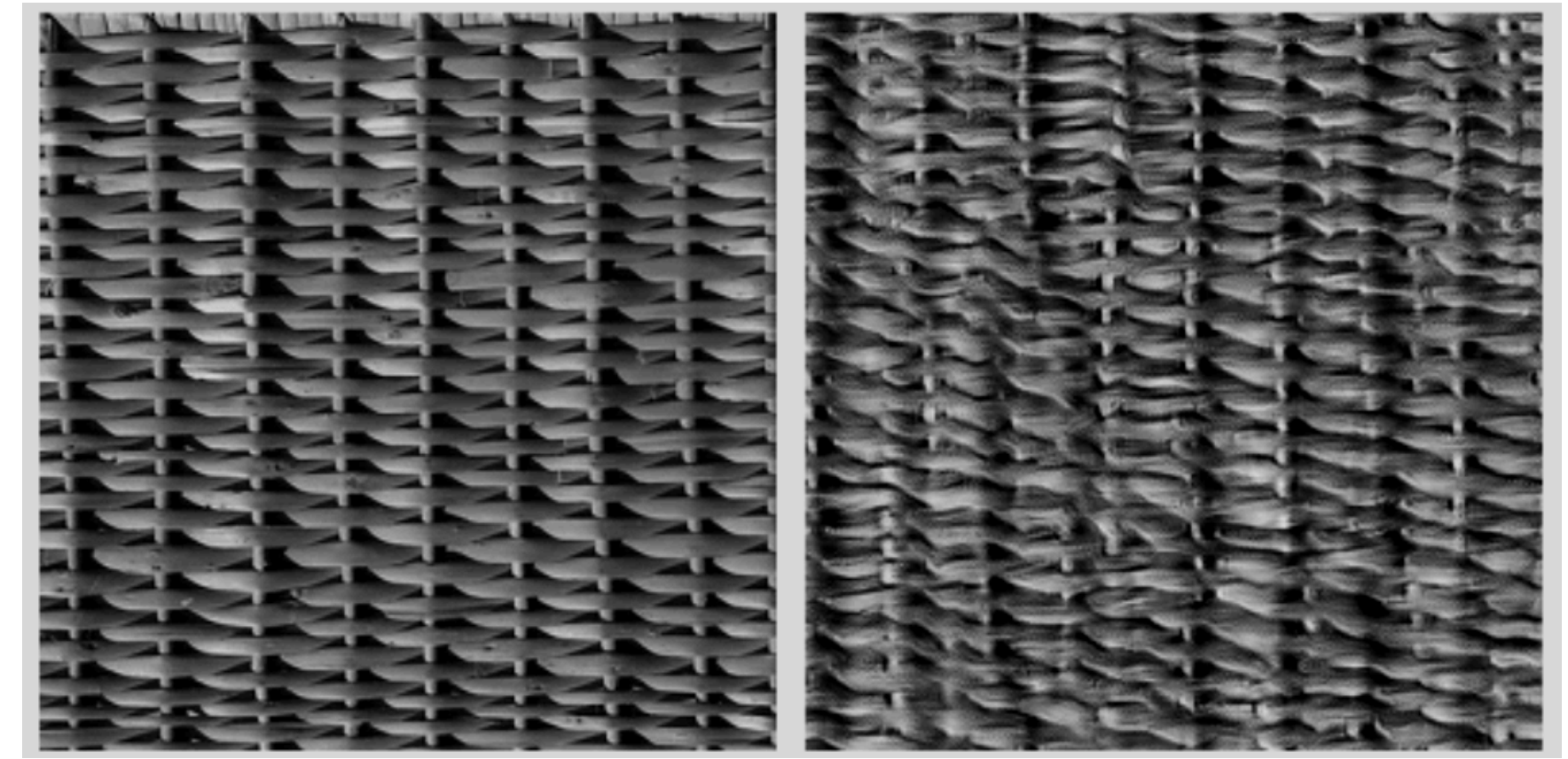
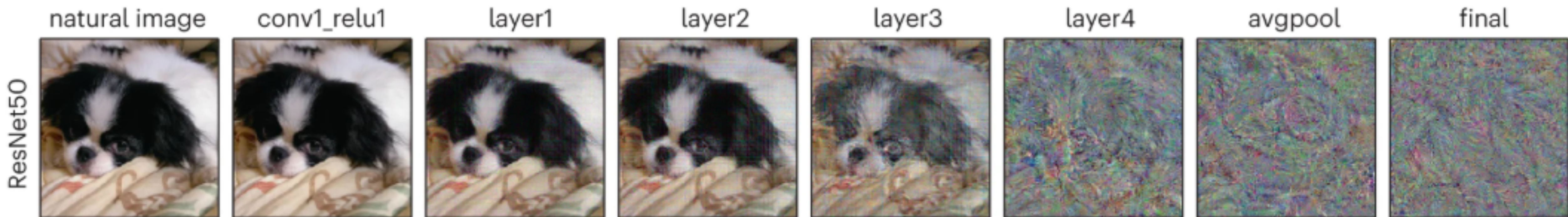


Image statistics metamer (Portilla & Simoncelli 2000, Freeman & Simoncelli 2011)

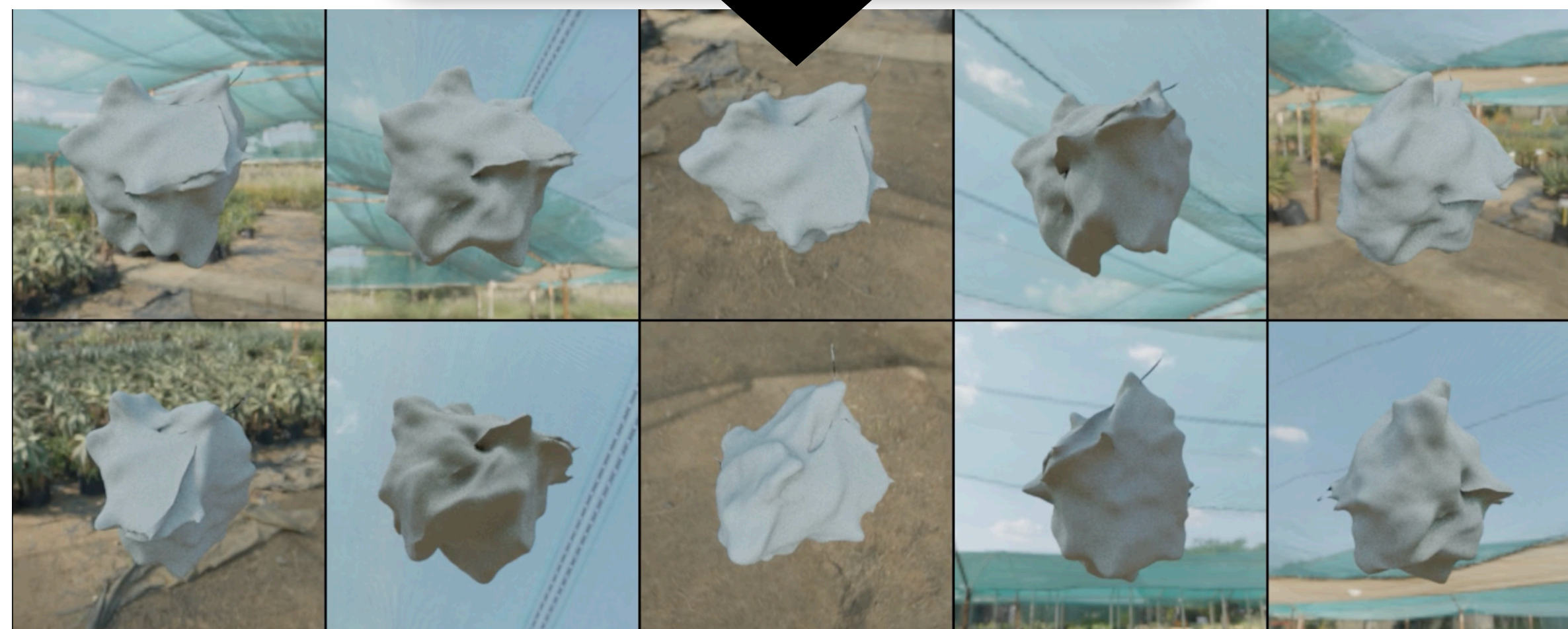


Neural Network metamer
(Feather et al. 2019)

Metamers

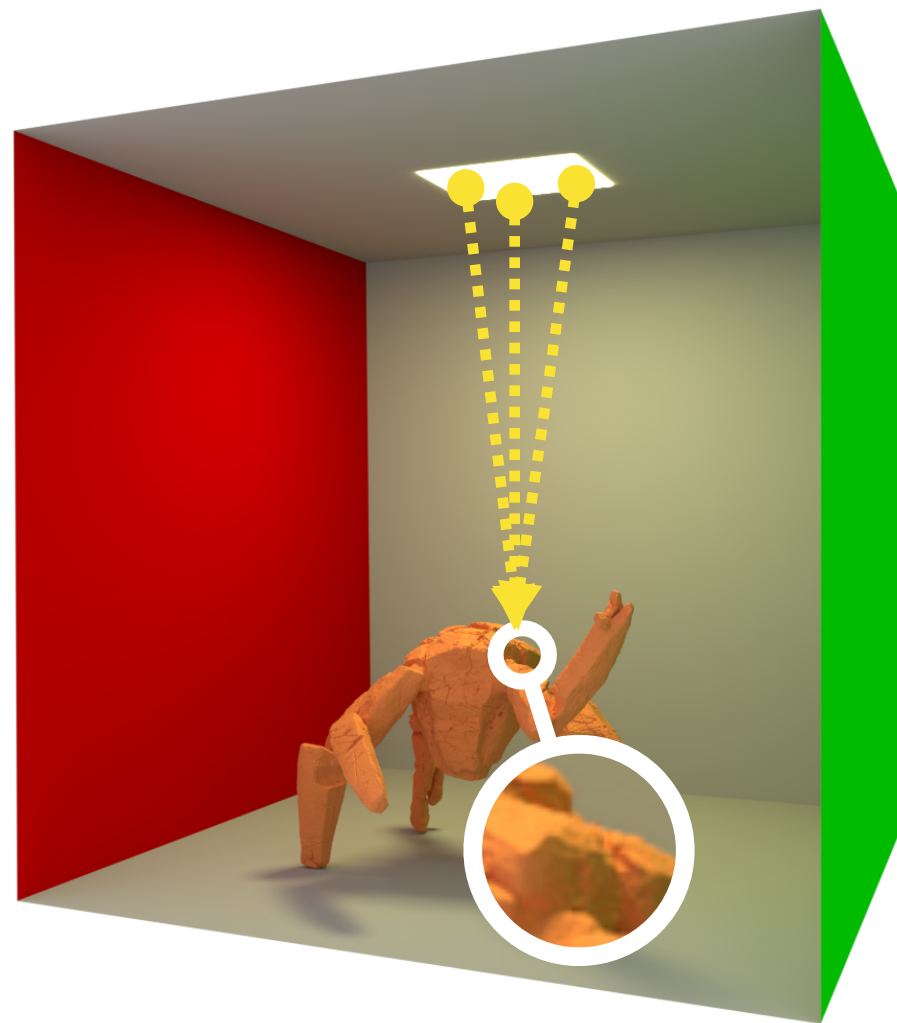


Look the same to the model



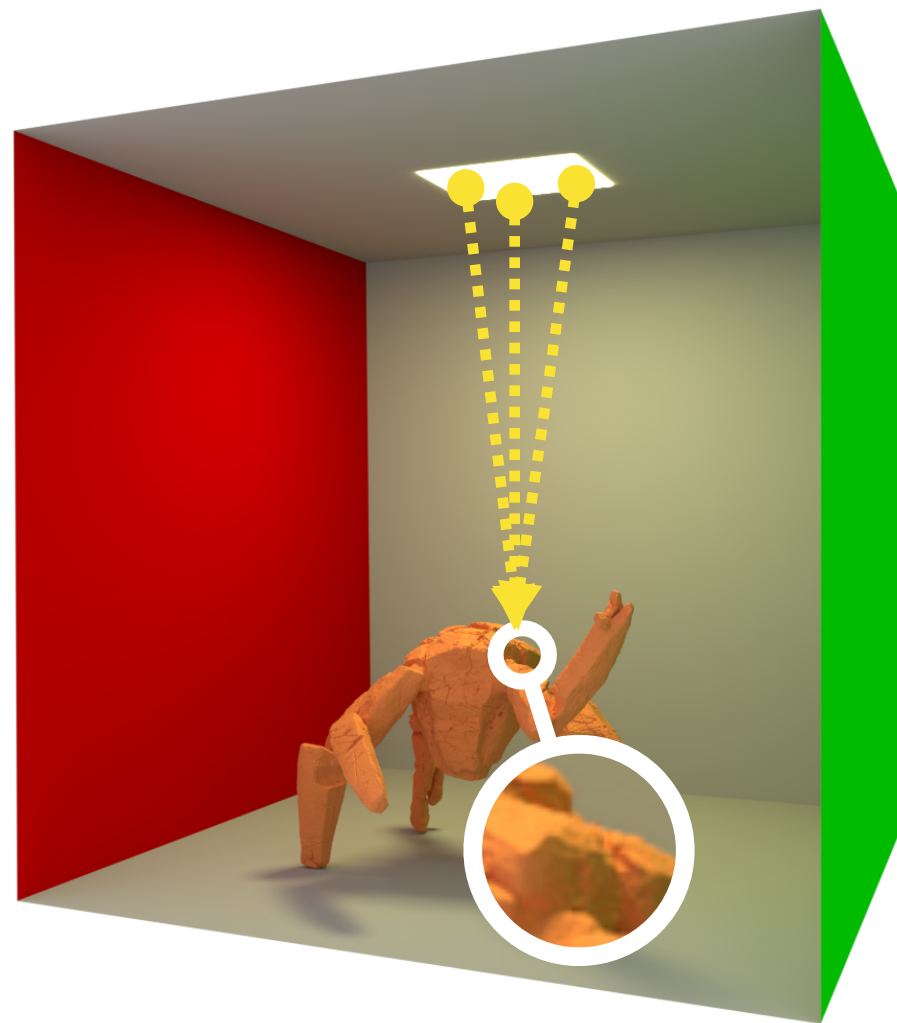
Physically Based Differentiable Rendering

