Representing Scenes with a Constrained Number of Primitives
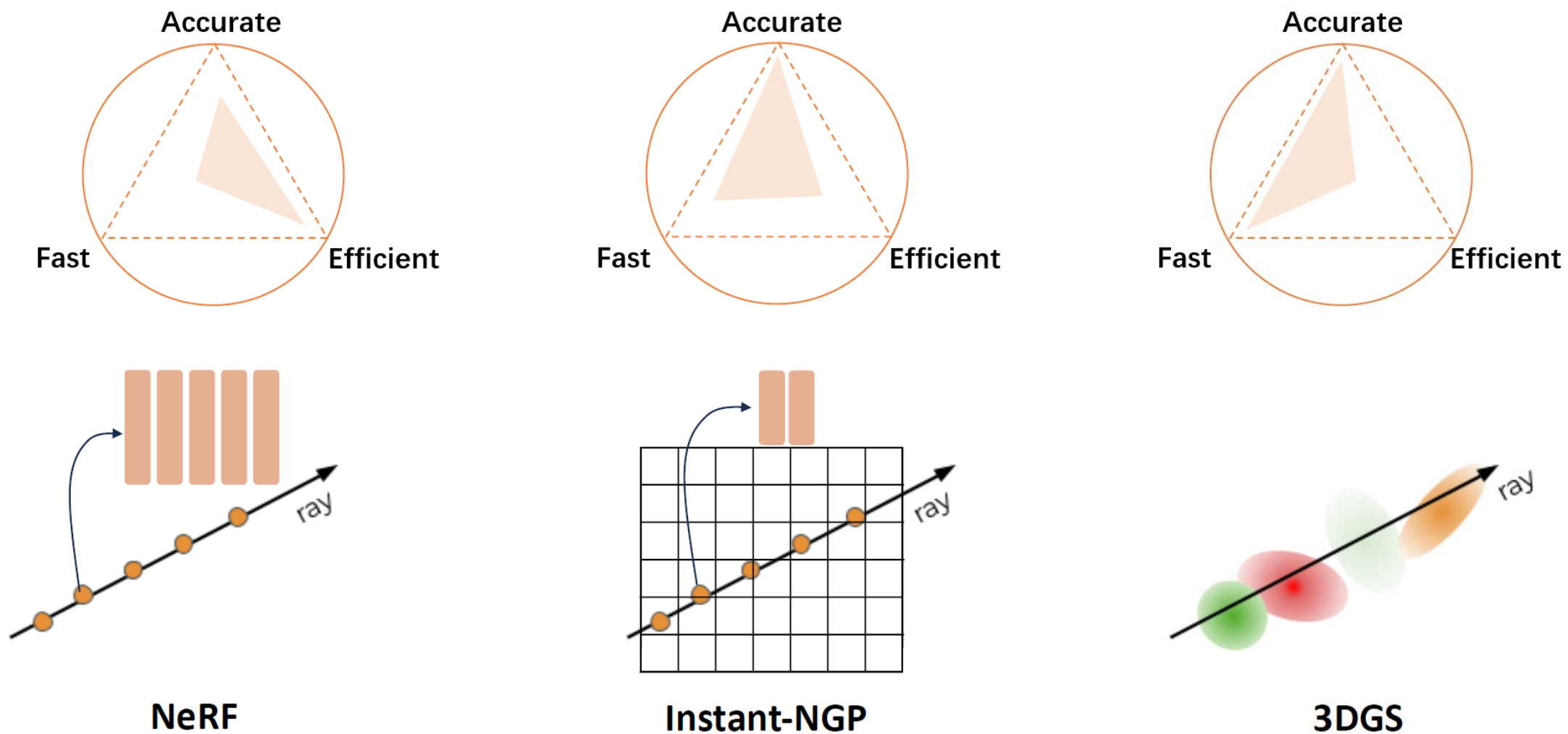
Xiaoqian Liang