Physically Based Differentiable Rendering

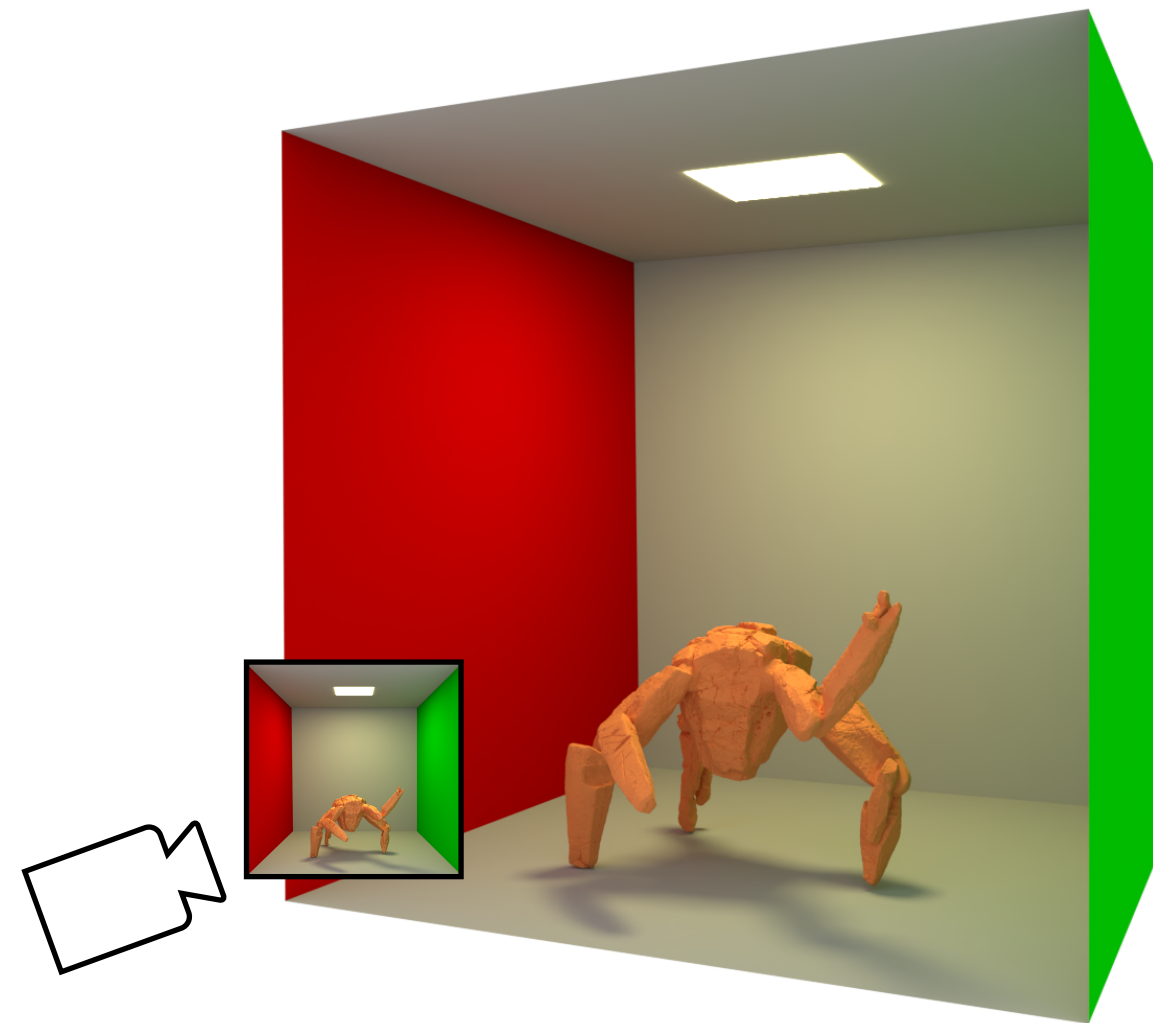


Physically based

Physically Based Differentiable Rendering

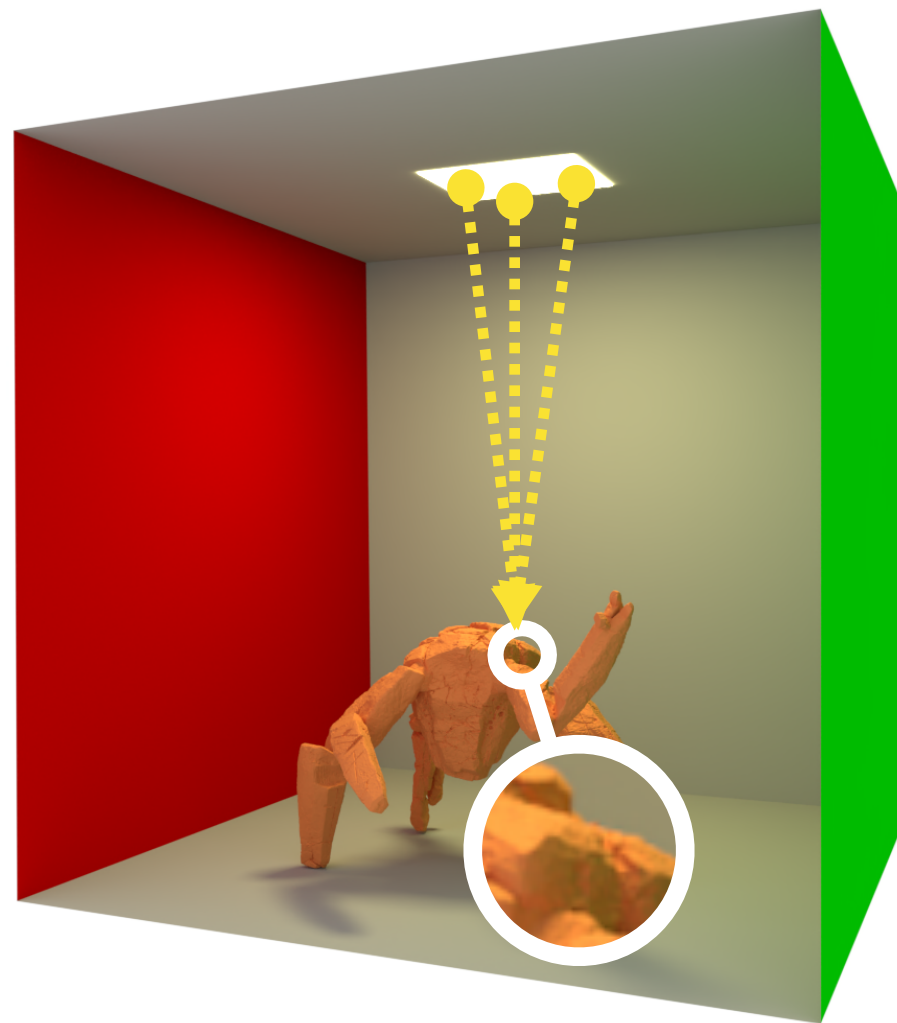


Physically based

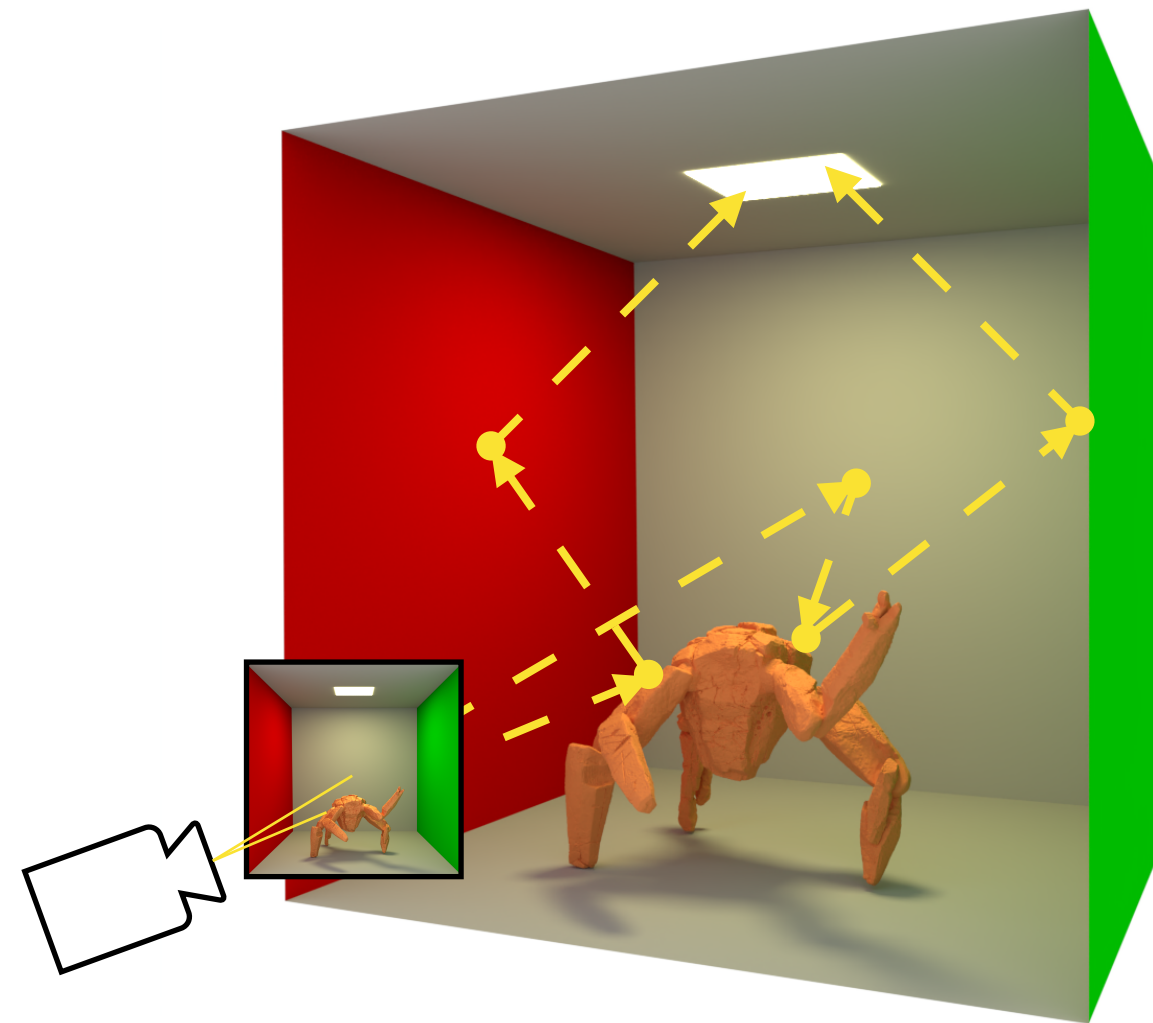


Interpretable

Physically Based Differentiable Rendering

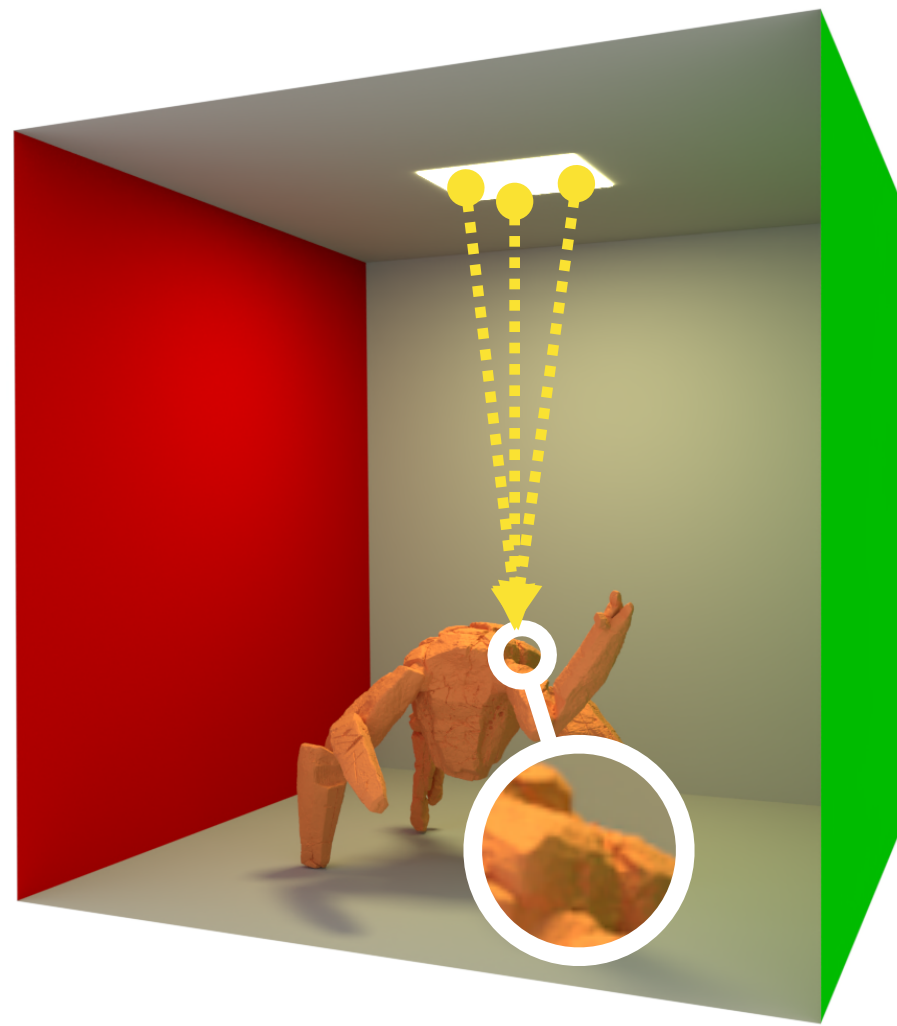


Physically based

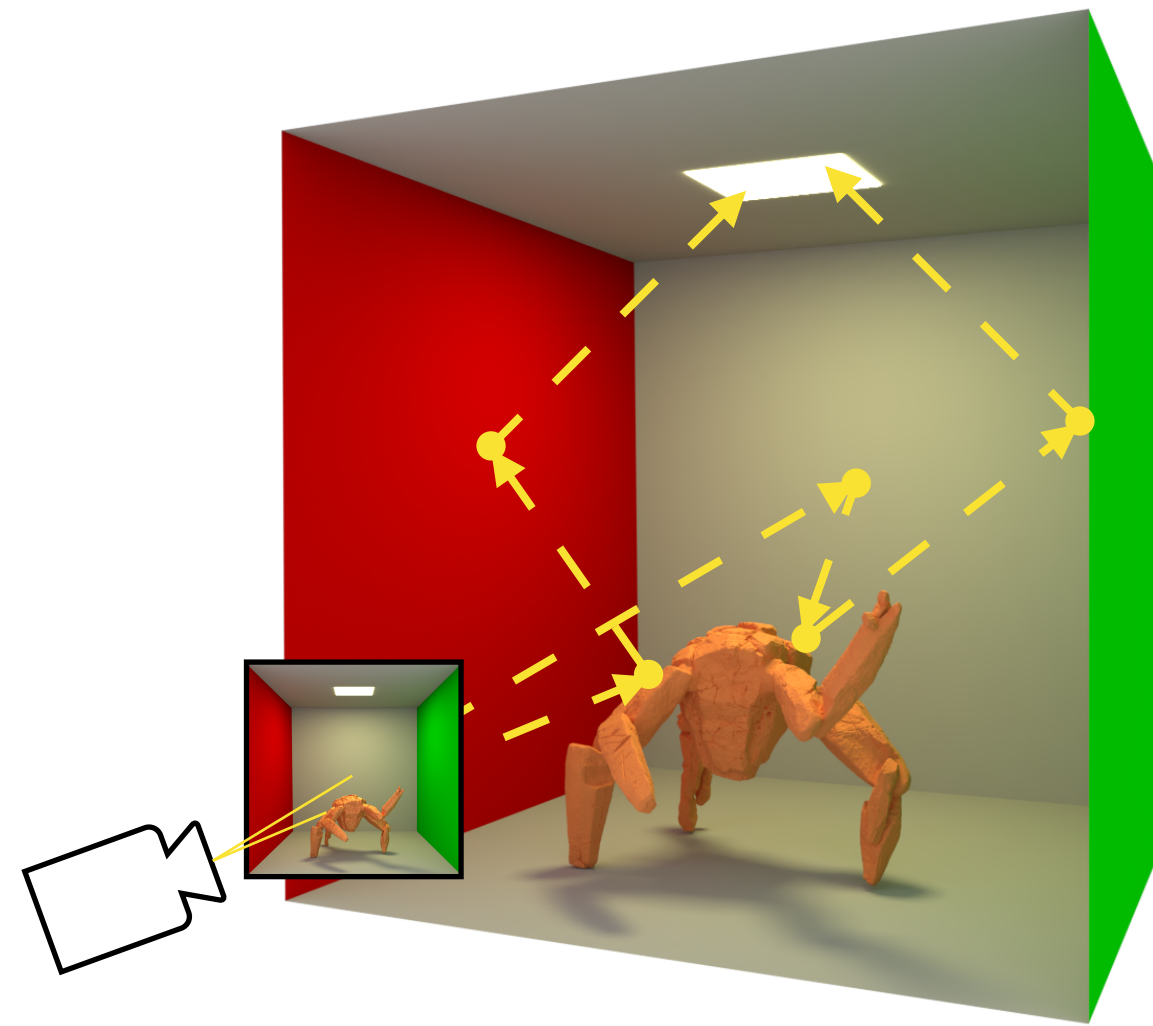


Interpretable

Physically Based Differentiable Rendering



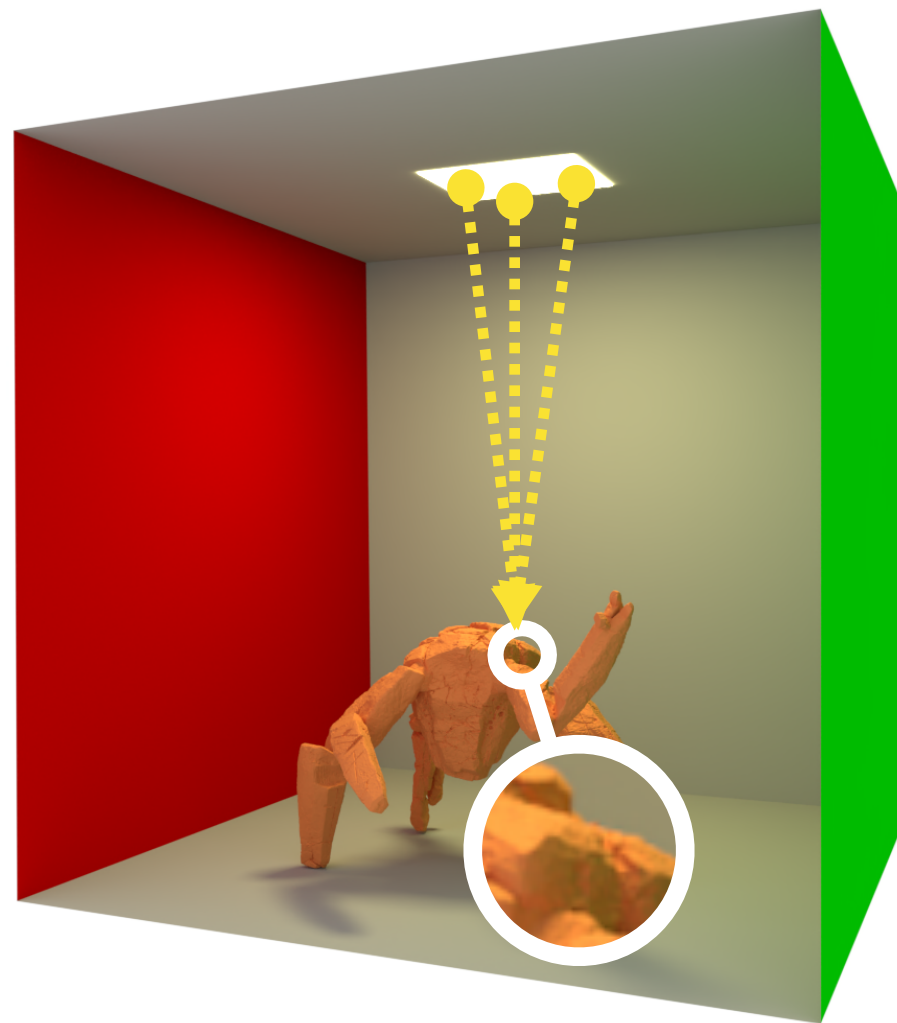
Physically based



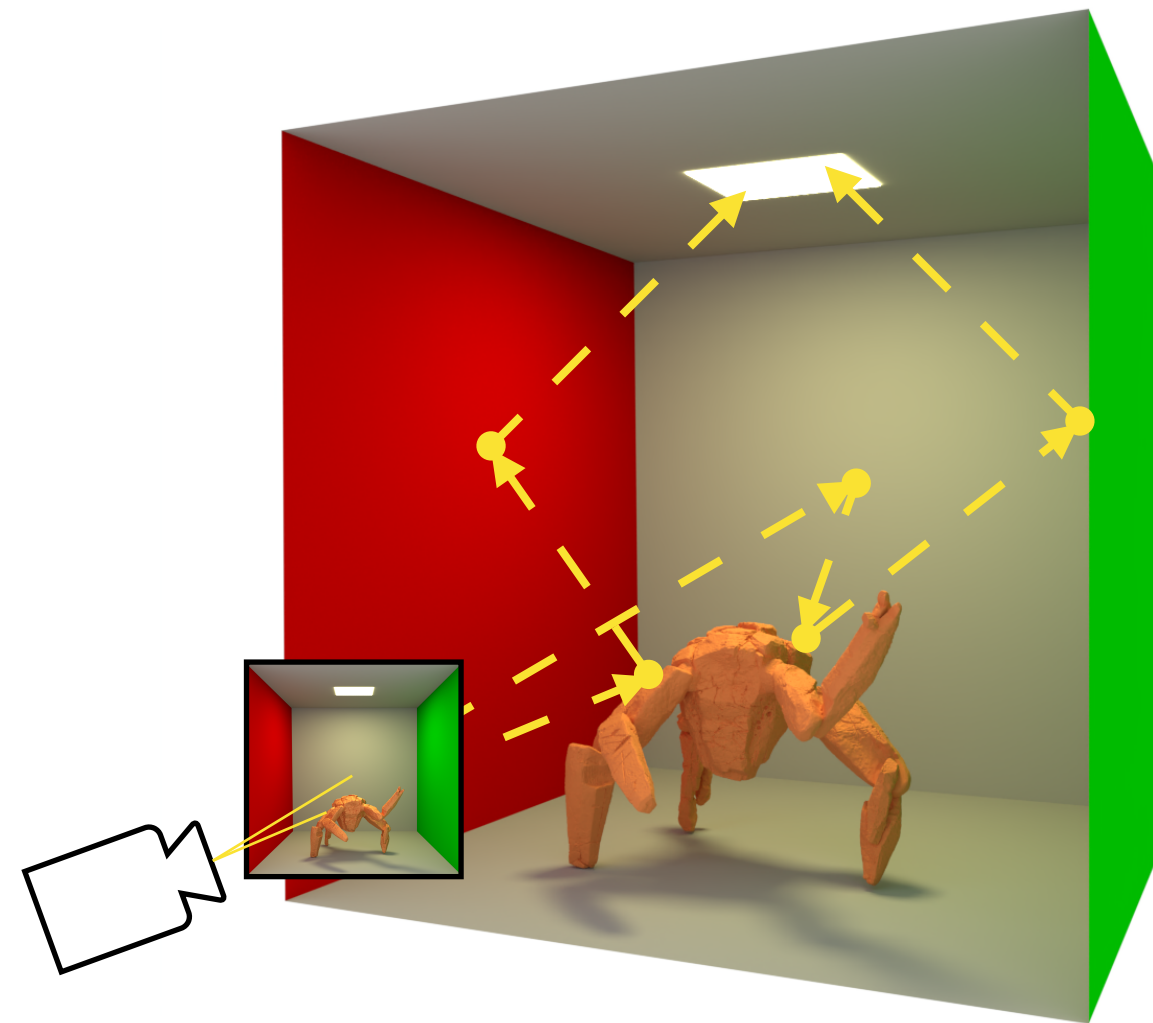
Interpretable

Differentiable

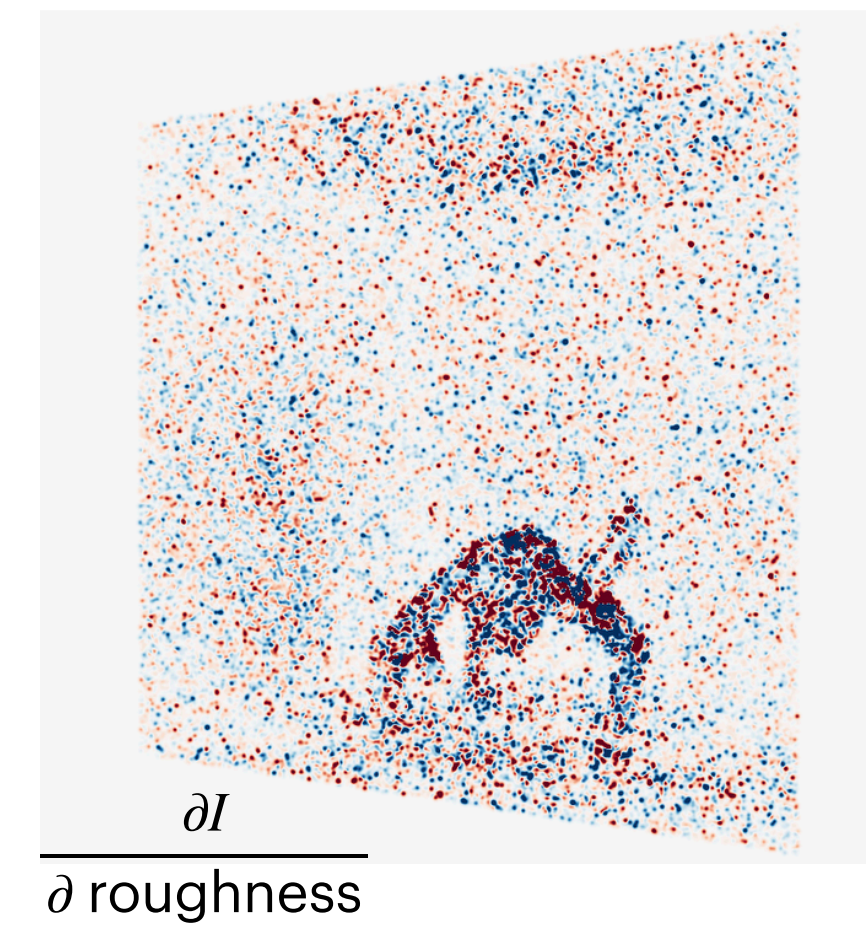
Physically Based Differentiable Rendering



Physically based

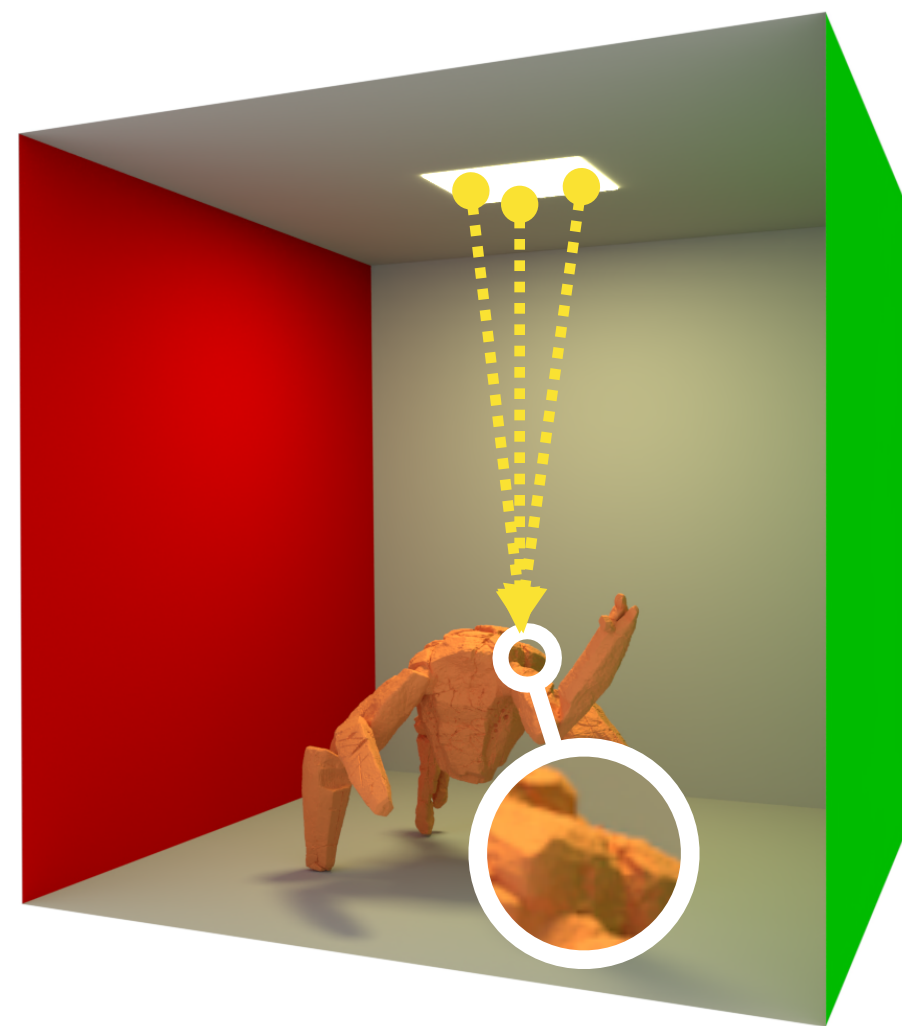


Interpretable

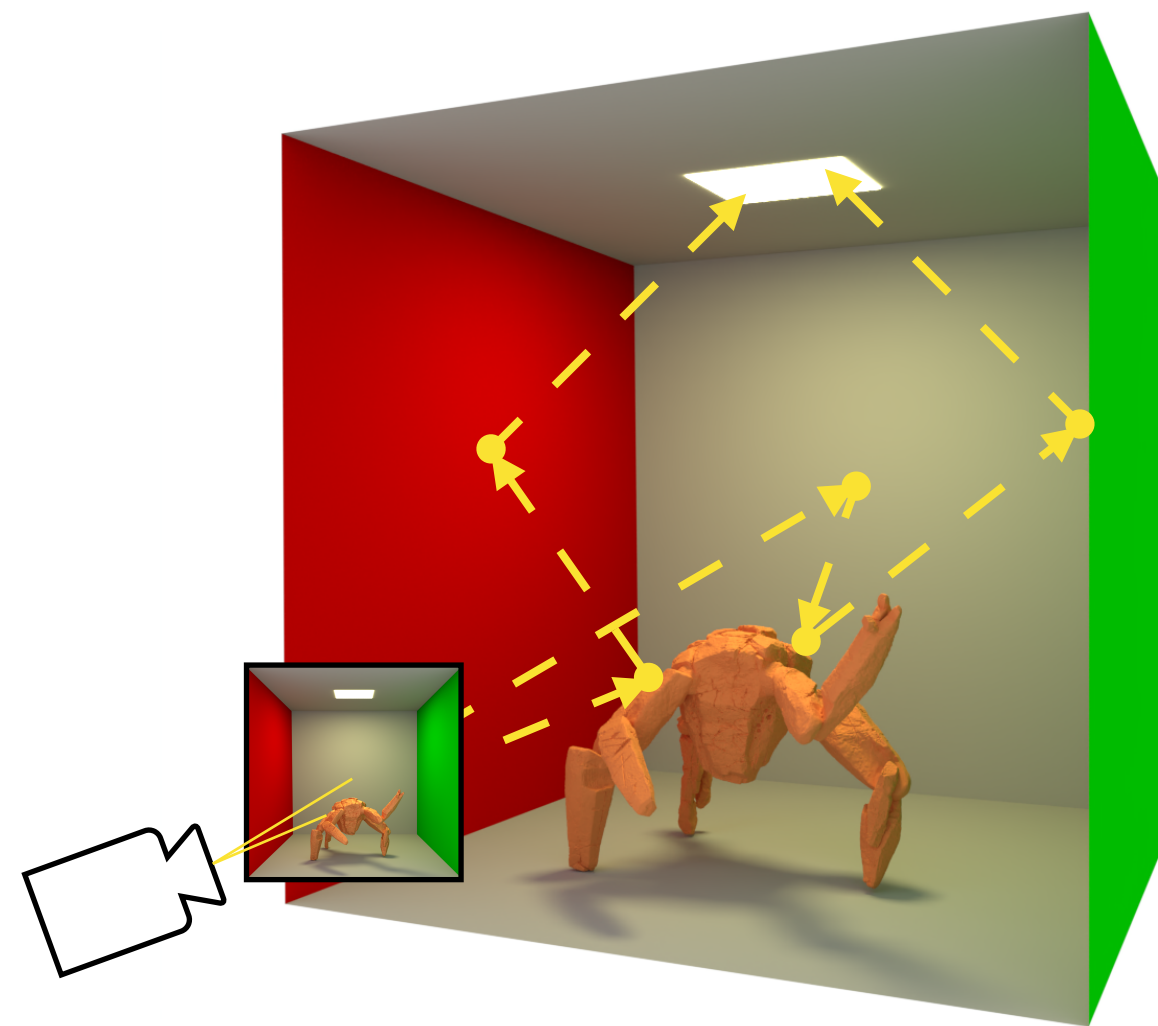


Differentiable

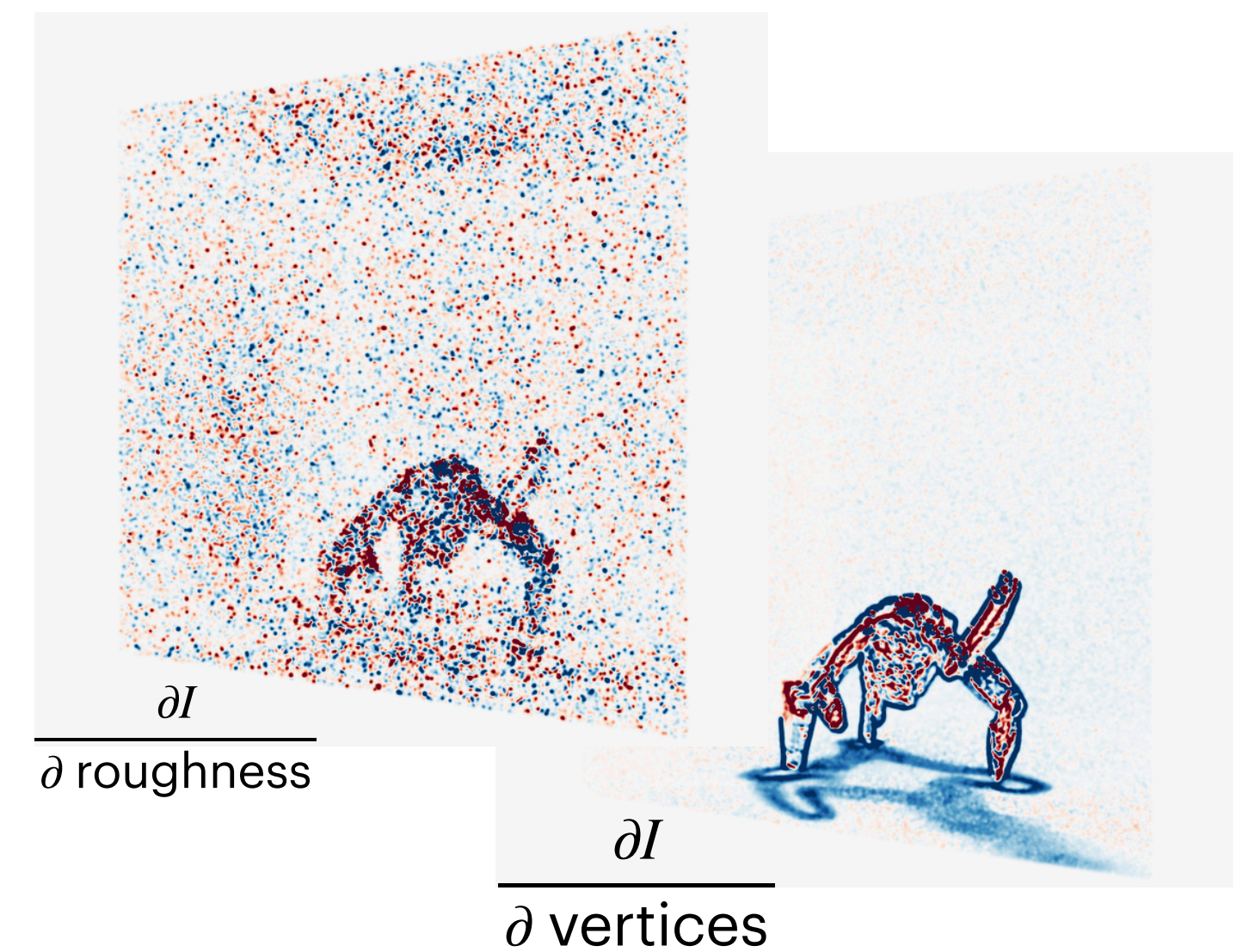
Physically Based Differentiable Rendering