Xi'an Jiaotong University

2024/12/16

Motivation
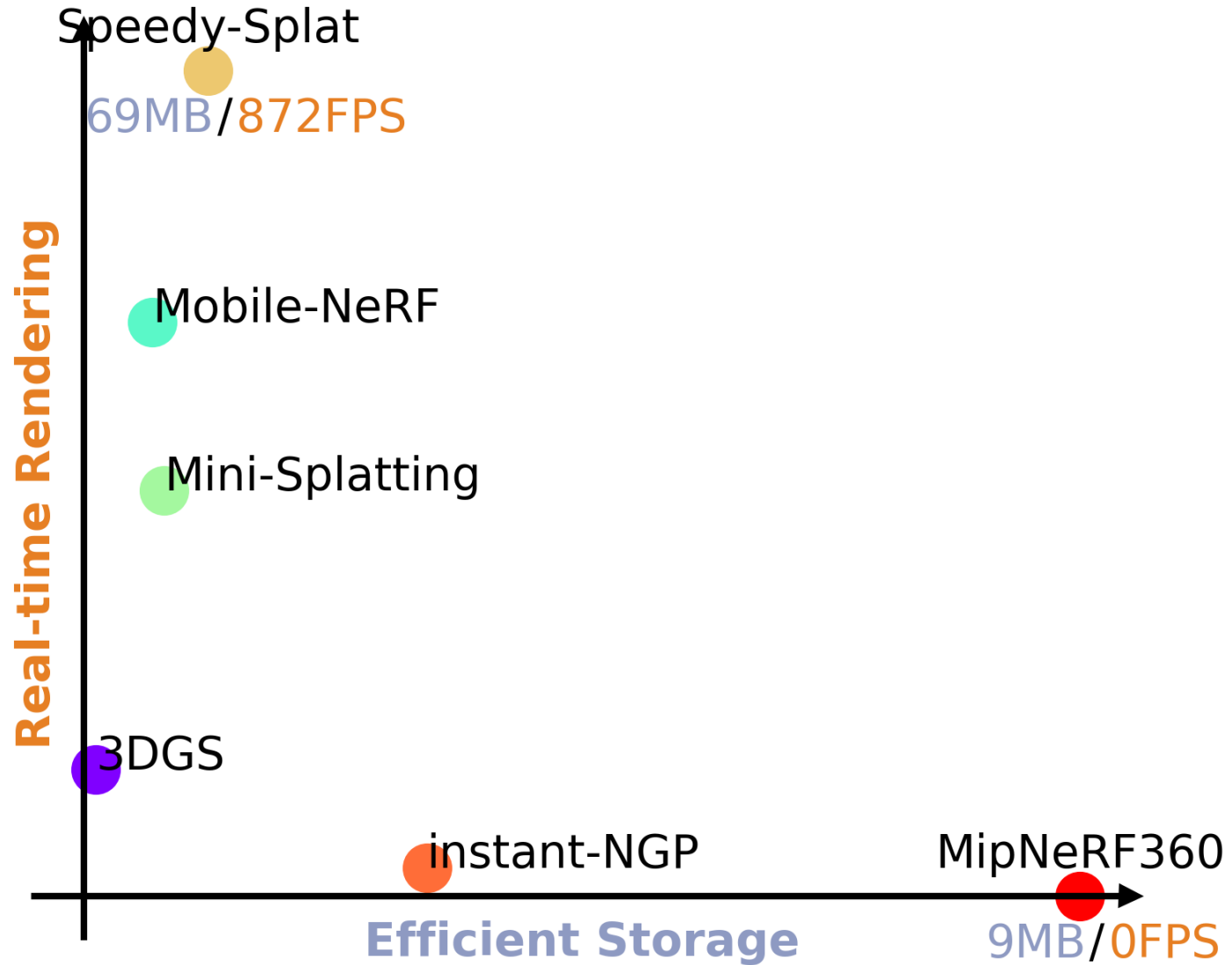
Ideal 3D Representations:

- **Accurate**

- **Fast**

- **Memory Efficient**
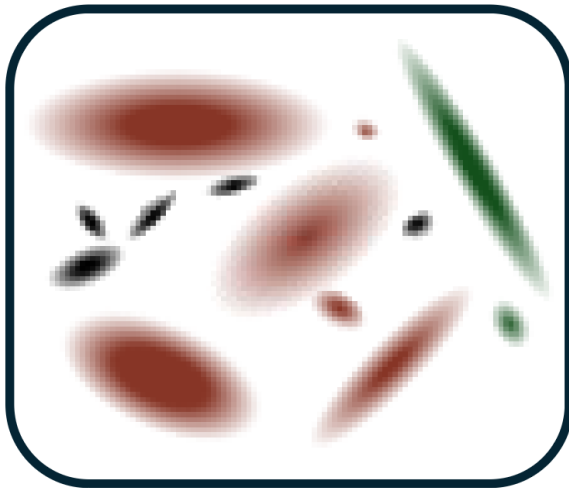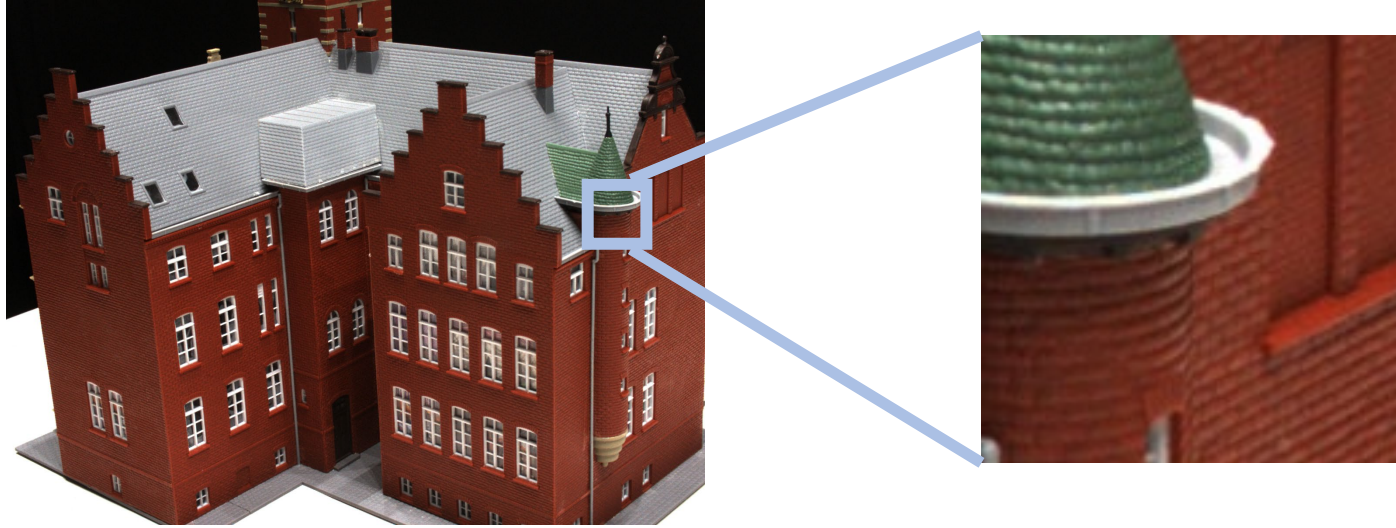
- **Practical**: easy to integrate in frameworks