Physically based



Interpretable



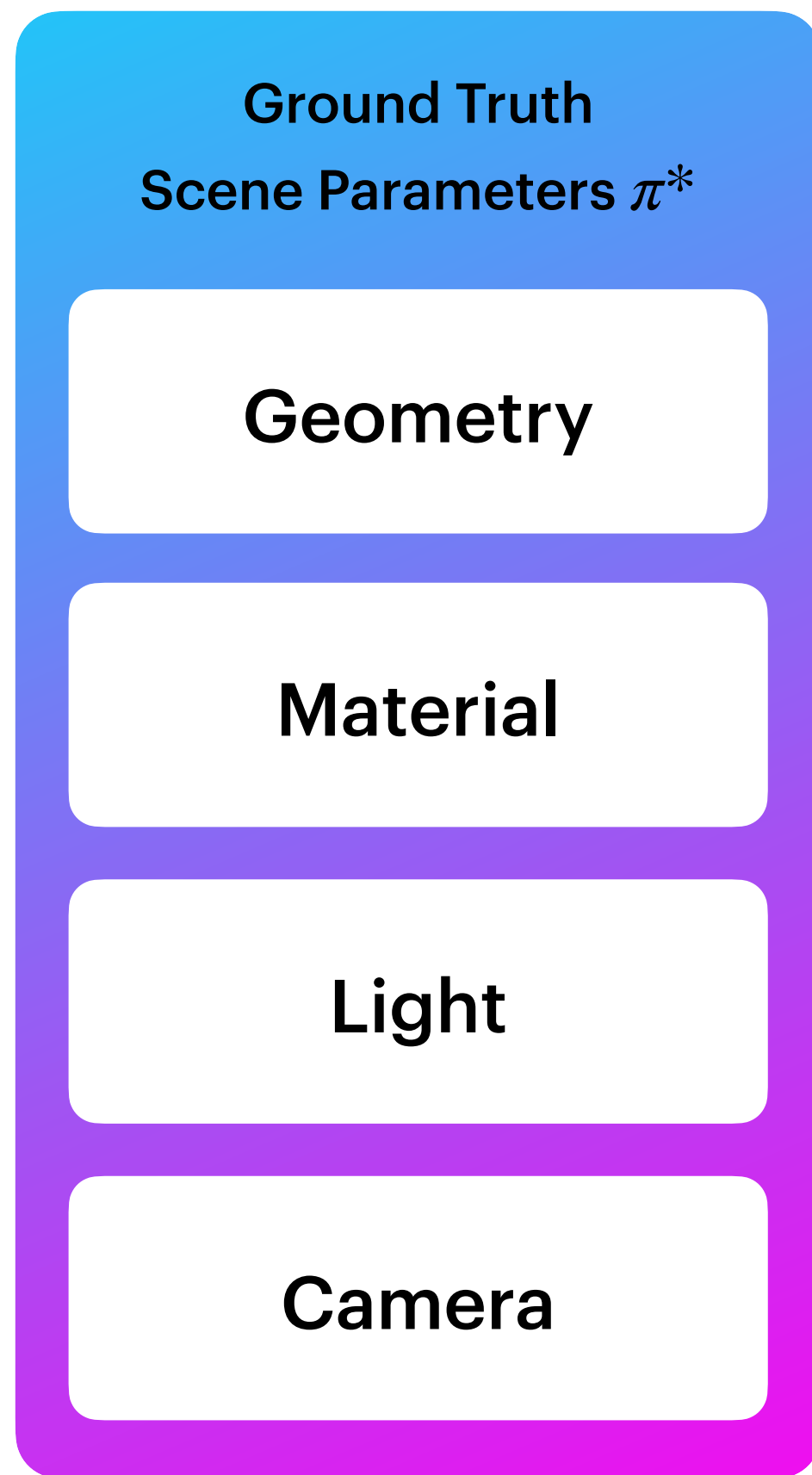
Differentiable

Approach

Geometry Example

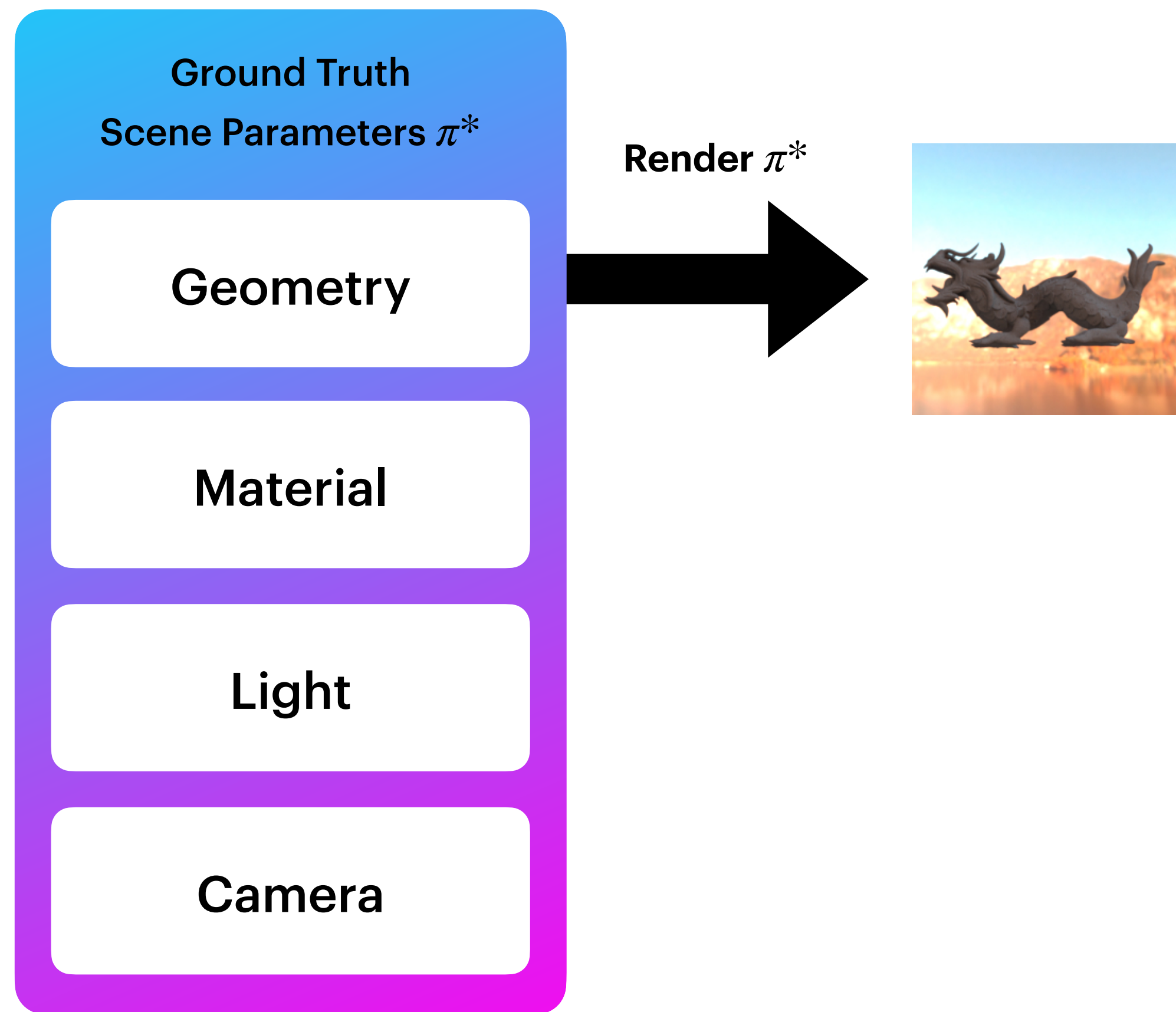
Approach

Geometry Example



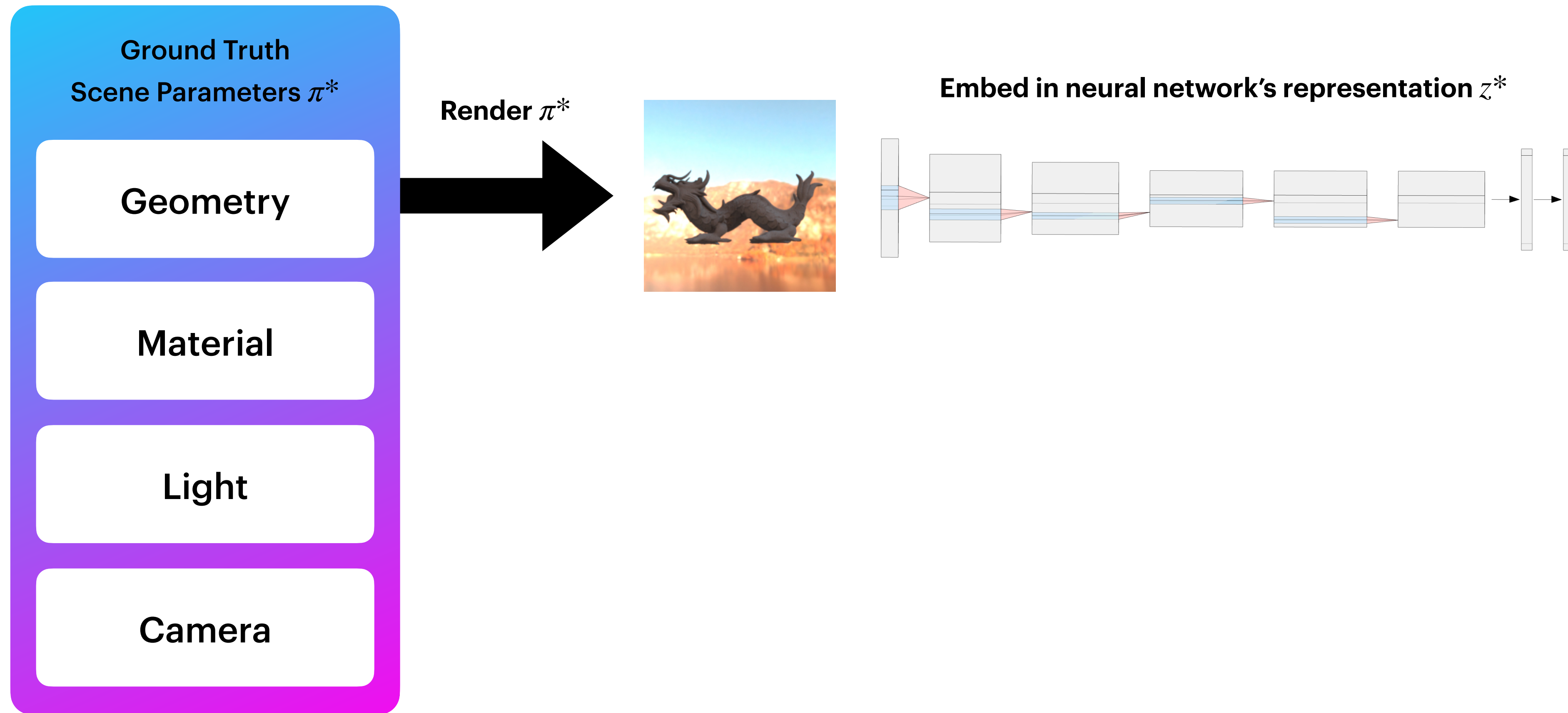
Approach

Geometry Example



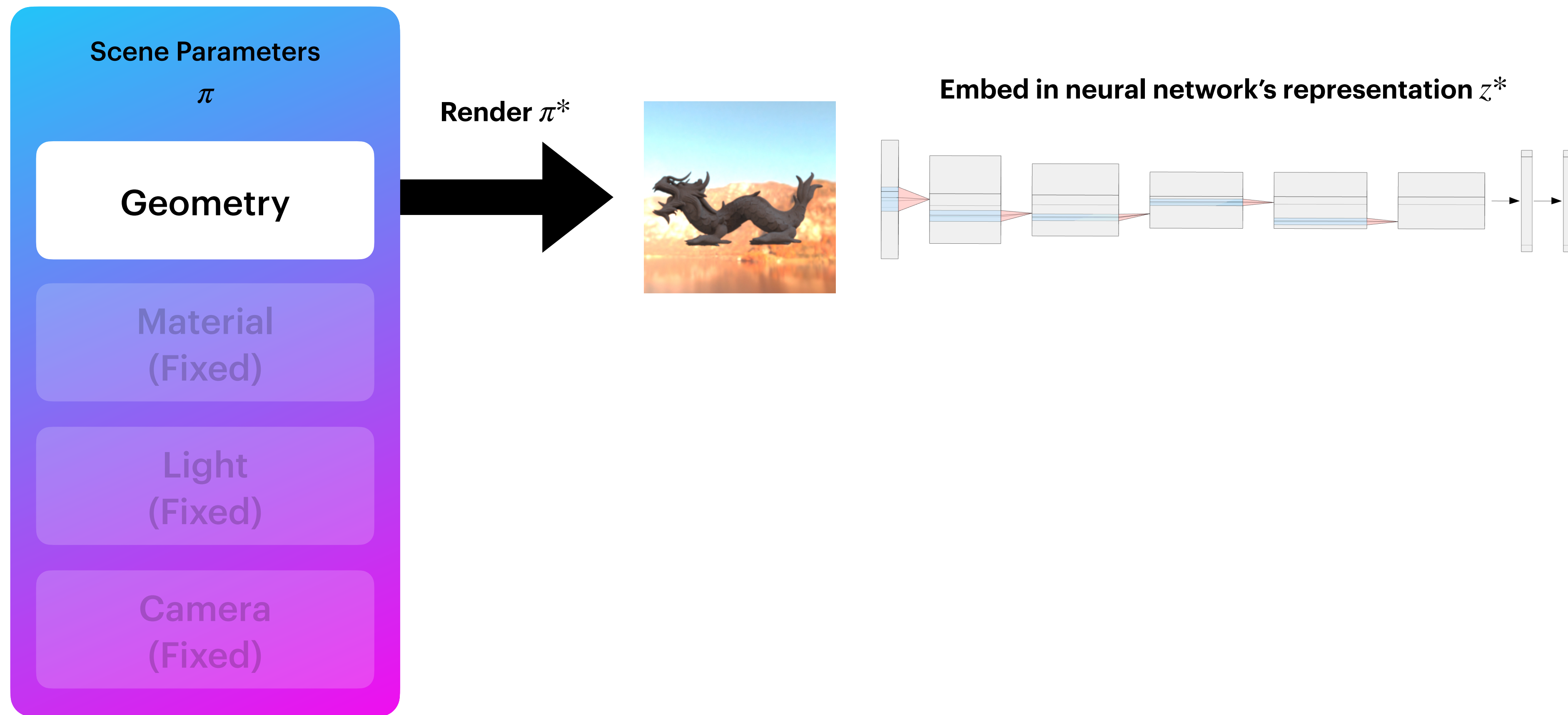
Approach

Geometry Example



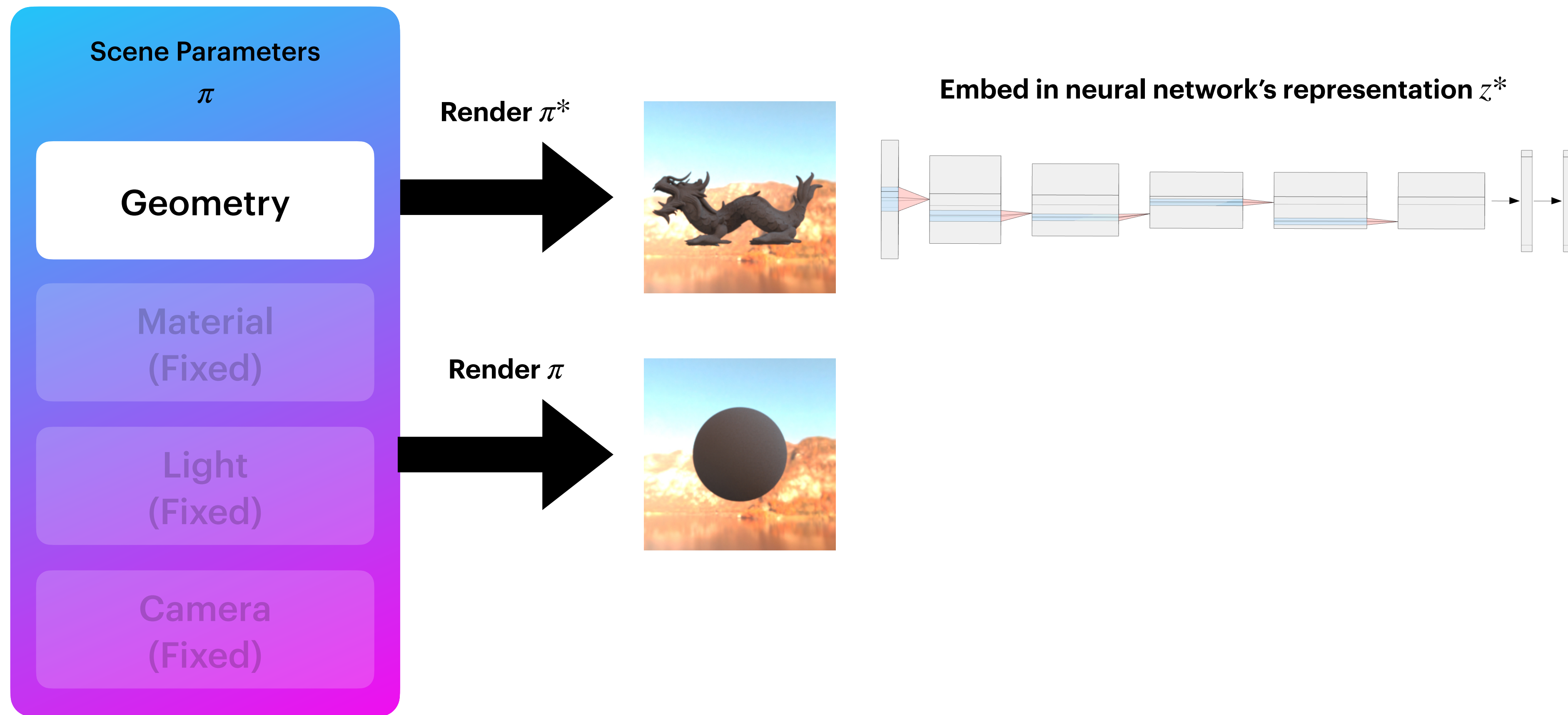
Approach

Geometry Example



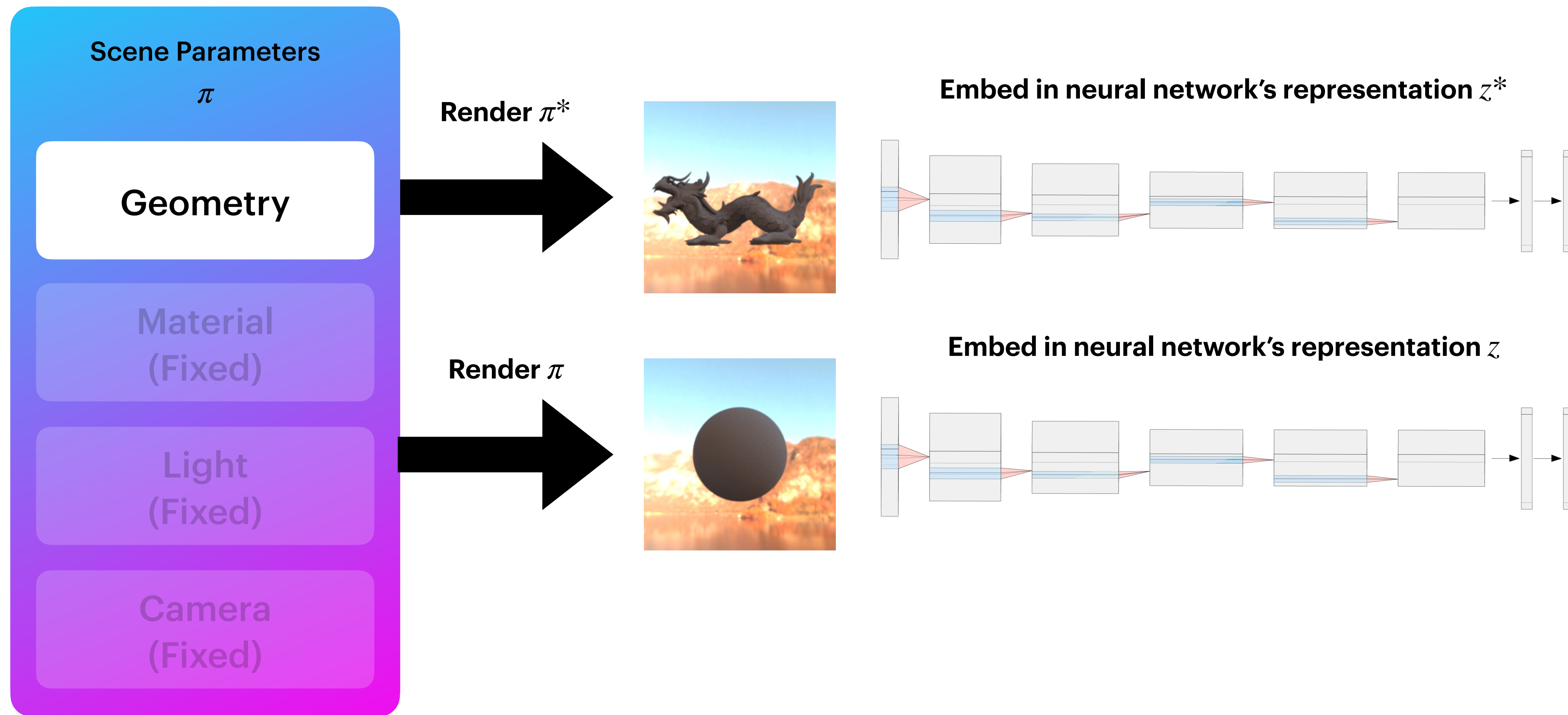
Approach

Geometry Example



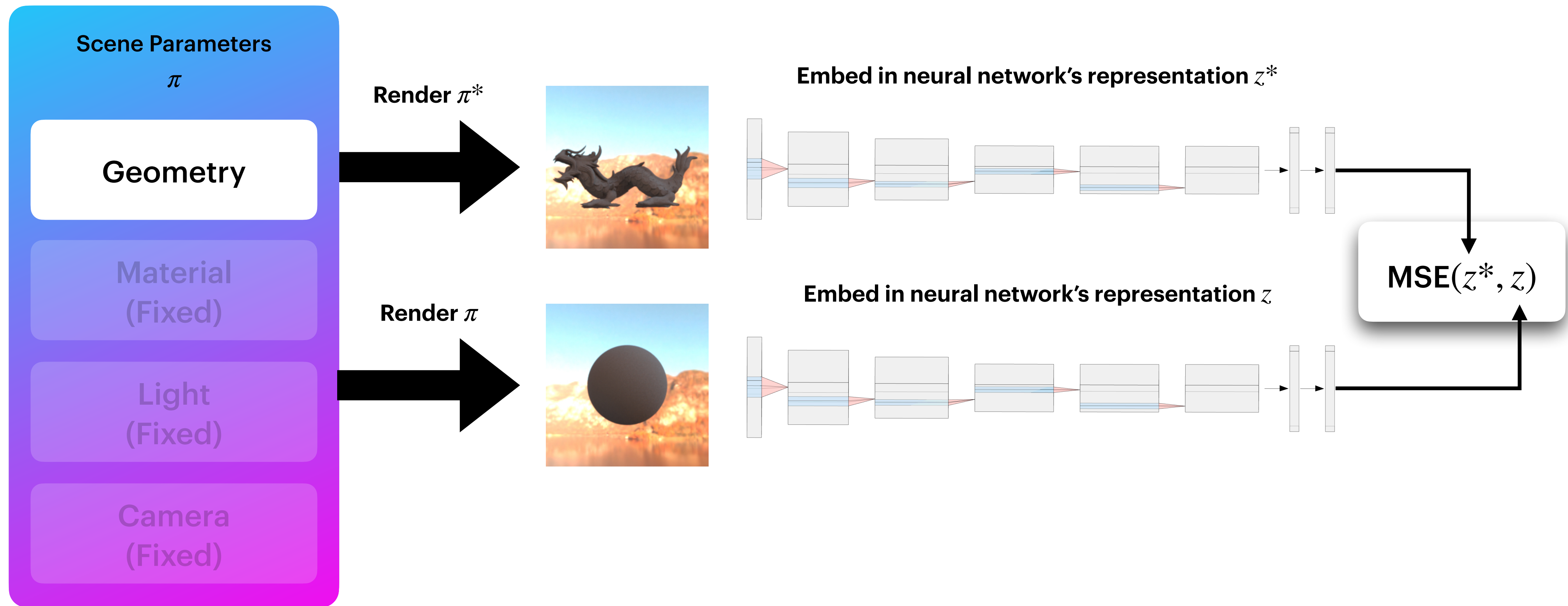