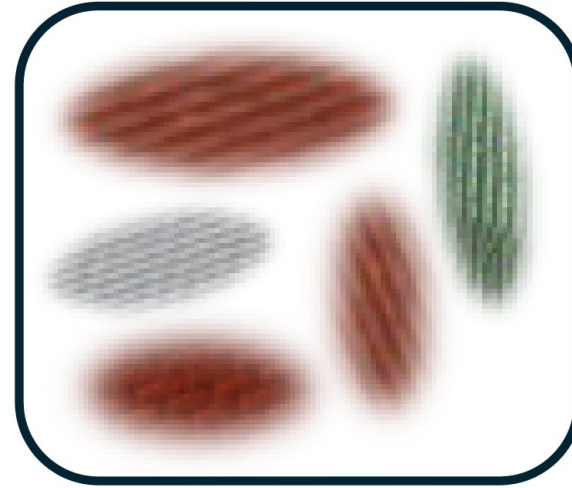Credit to Georgios Kopanas in 3DV 2024

Motivation

NeRF

Instant-NGP

3DGS

Related Works

Speedy-Splat
69MB/872FPS

Real-time Rendering

Mobile-NeRF

Mini-Splatting
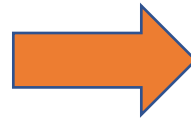
3DGS

instant-NGP

MipNeRF360

Efficient Storage
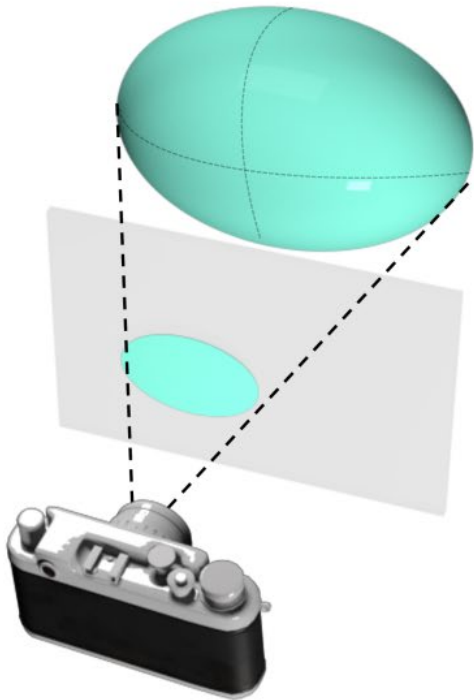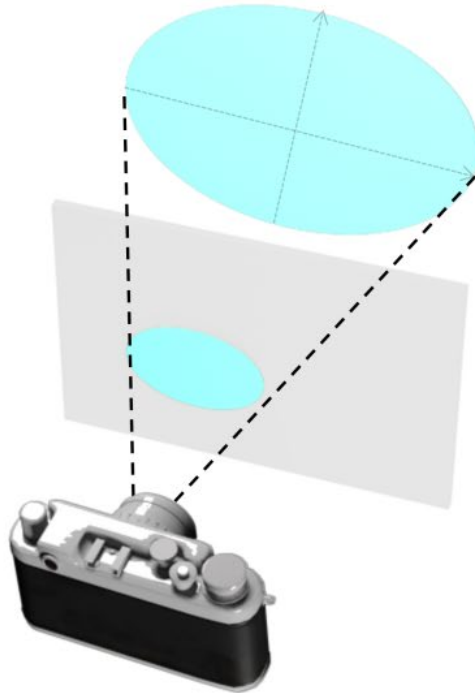9MB/0FPS

4

Method

3DGS

Texture GS

Concurrent Works

- Textured Gaussians for Enhanced 3D Scene Appearance Modeling

- GStex: Per-Primitive Texturing of 2D Gaussian Splatting for Decoupled Appearance and Geometry Modeling

- SuperGaussians: Enhancing Gaussian Splatting Using Primitives with Spatially Varying Colors