Approach

Geometry Example



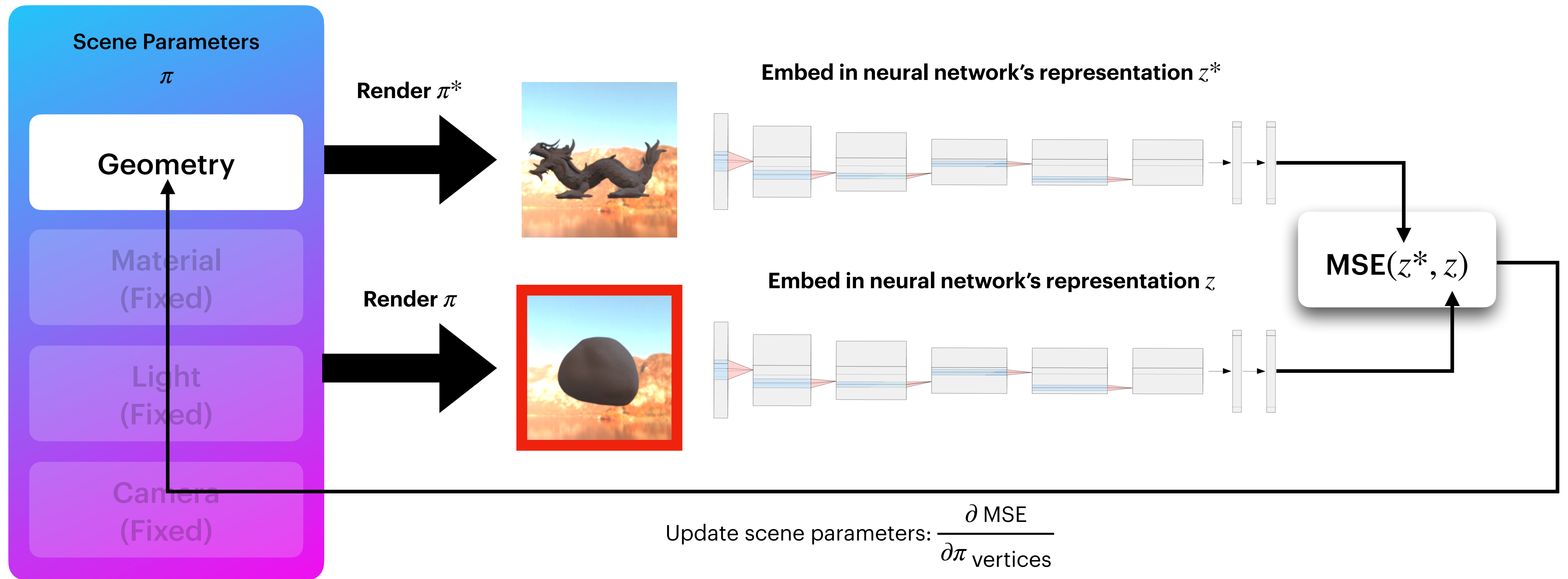
Approach

Geometry Example



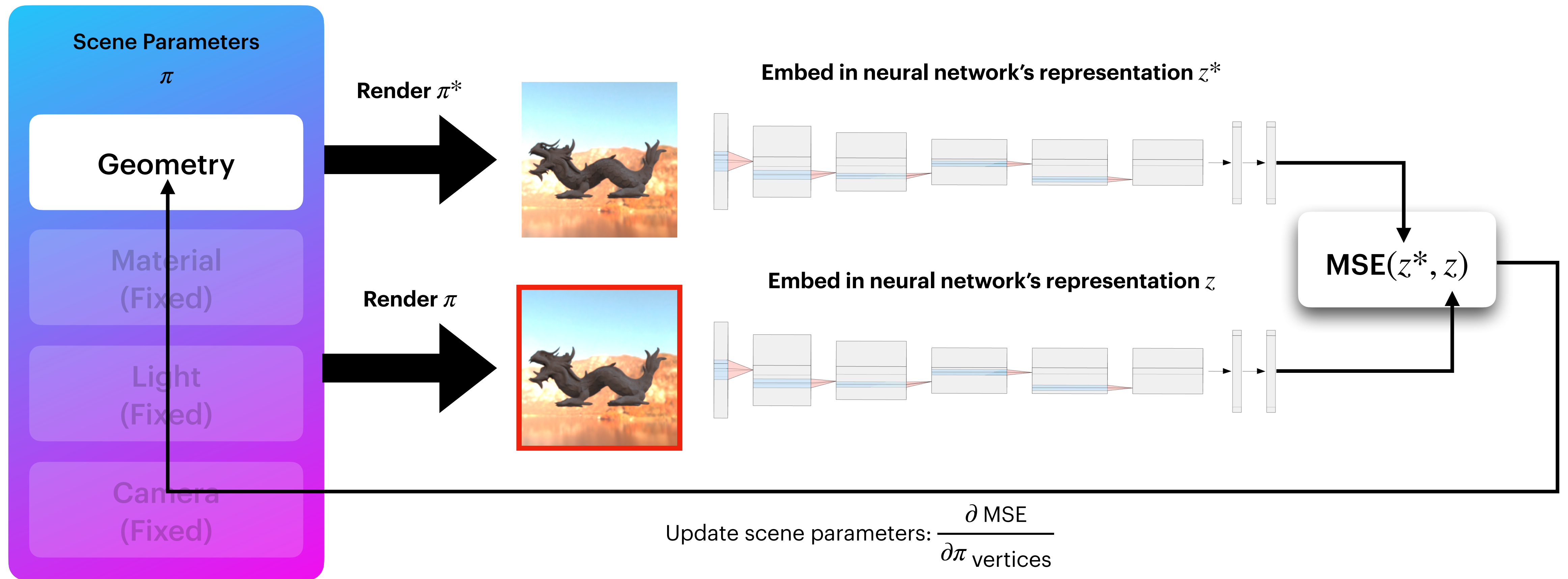
Approach

Geometry Example



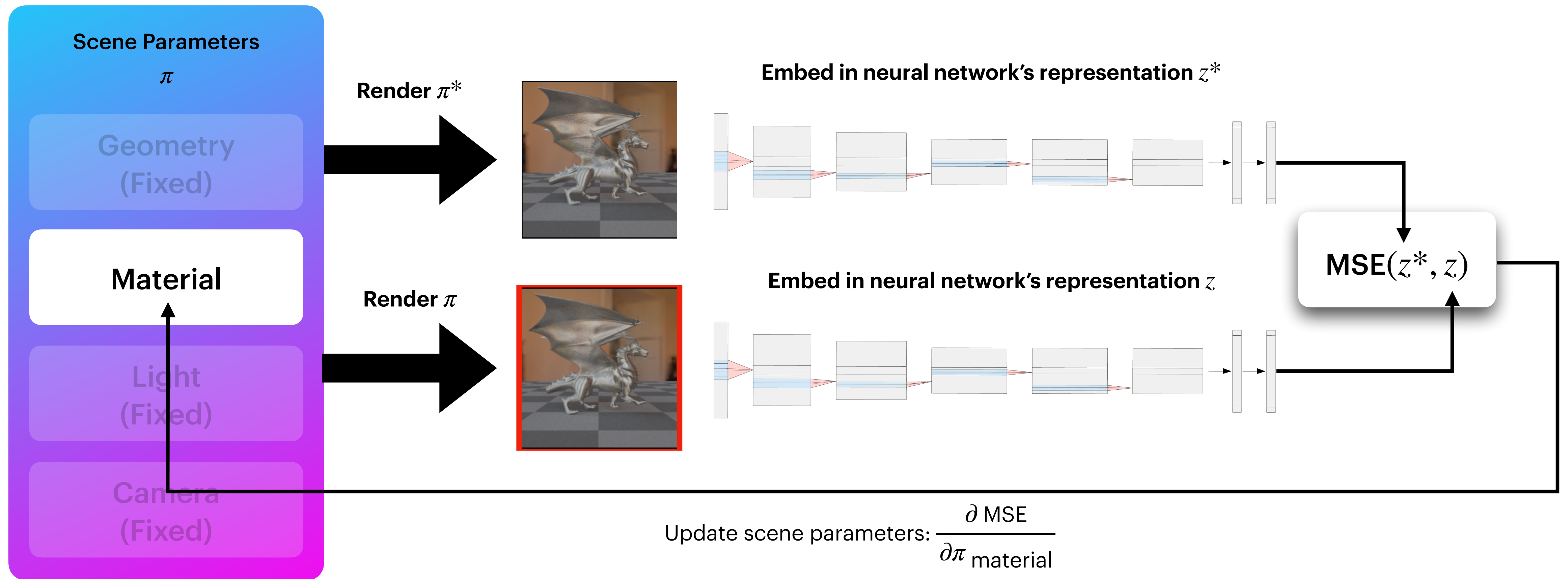
Approach

Geometry Example



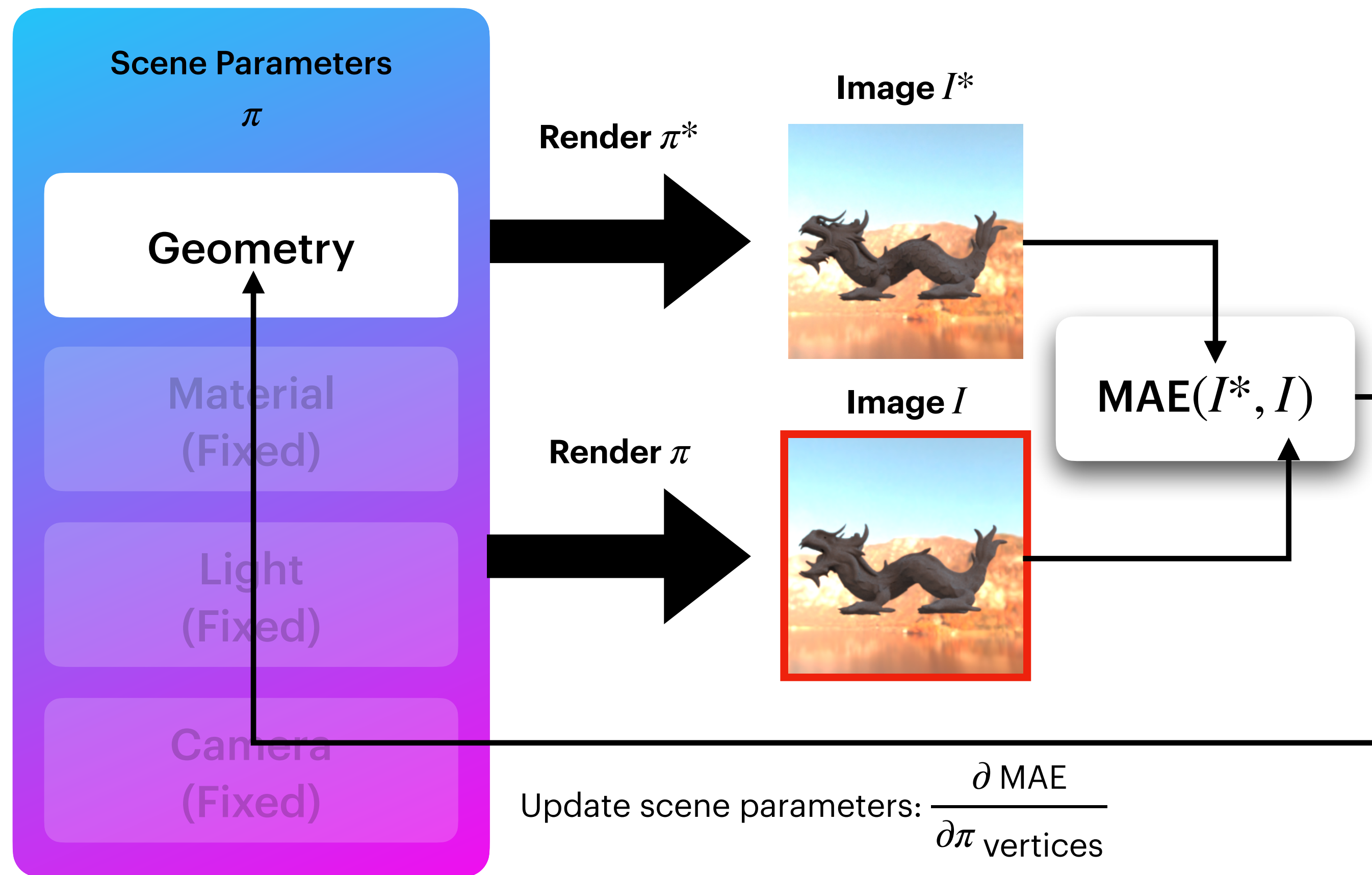
Approach

Material Example



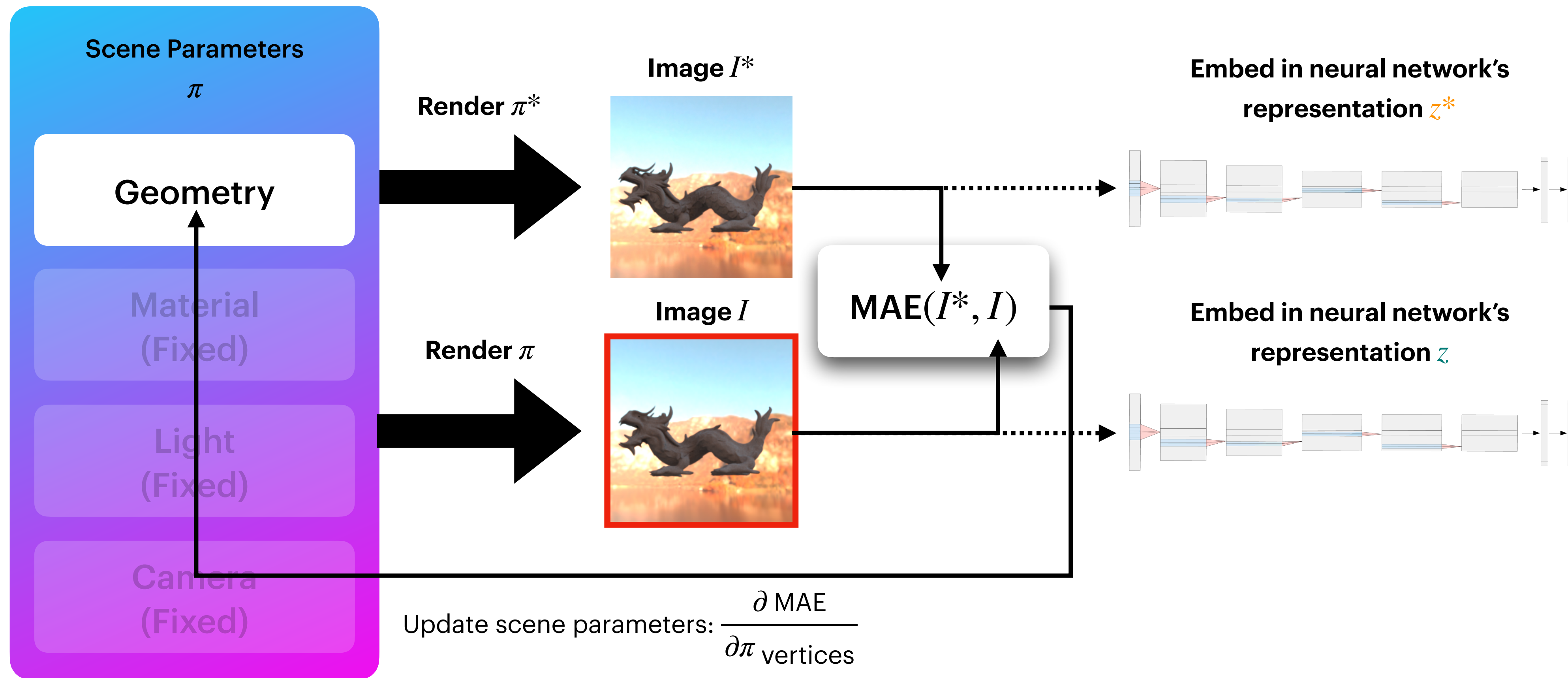
Baseline Similarity

Geometry Example



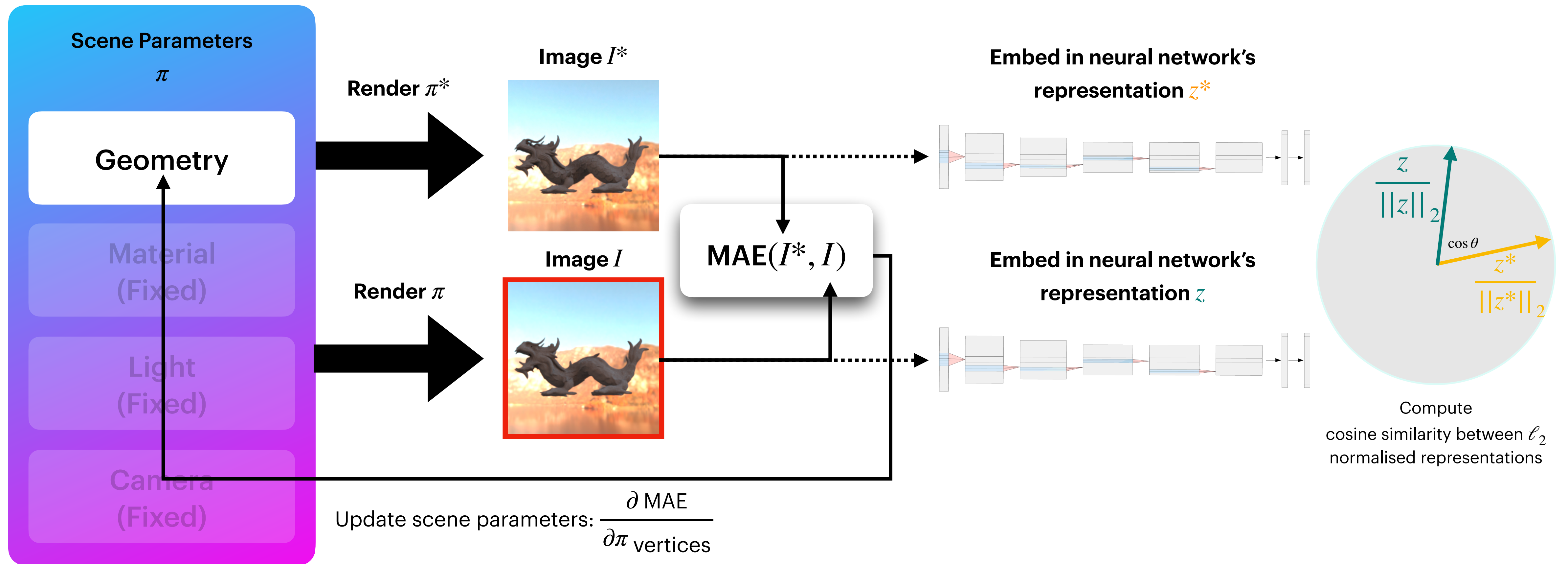
Baseline Similarity

Geometry Example