- HDGS: Textured 2D Gaussian Splatting for Enhanced Scene Rendering

- BillBoard Splatting (BBSplat): Learnable Textured Primitives for Novel View Synthesis
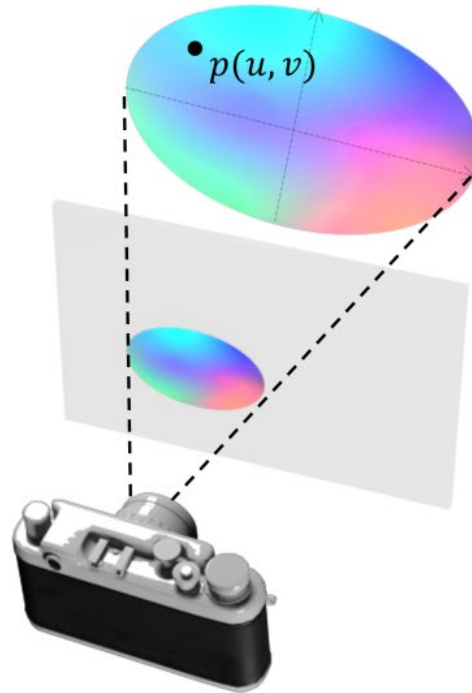
Method

(a) 3DGS   (b) 2DGS   (c) SuperGaussians
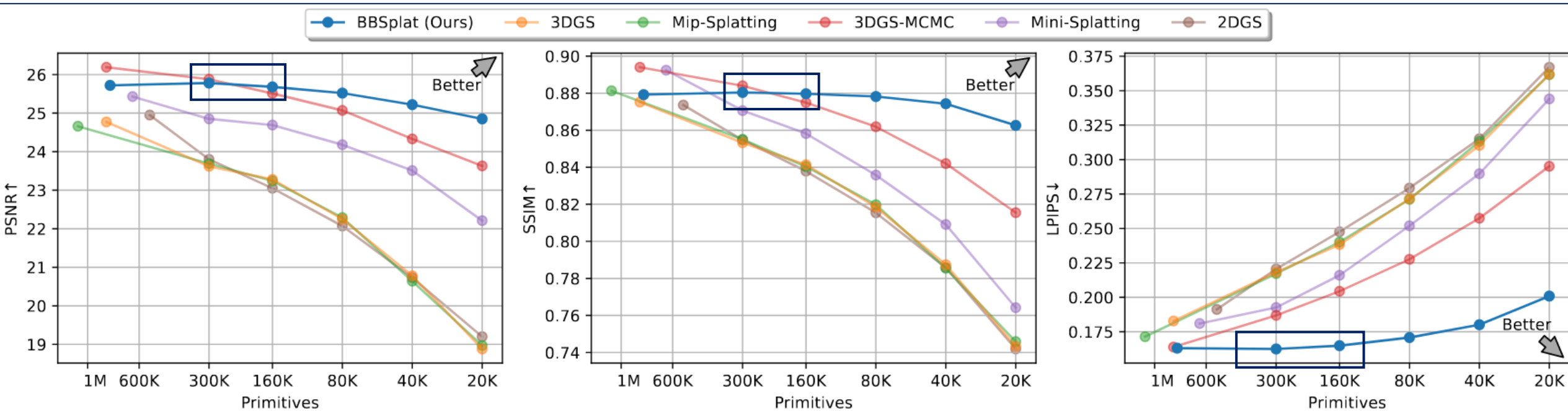
$p(u, v)$

- **Texture Map**

- **Neural Network**

- **...**

SuperGaussians: Enhancing Gaussian Splatting Using Primitives with Spatially Varying Colors

Result

3DGS   SuperGaussians   Ground Truth

Result

- The number of Primitives decreased by **one-tenth**.