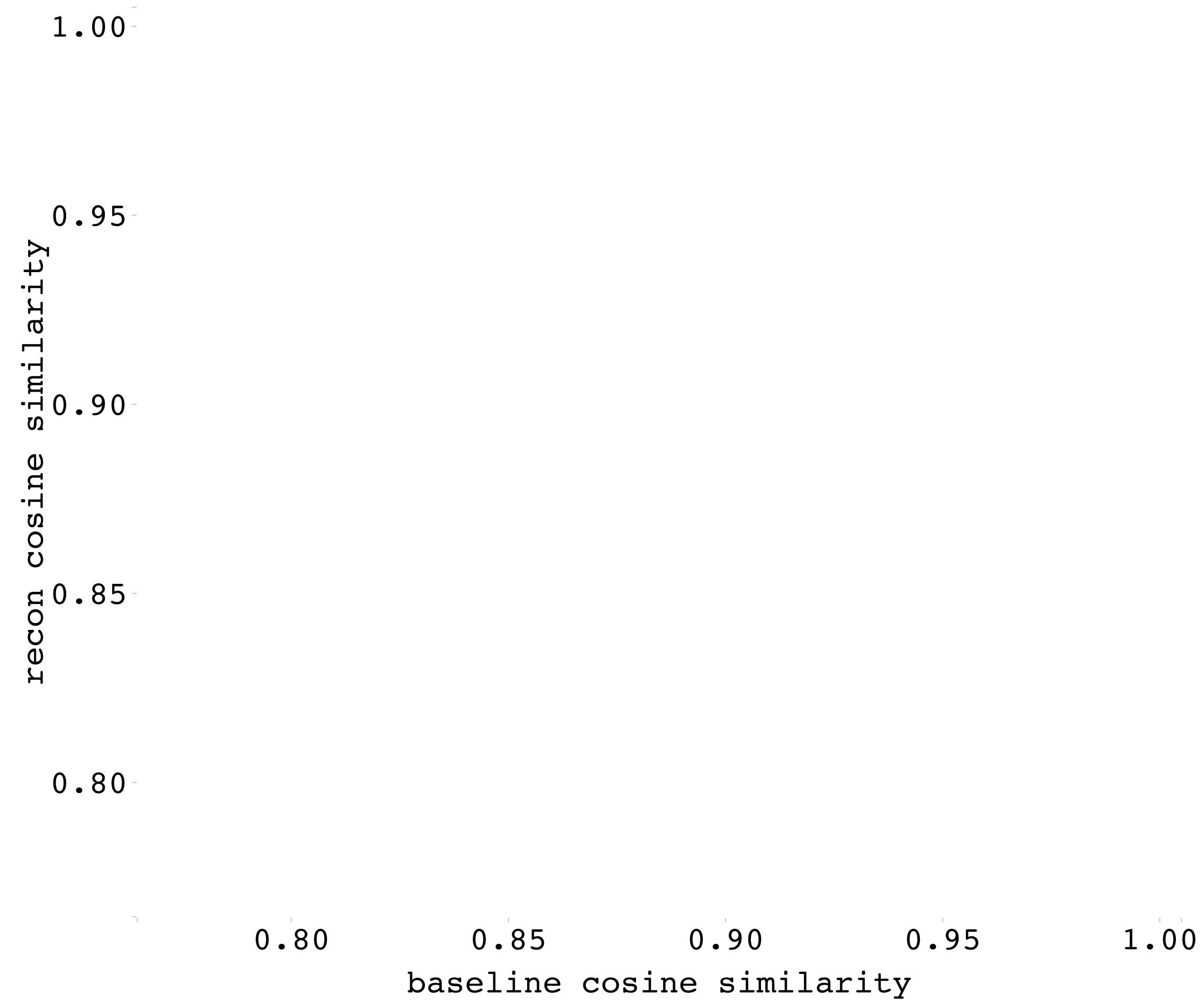


Baseline Similarity

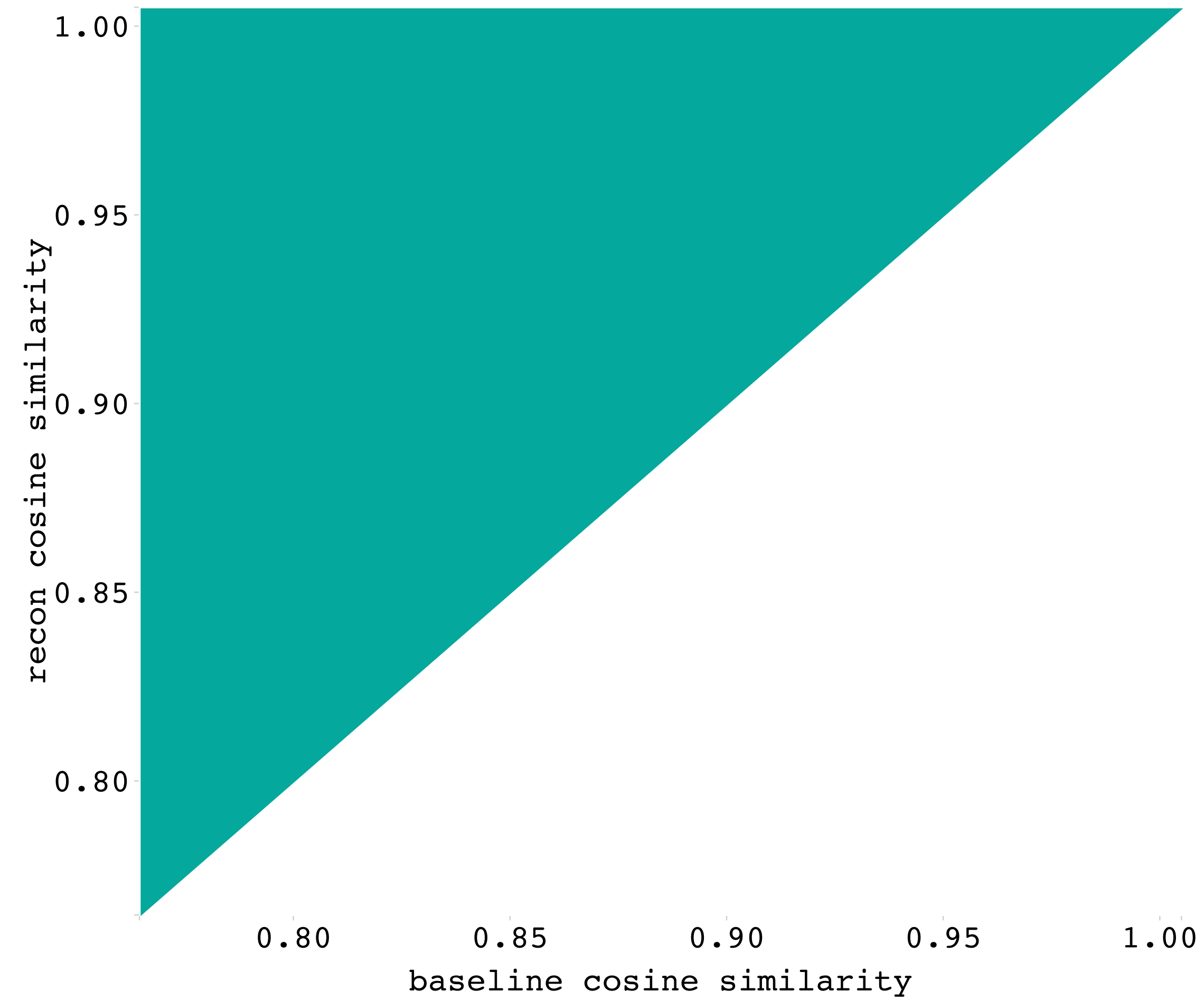
Geometry Example



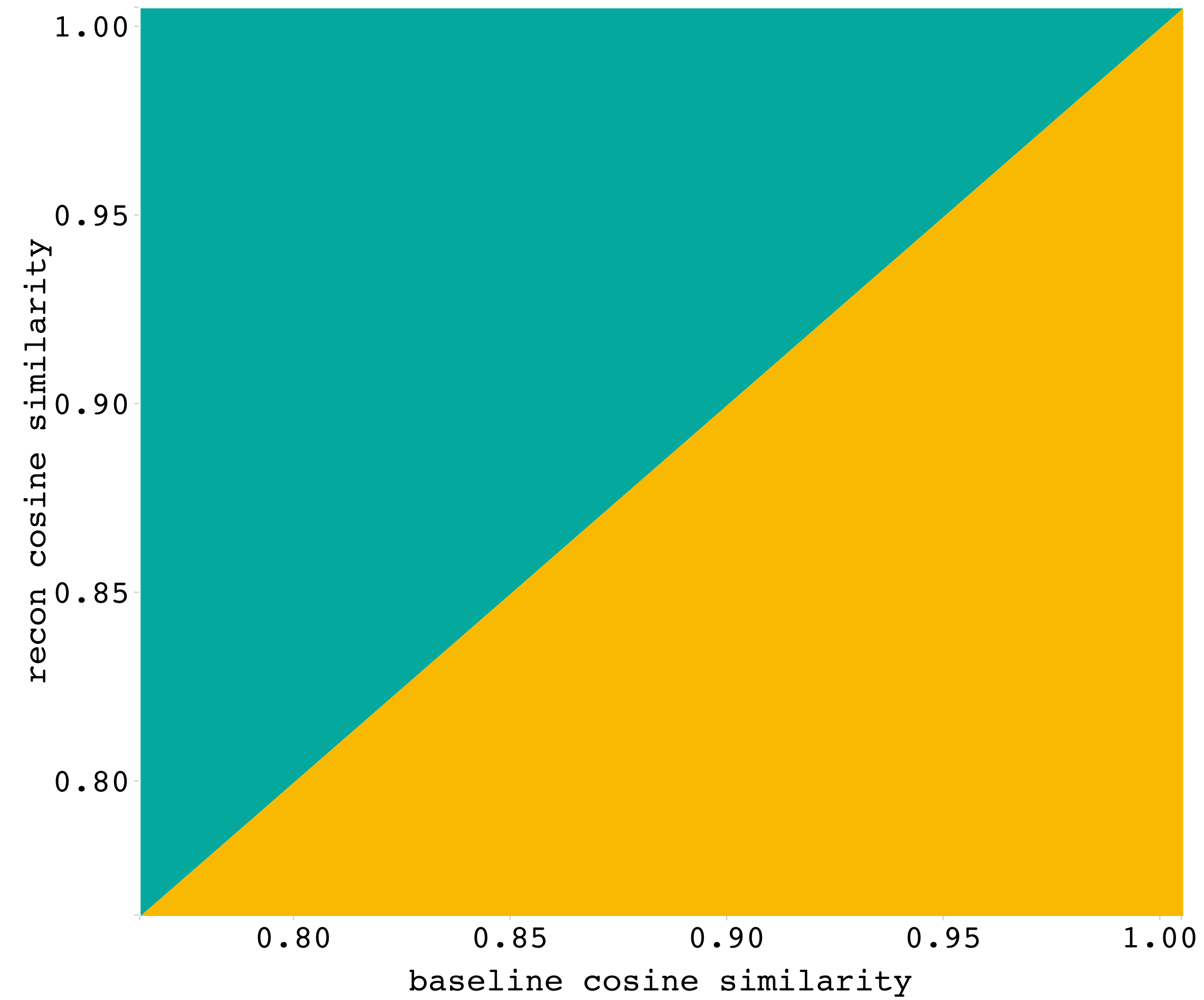
Results



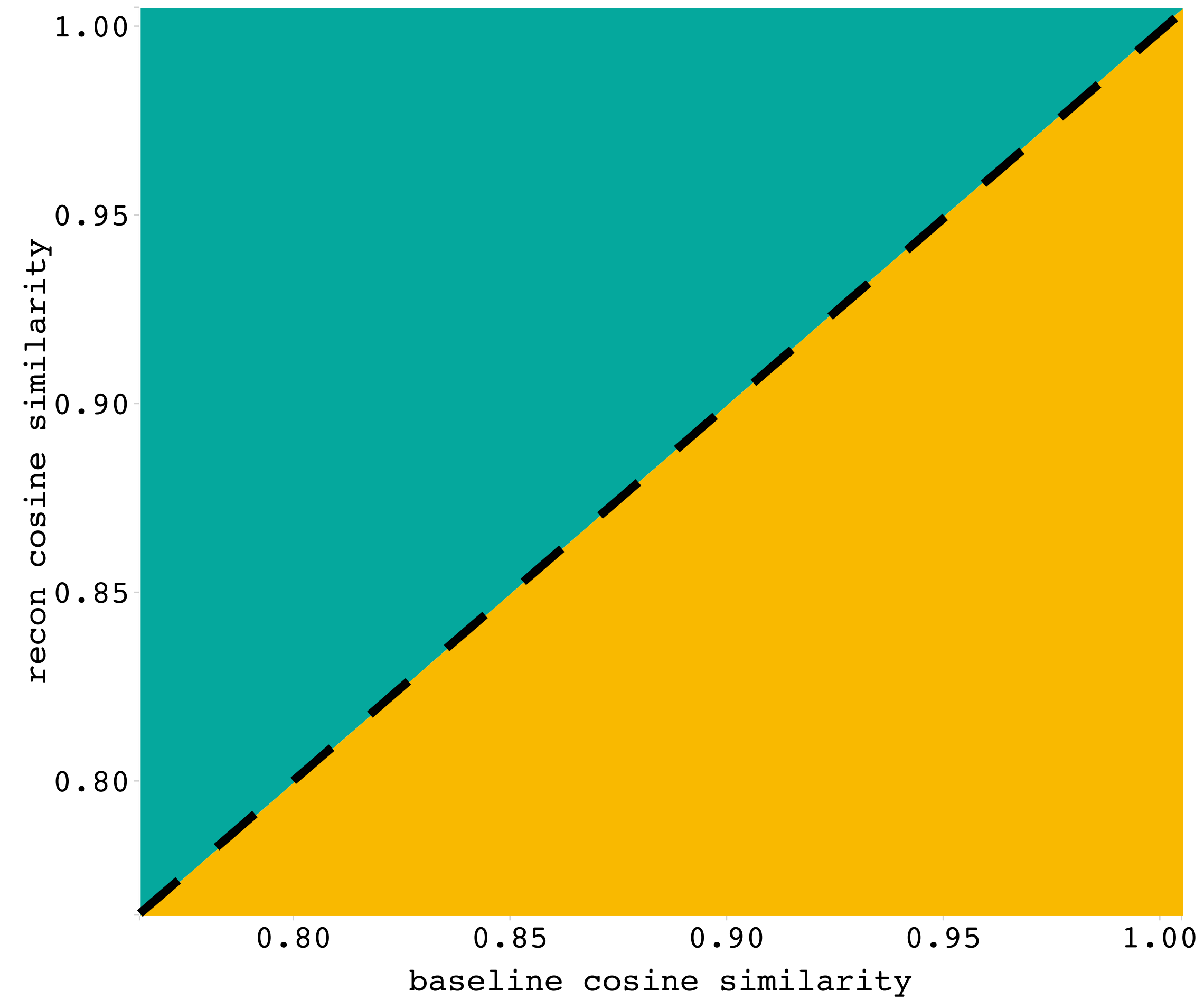
Results



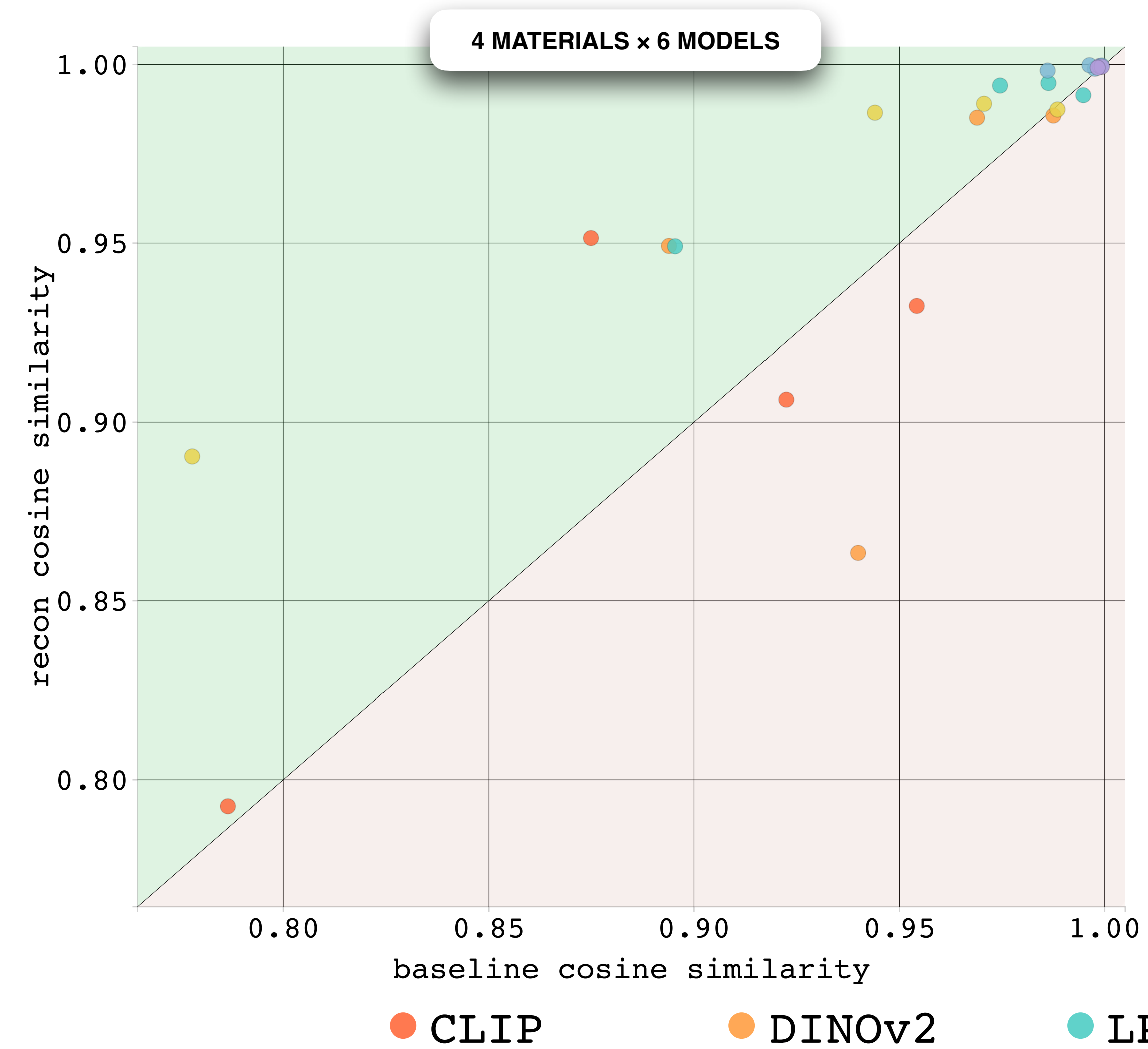
Results



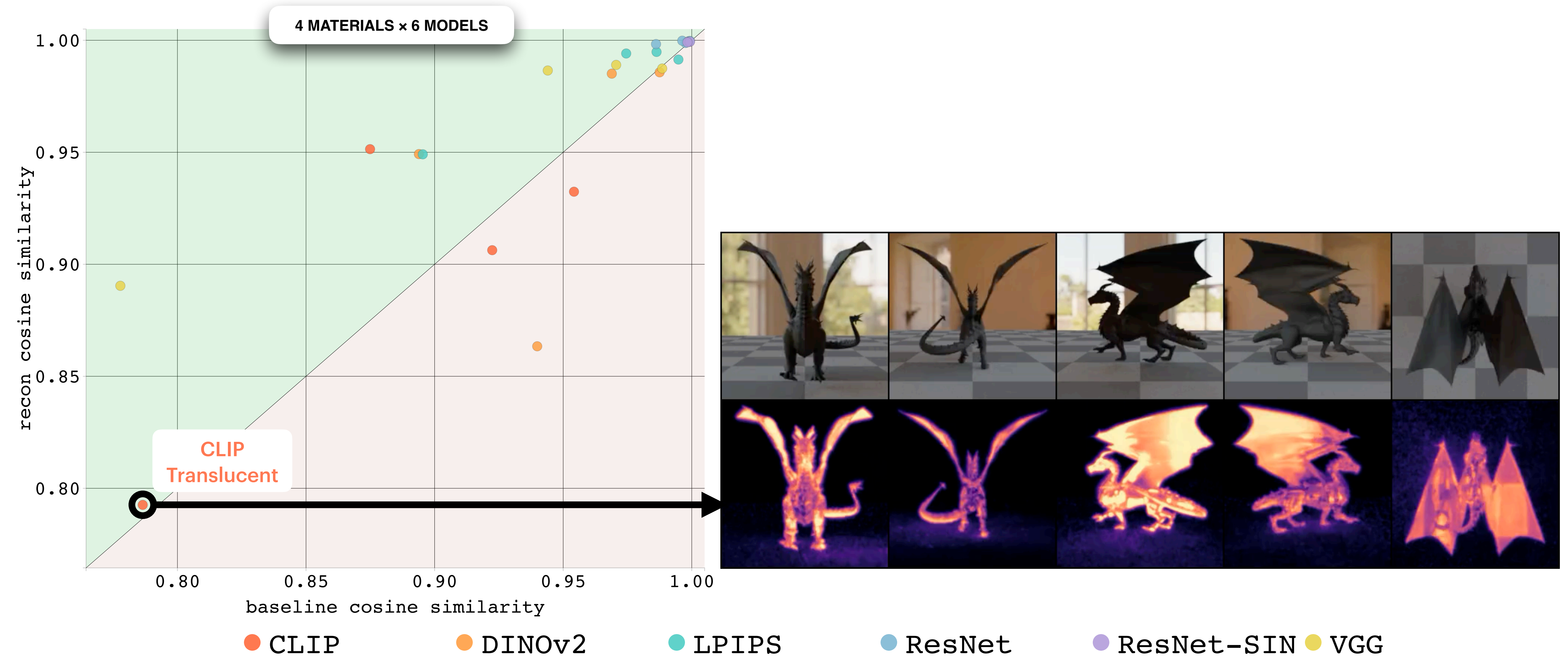
Results



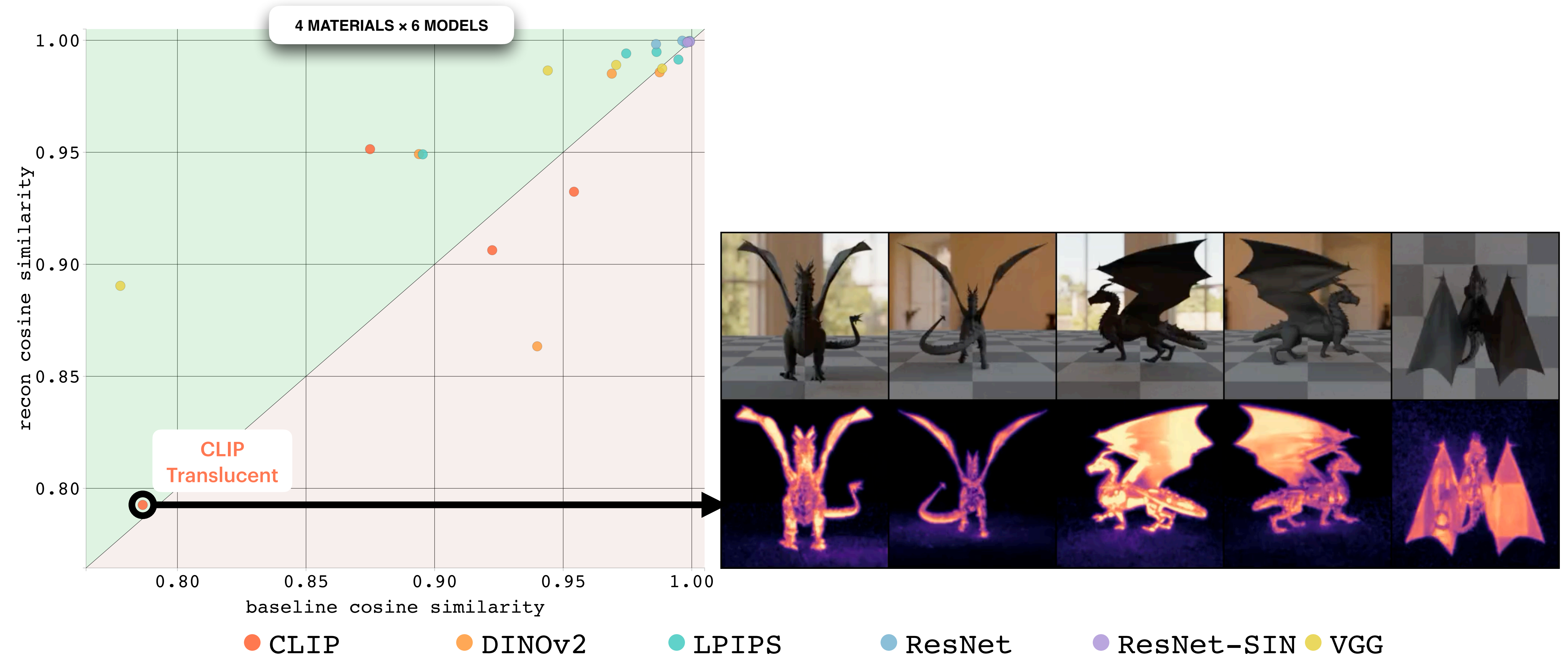
Results – Material



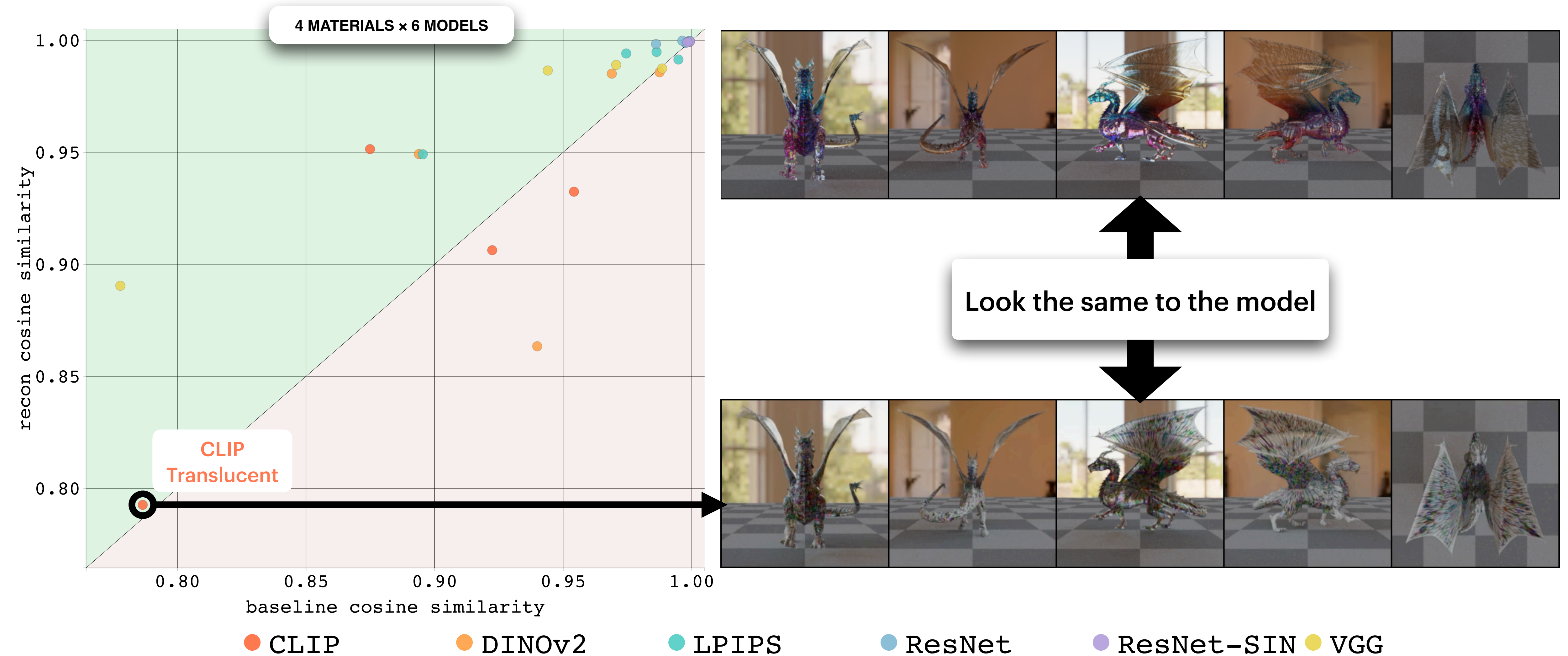
Results – Material



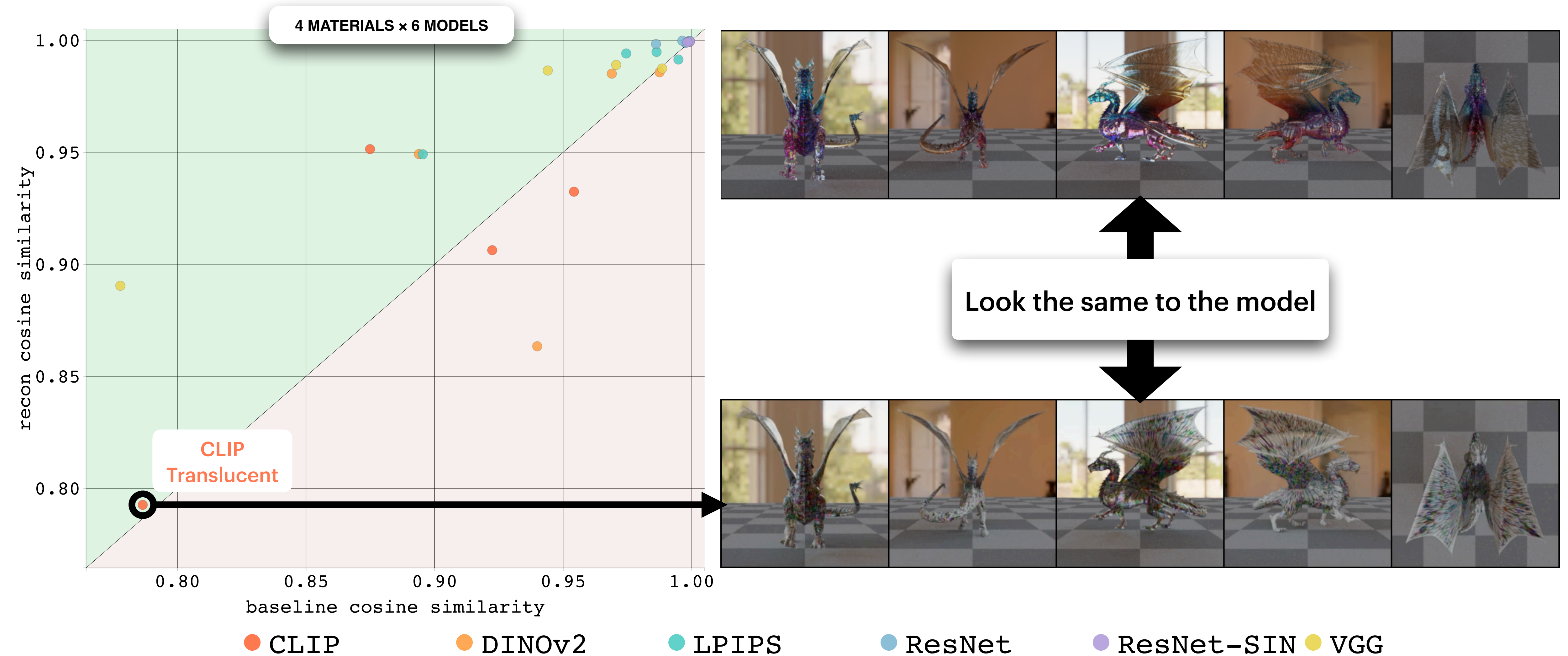