BillBoard Splatting (BBSplat): Learnable Textured Primitives for Novel View Synthesis
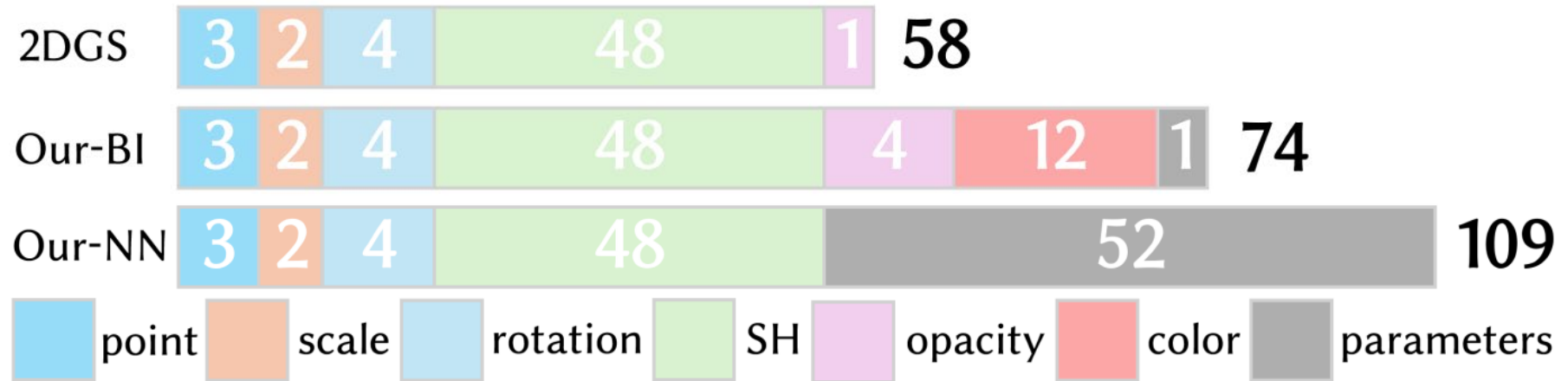
Result

- The Memory size increased **by double**.

SuperGaussians: Enhancing Gaussian Splatting Using Primitives with Spatially Varying Colors