Results – Material



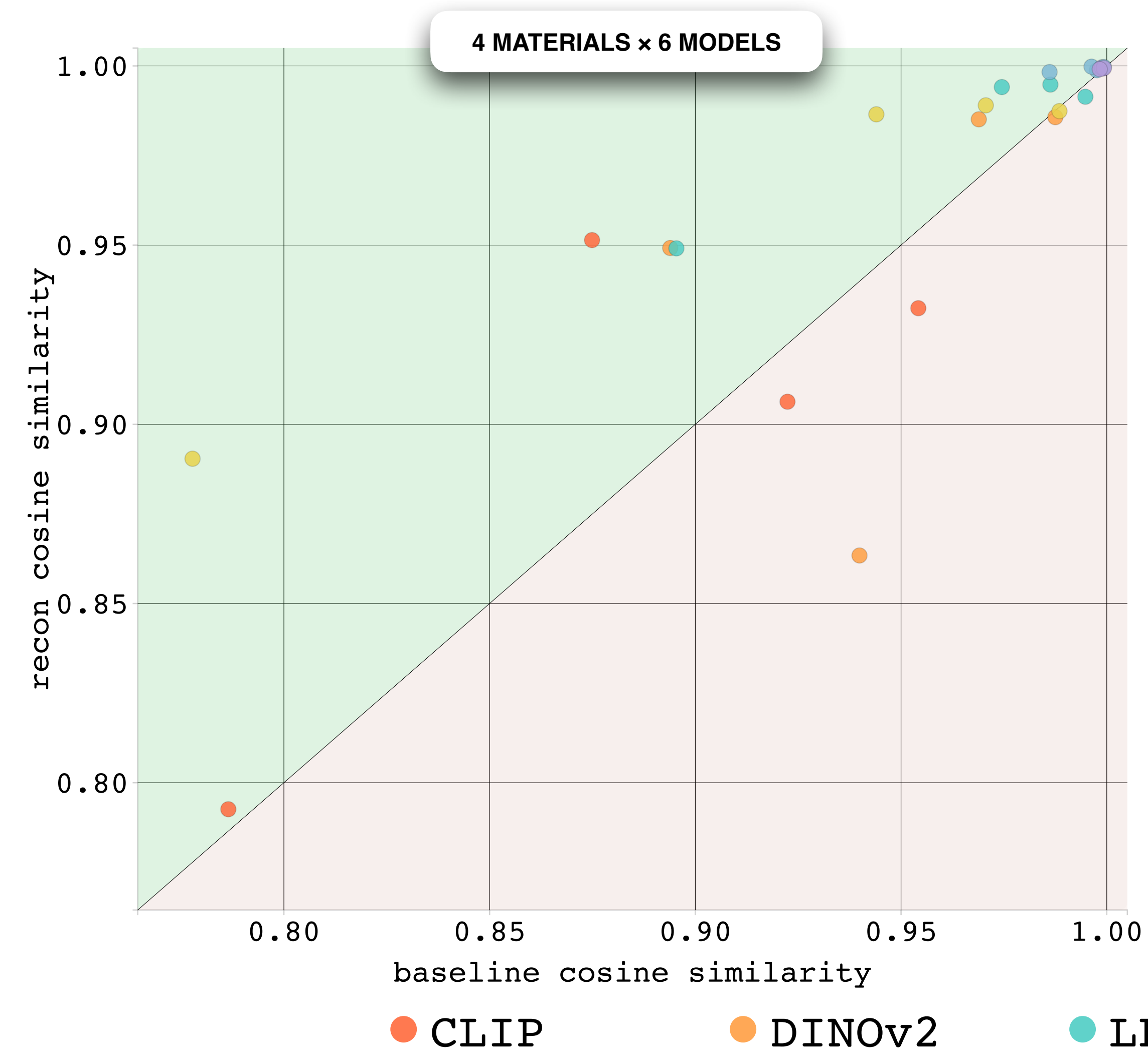
Results – Material



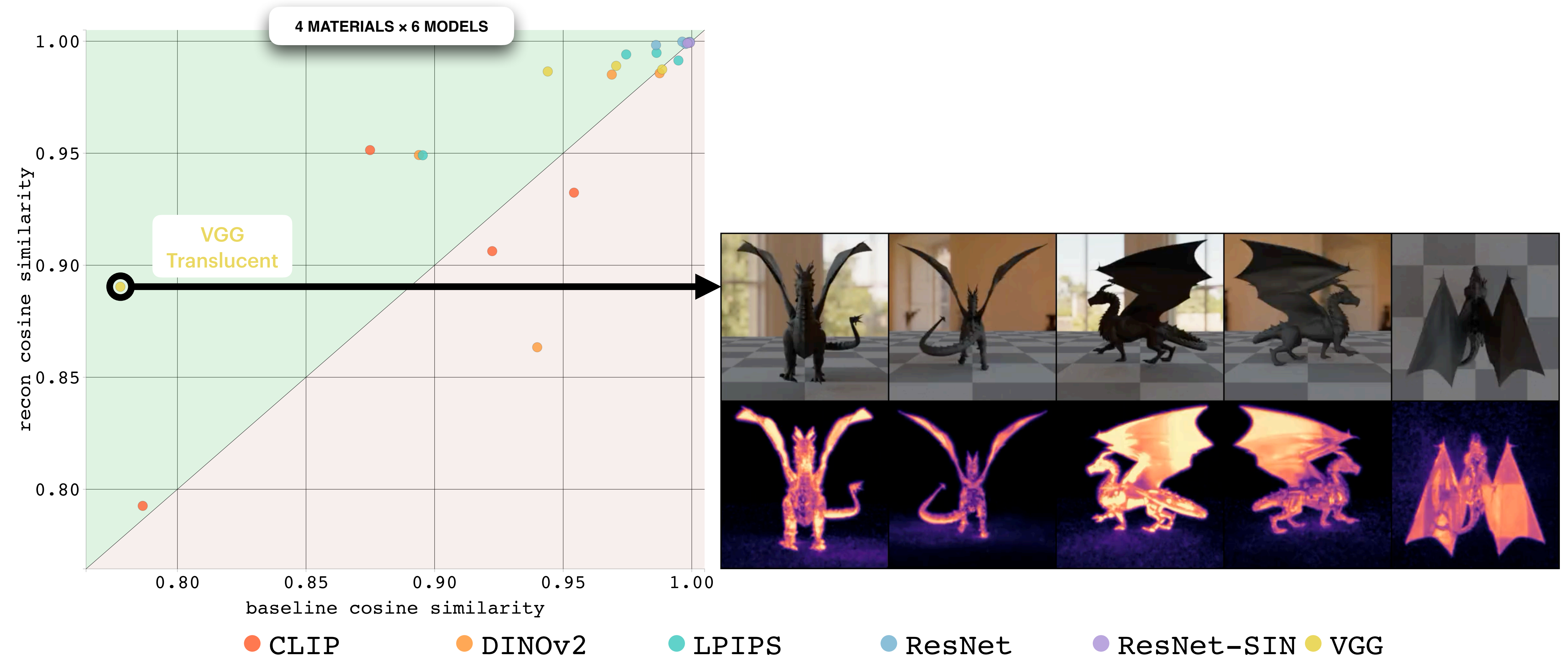
Results – Material



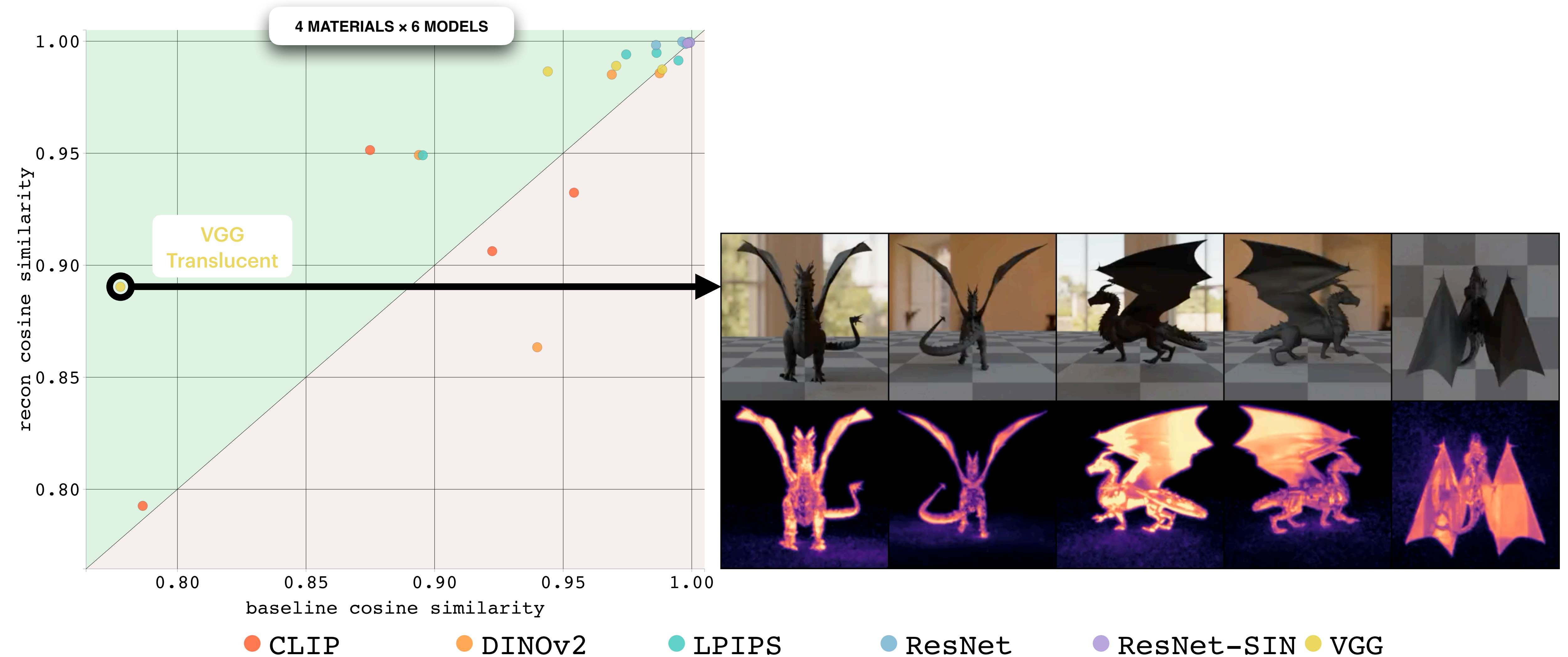
Results – Material



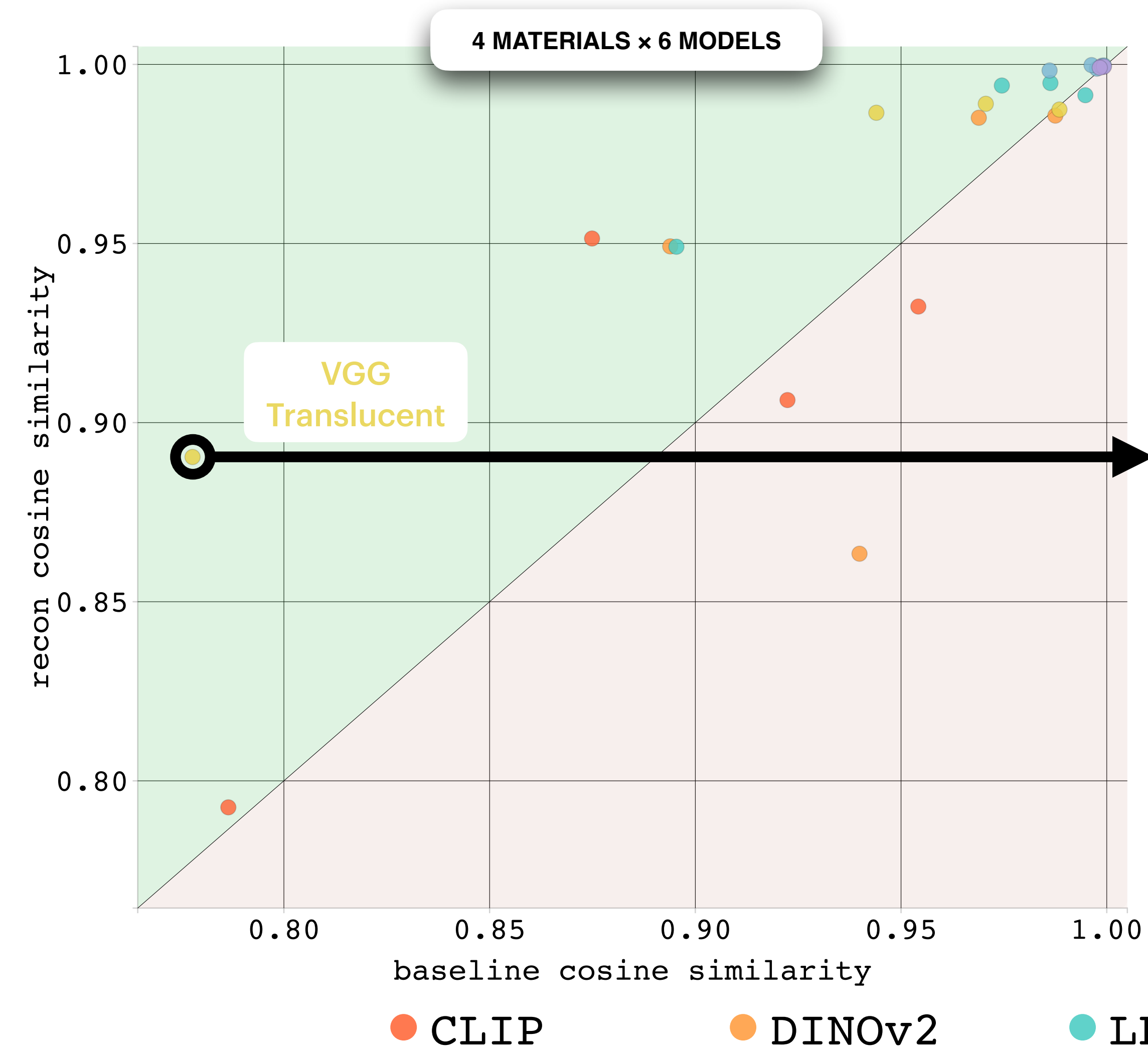
Results – Material



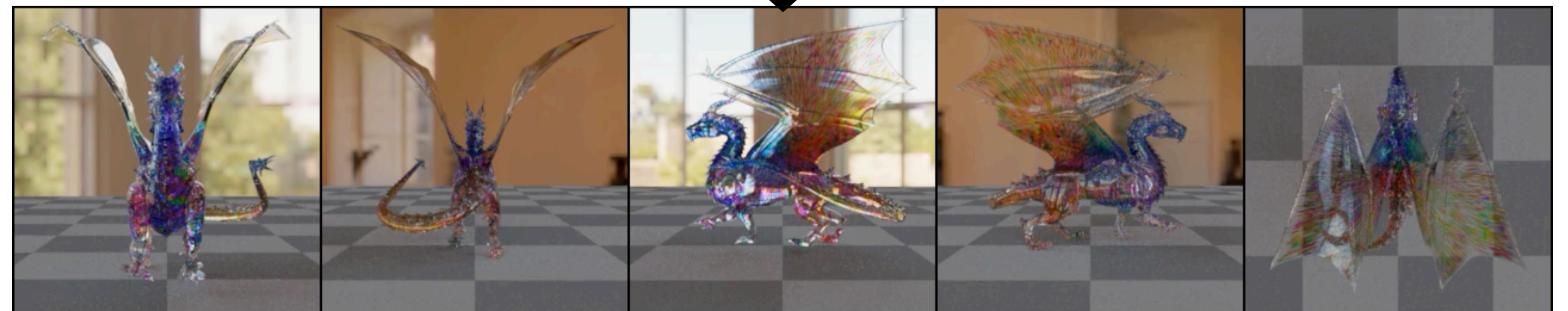
Results – Material



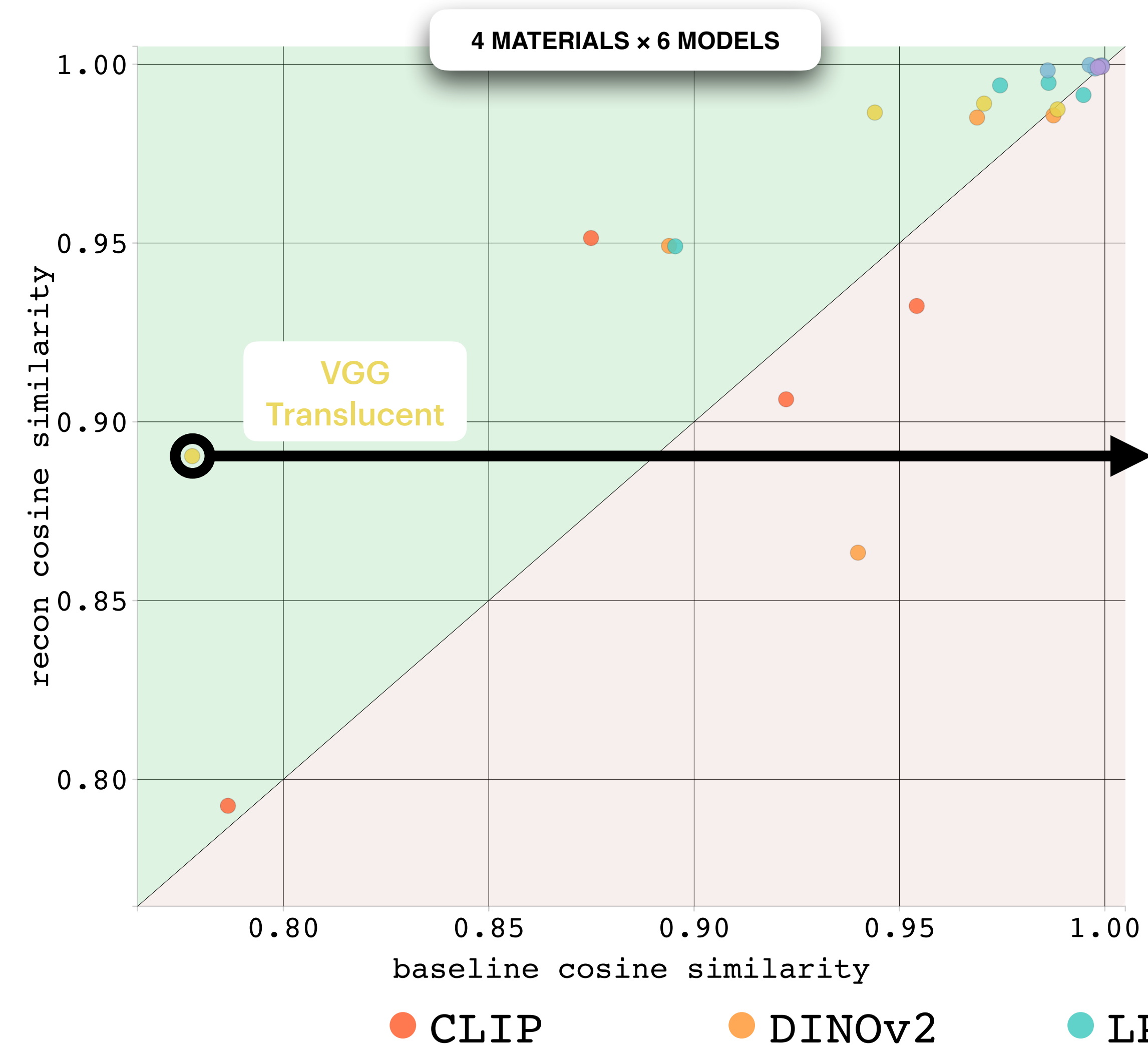
Results – Material



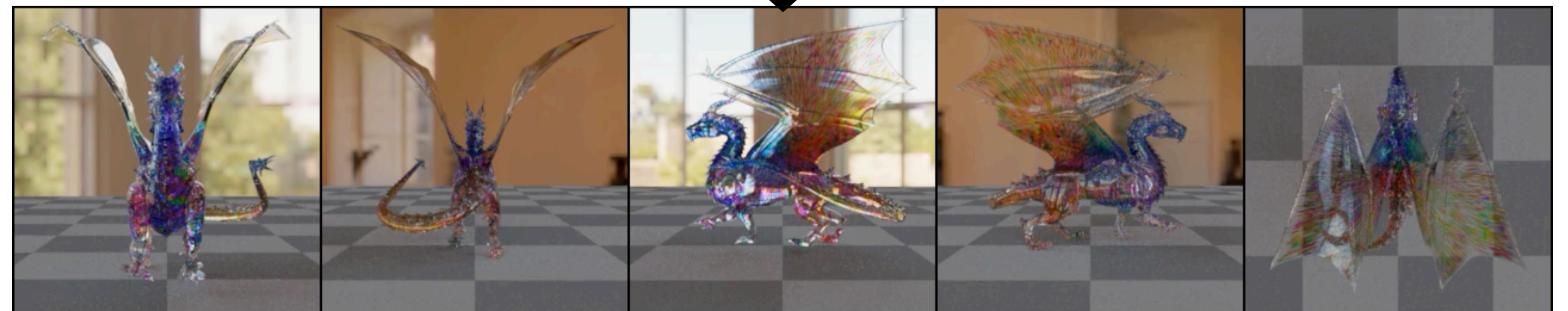
Look the same to the model



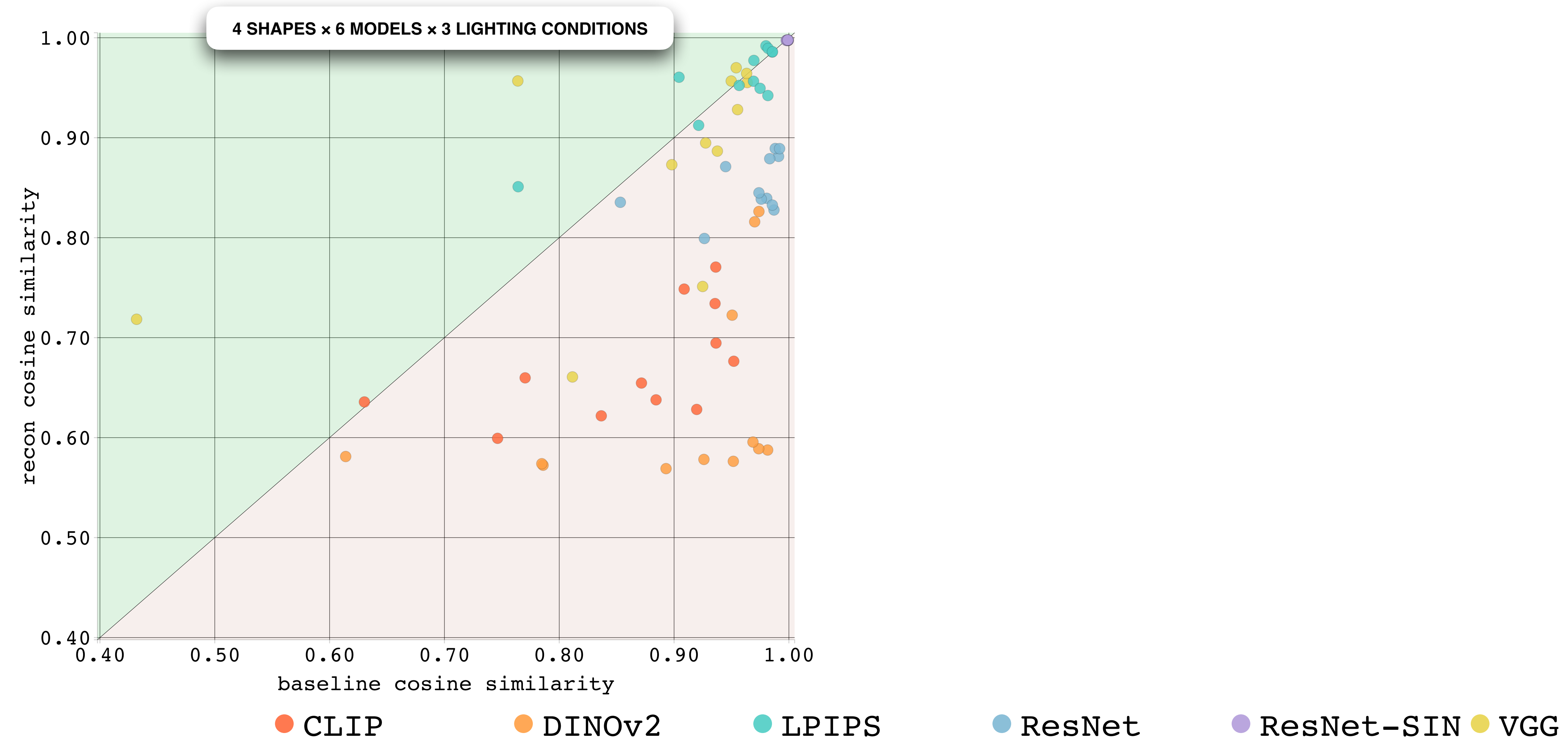
Results – Material



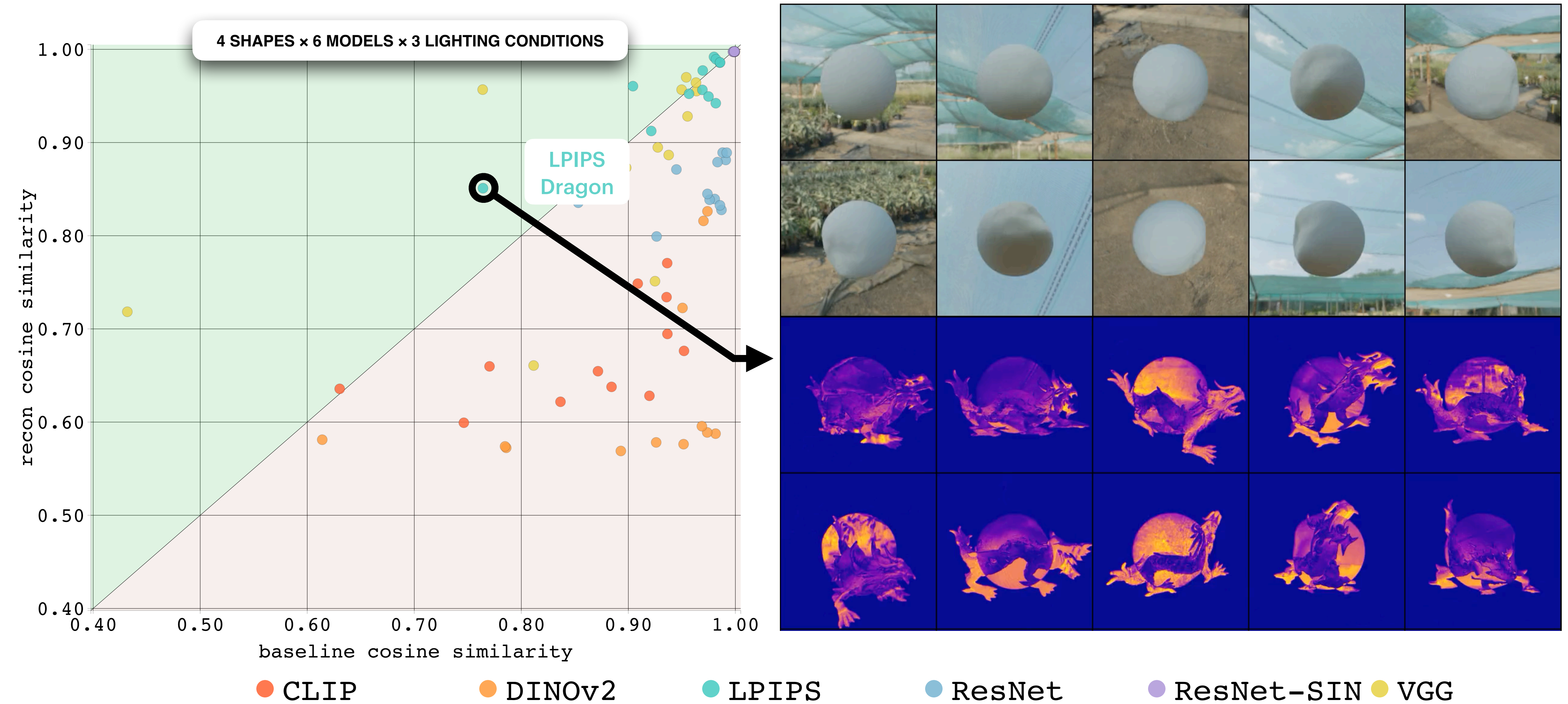
Look the same to the model



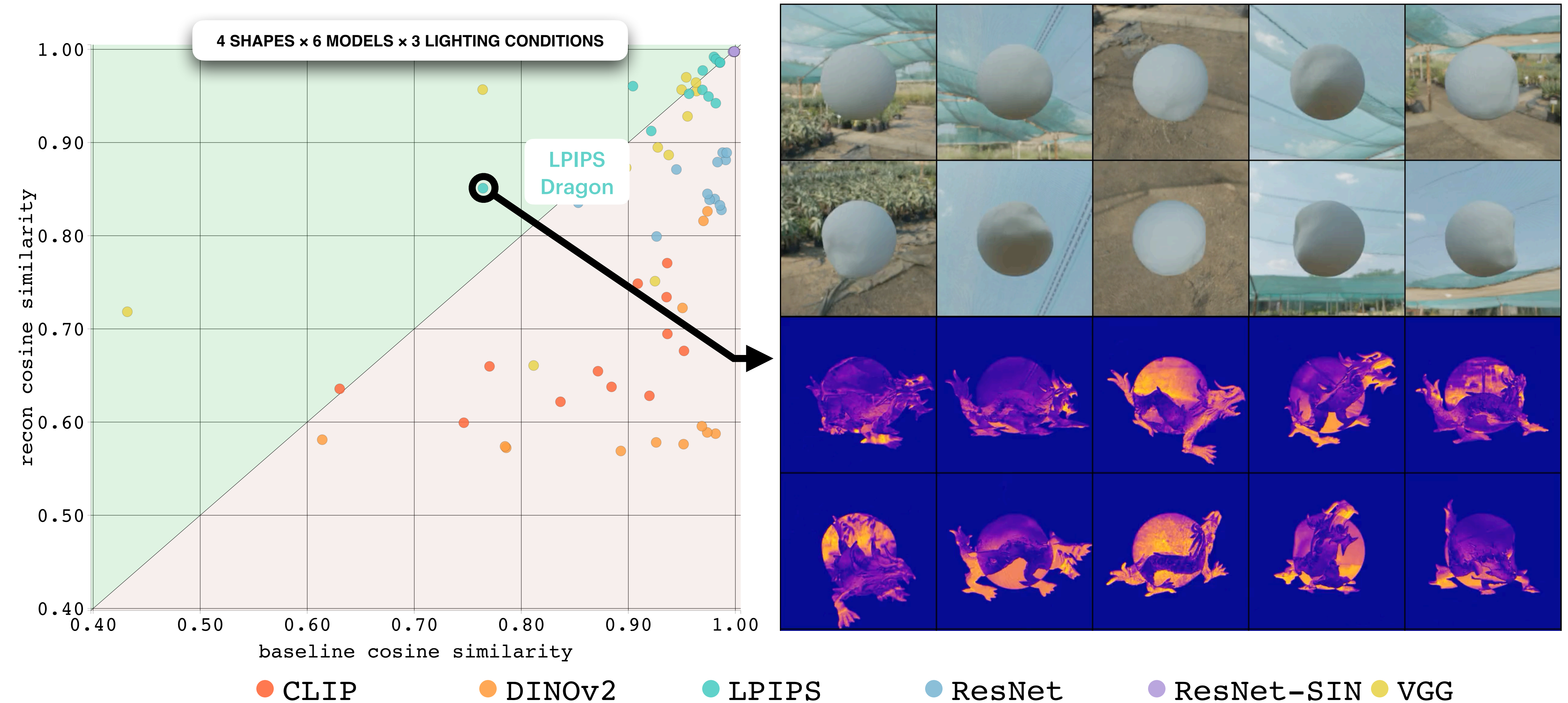
Results – Shape



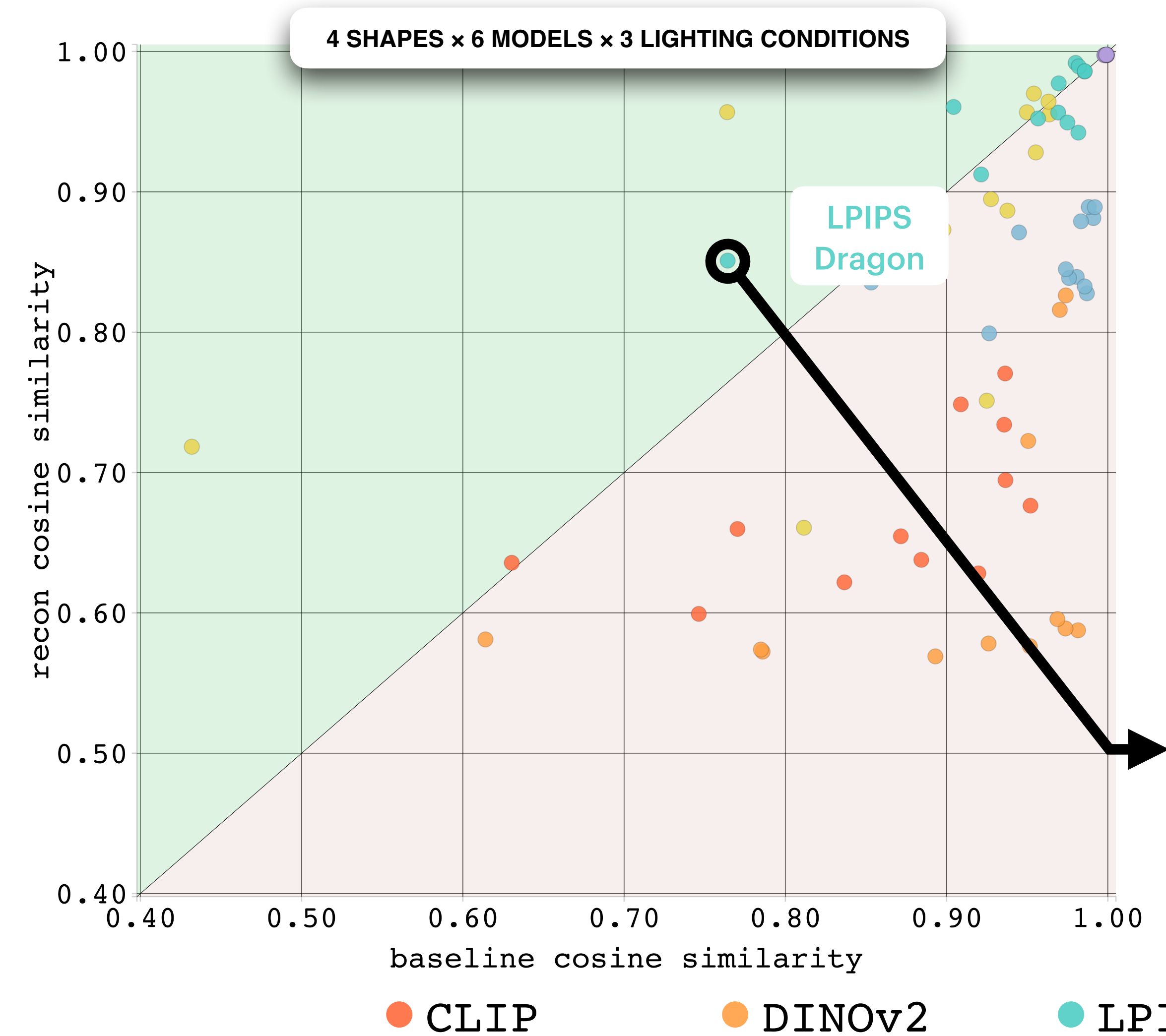
Results – Shape



Results – Shape



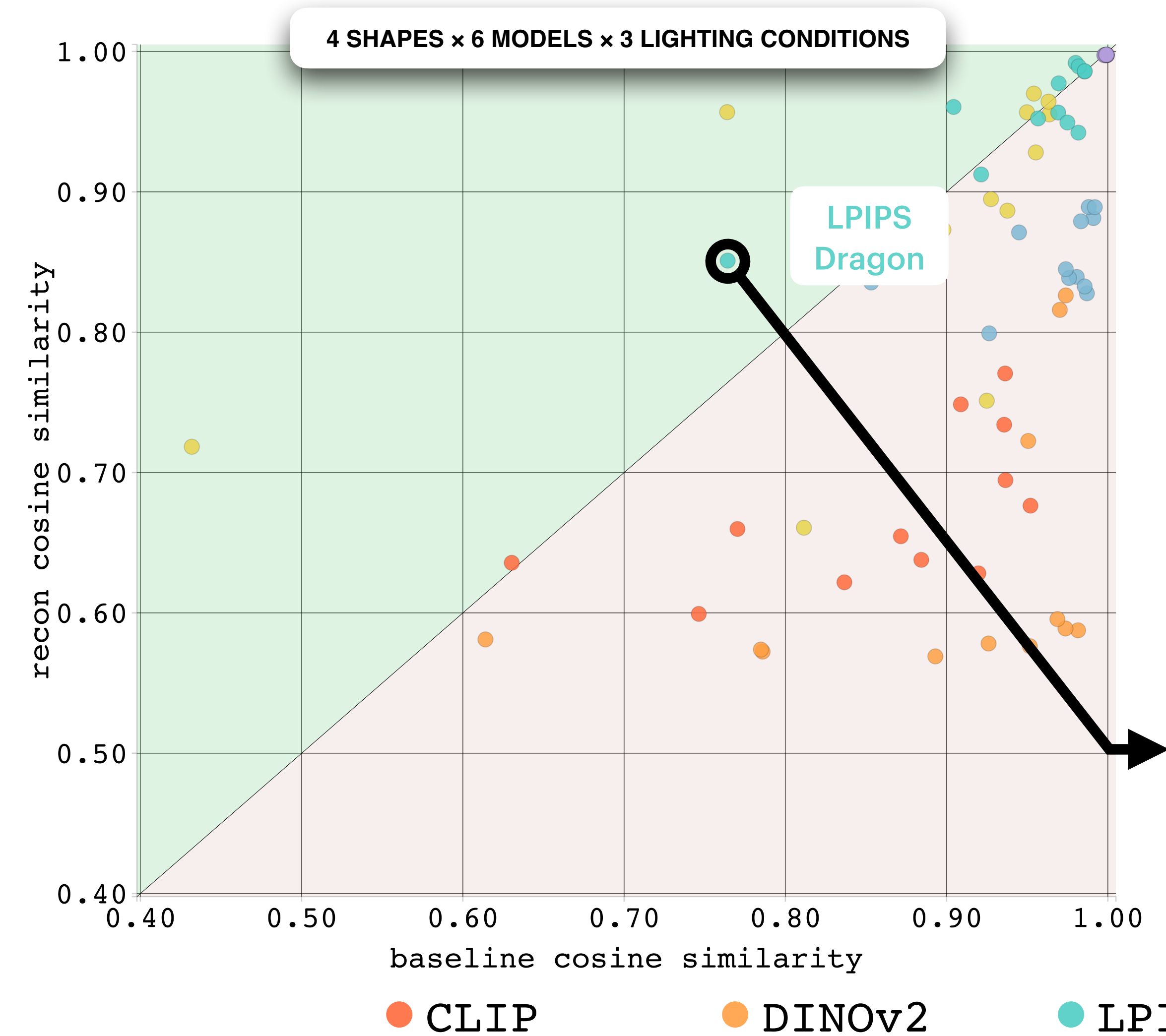
Results – Shape



Look the same to the model



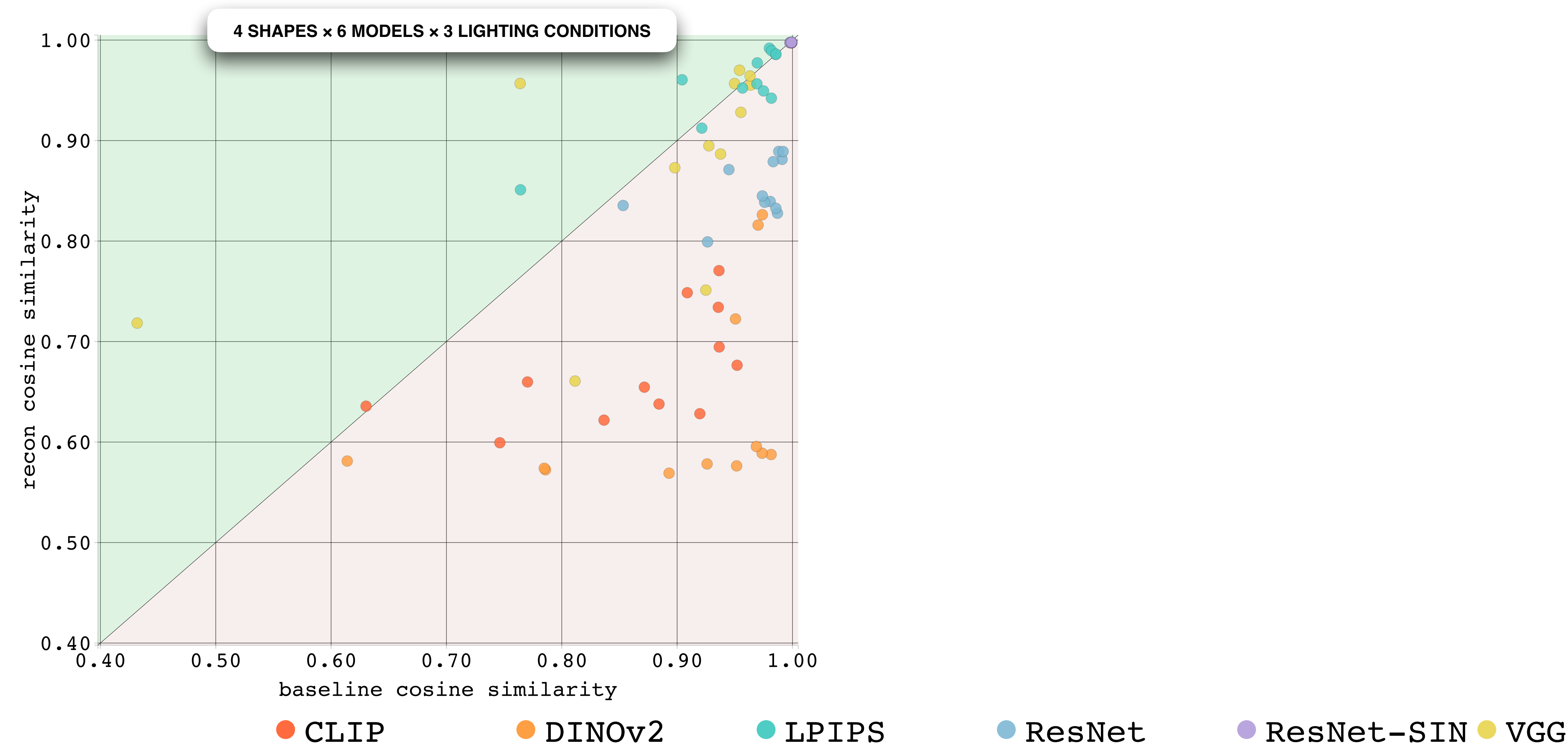
Results – Shape



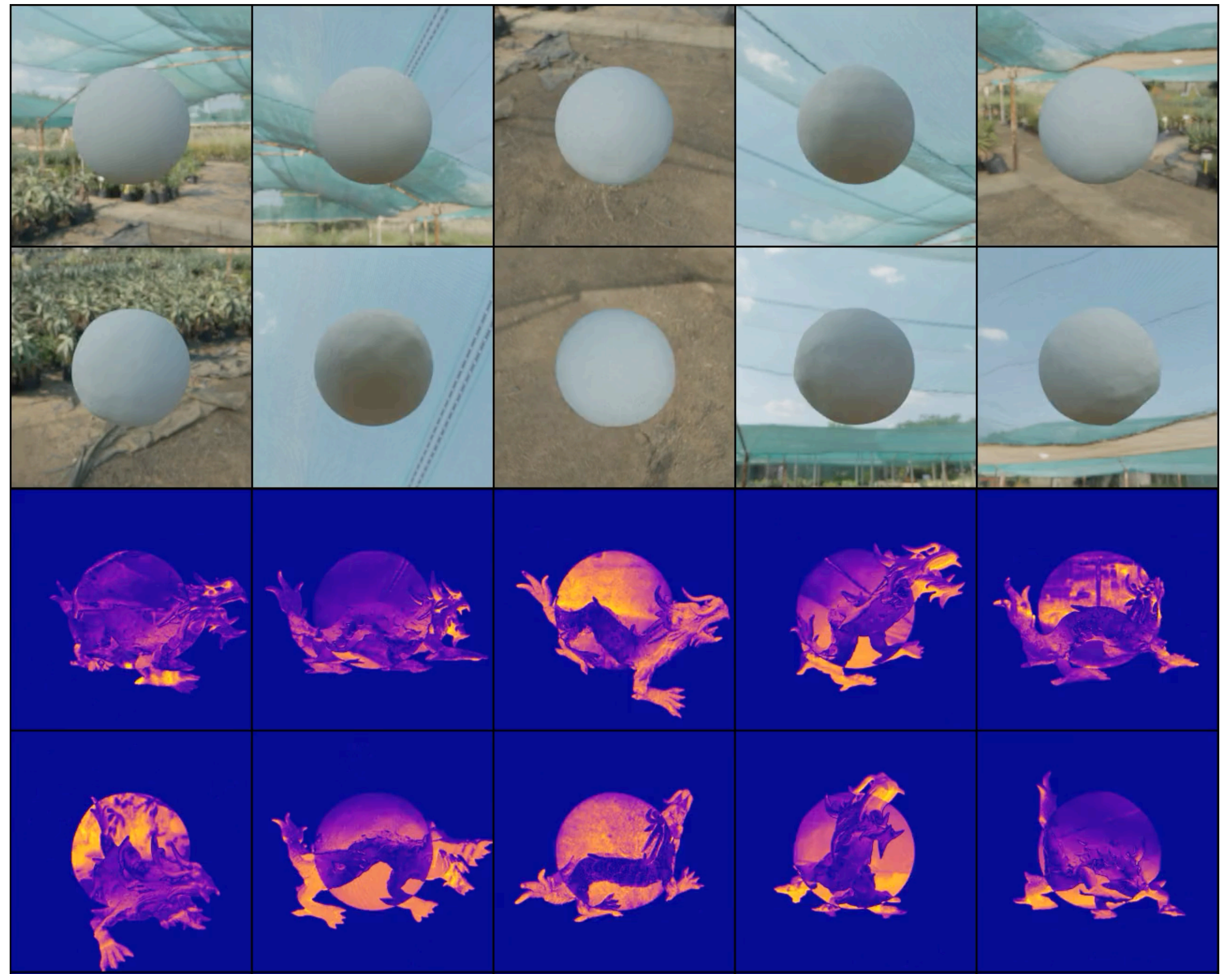
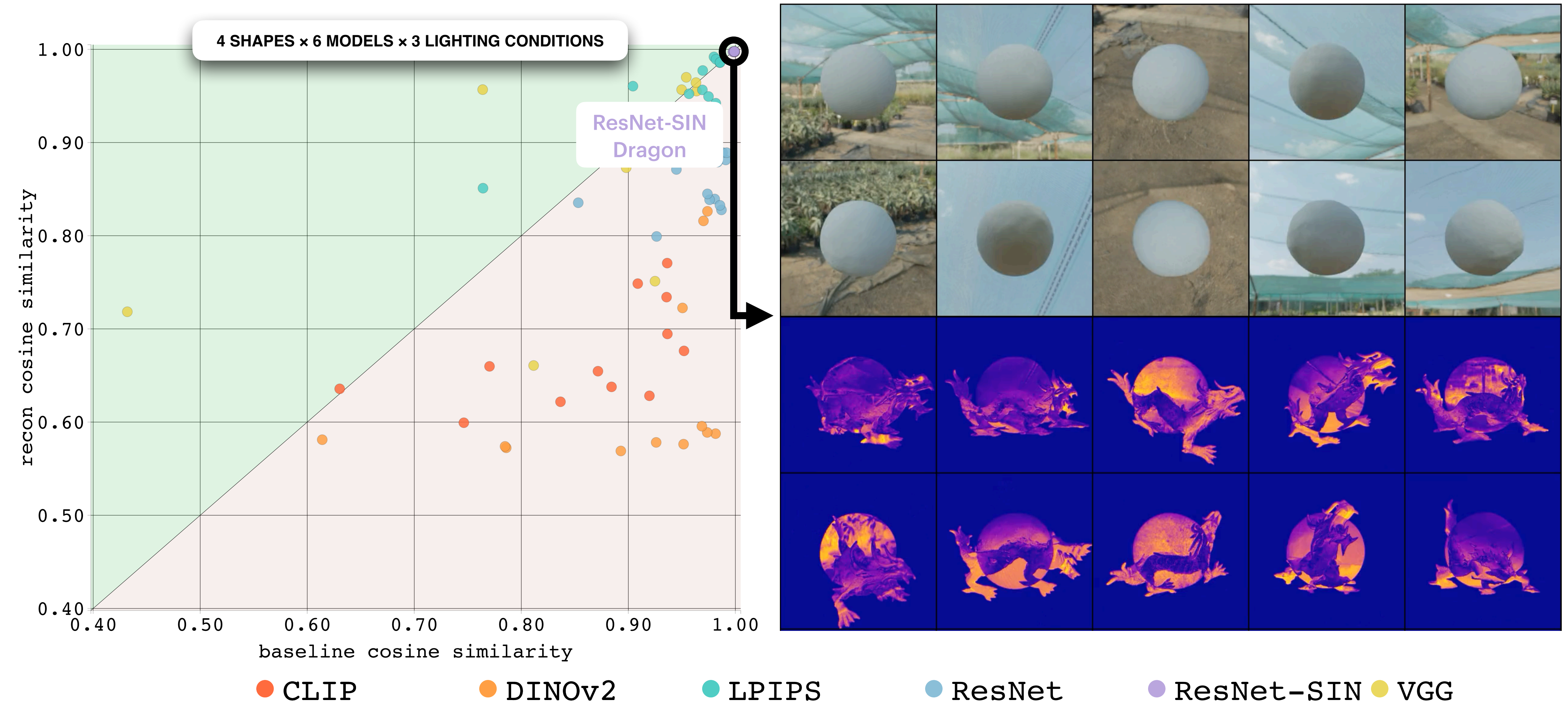
Look the same to the model



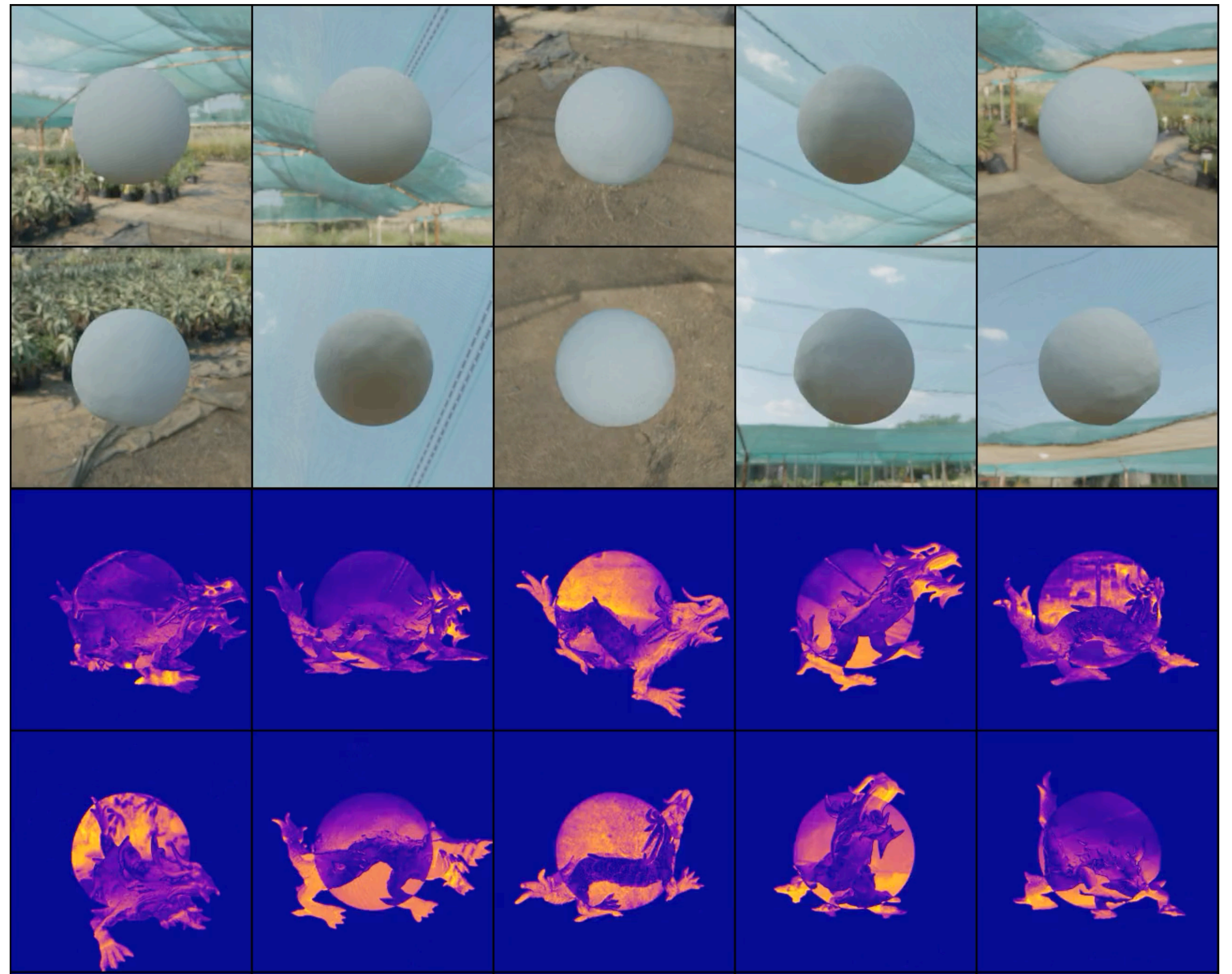
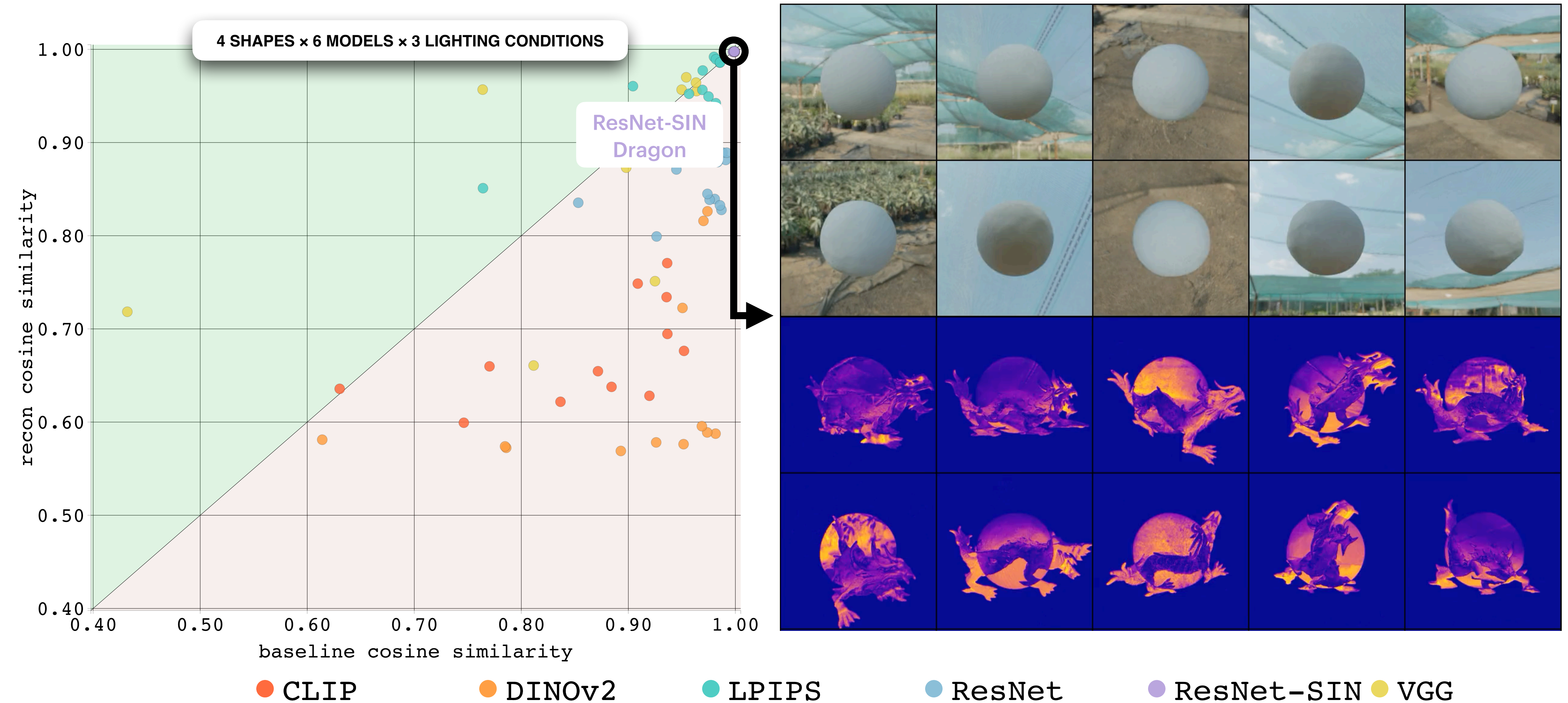
Results – Shape



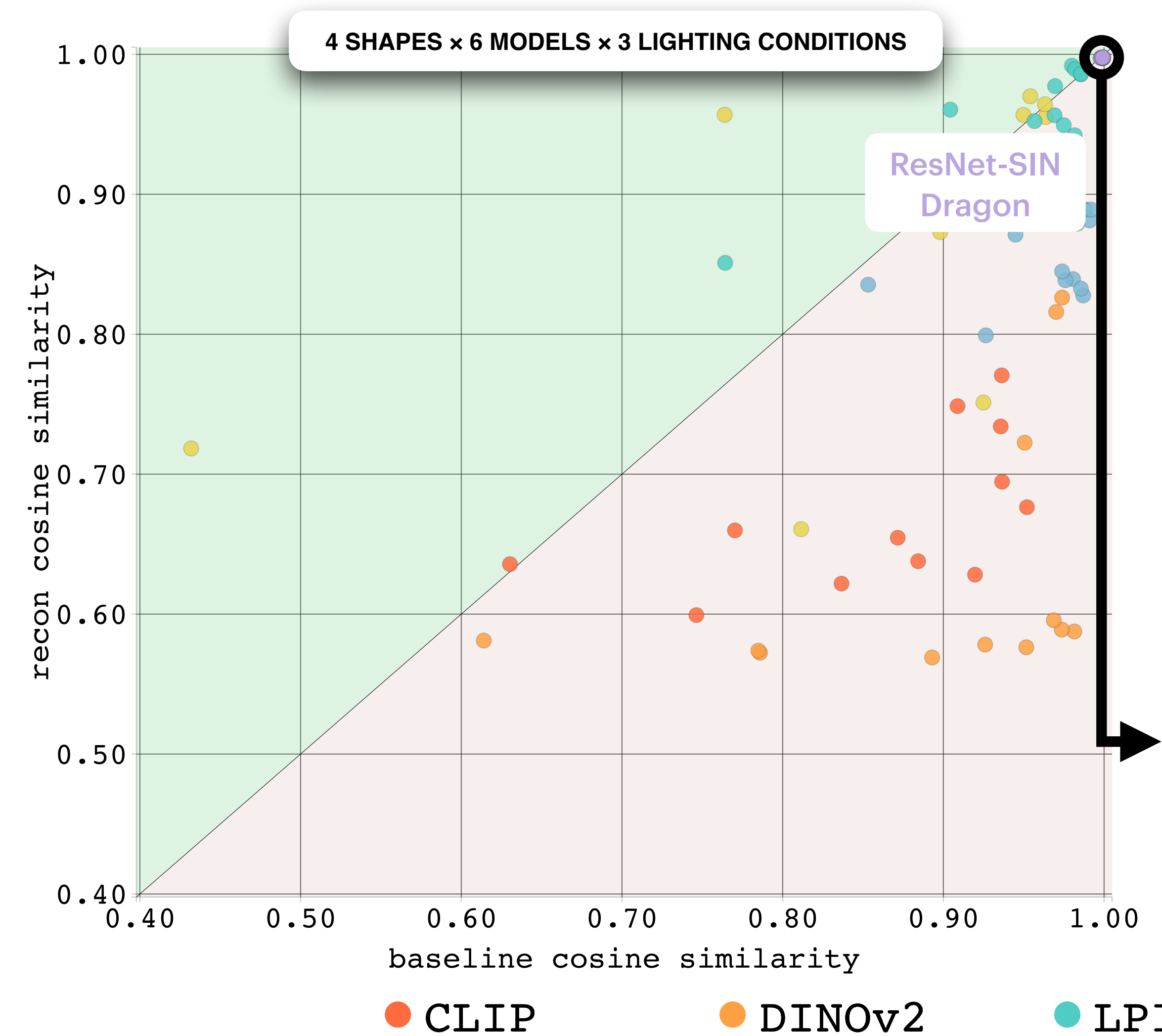
Results – Shape



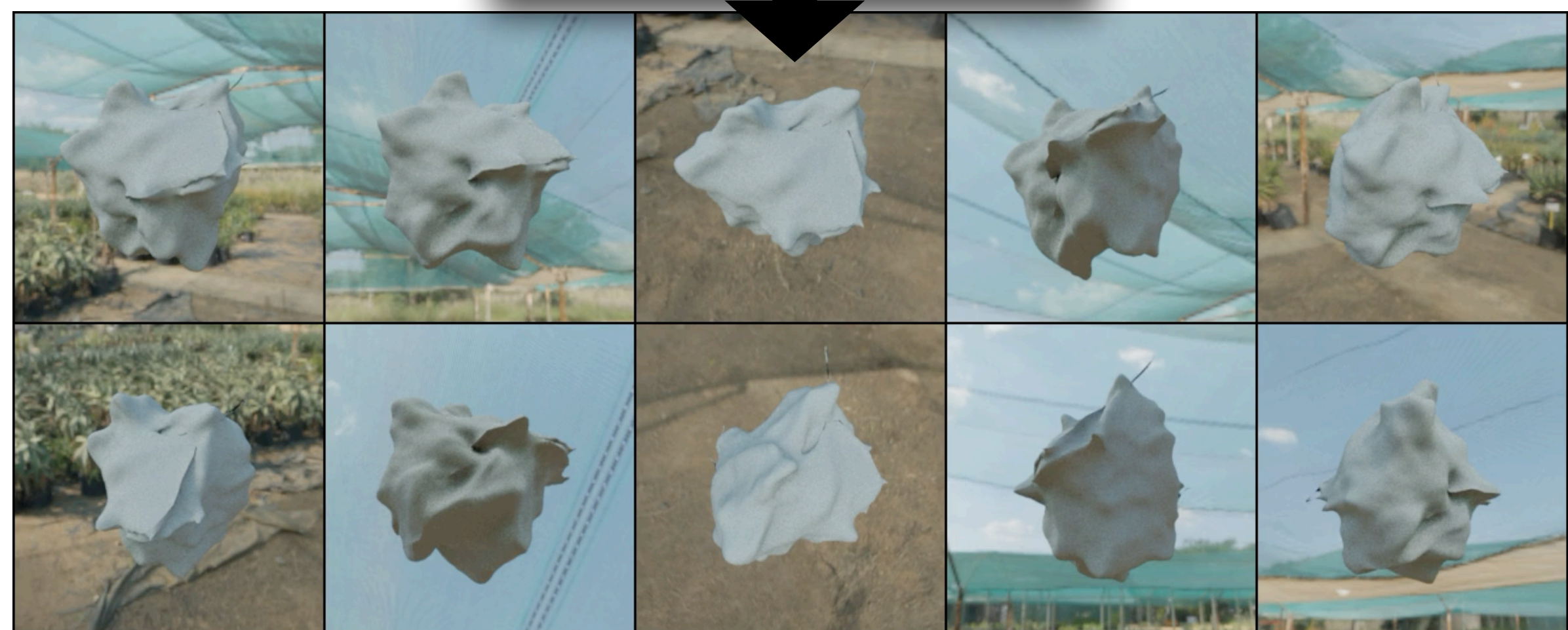
Results – Shape



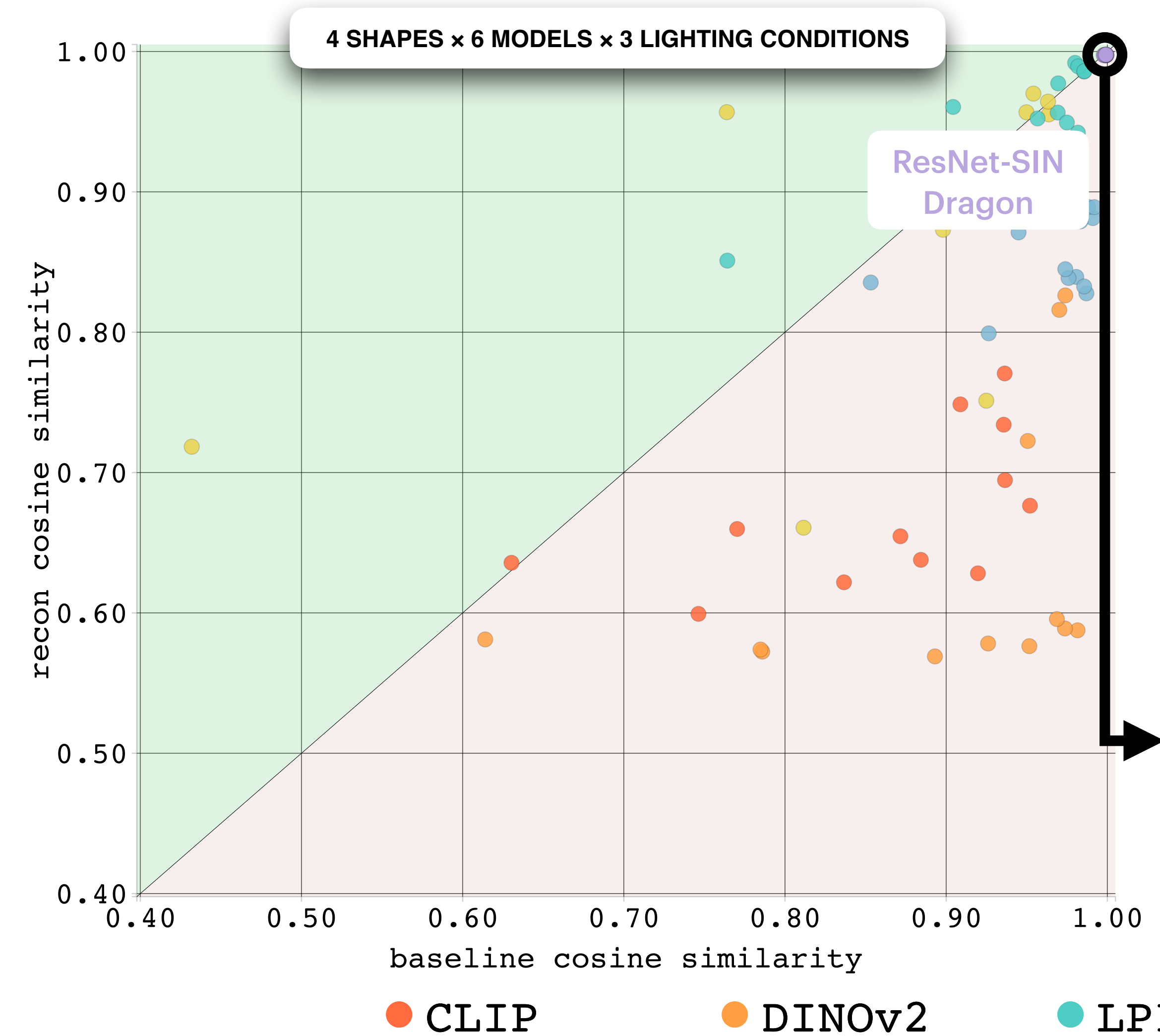
Results – Shape



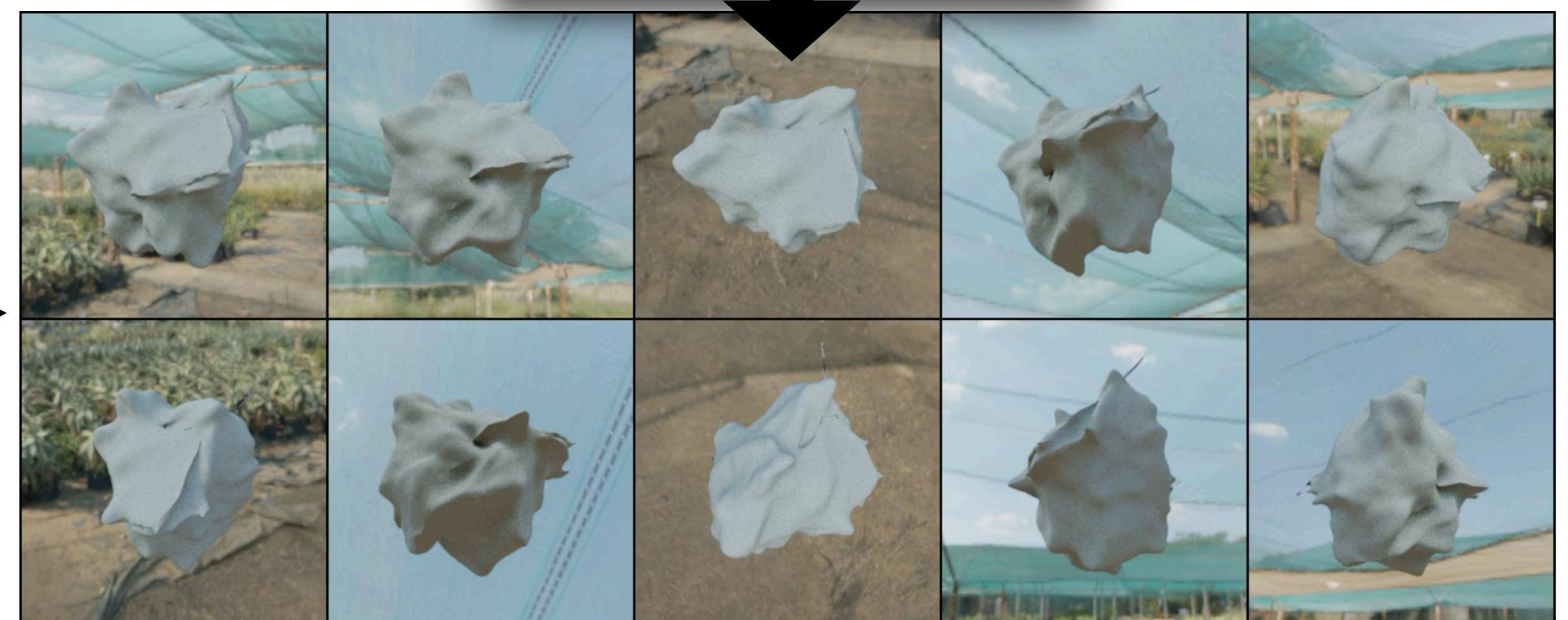
Look the same to the model



Results – Shape



Look the same to the model



Key Takeaways

github.com/ag-perception-wallis-lab/MRD

Key Takeaways

1. MRD enables physically grounded metavers.

github.com/ag-perception-wallis-lab/MRD

Key Takeaways

1. MRD enables physically grounded metamers.

2. Metamers are representation-dependent.

github.com/ag-perception-wallis-lab/MRD

Key Takeaways

1. MRD enables physically grounded metamers.

2. Metamers are representation-dependent.

3. Outlook: MRD can ground vision models in physical space.

github.com/ag-perception-wallis-lab/MRD