Result

Real-time Rendering

BBSplat
367MB / 187FPS

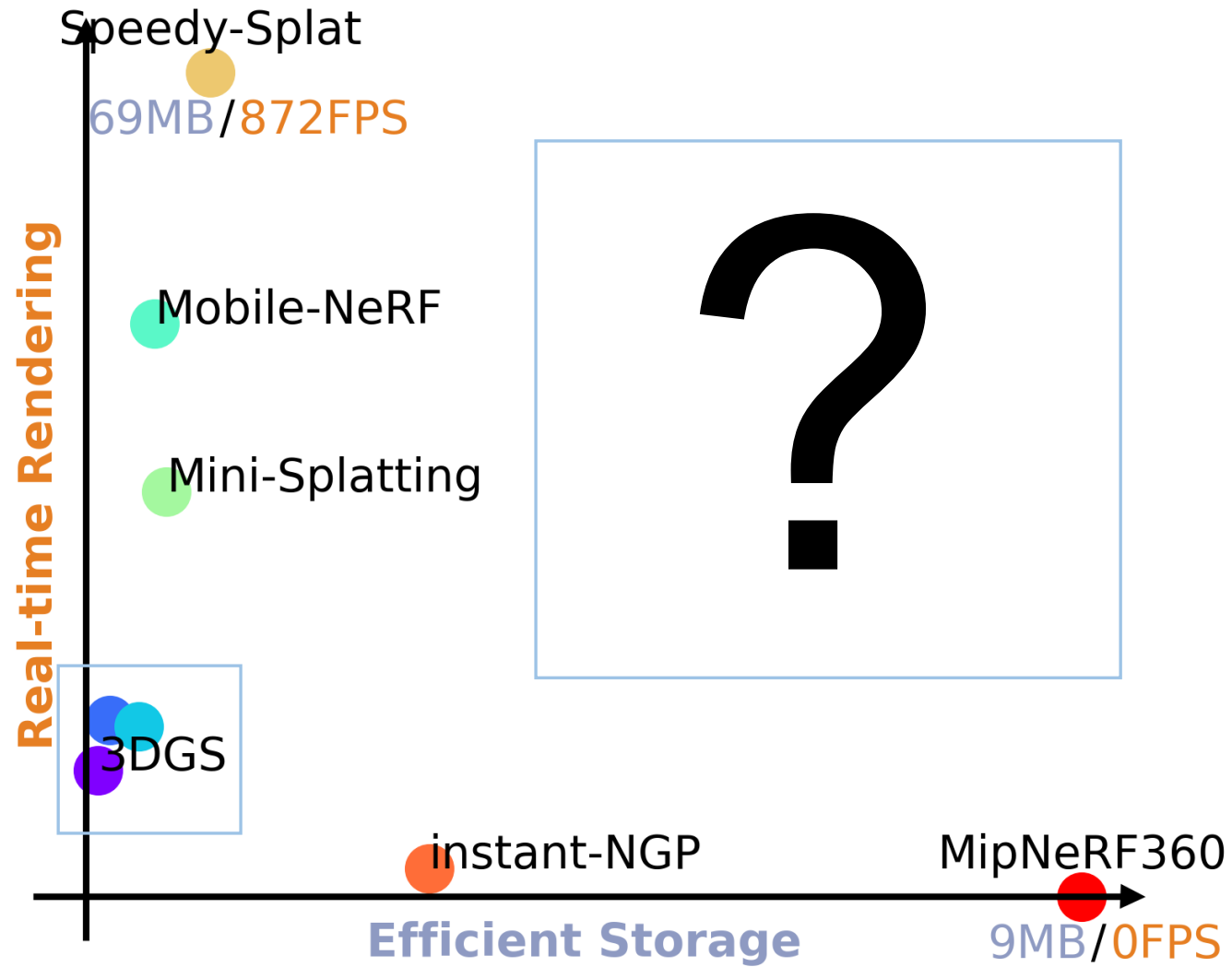Textured-GS
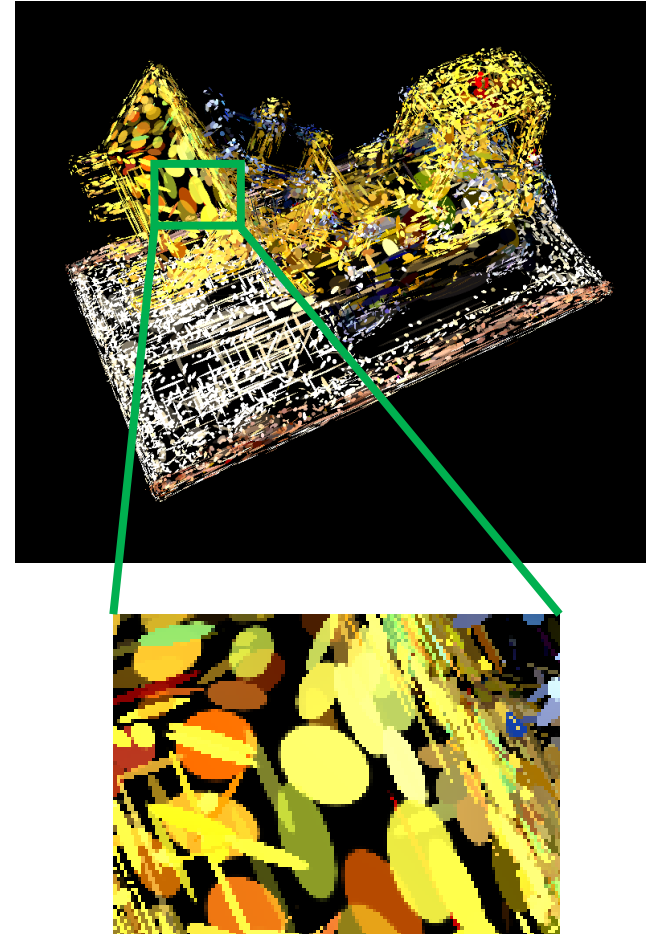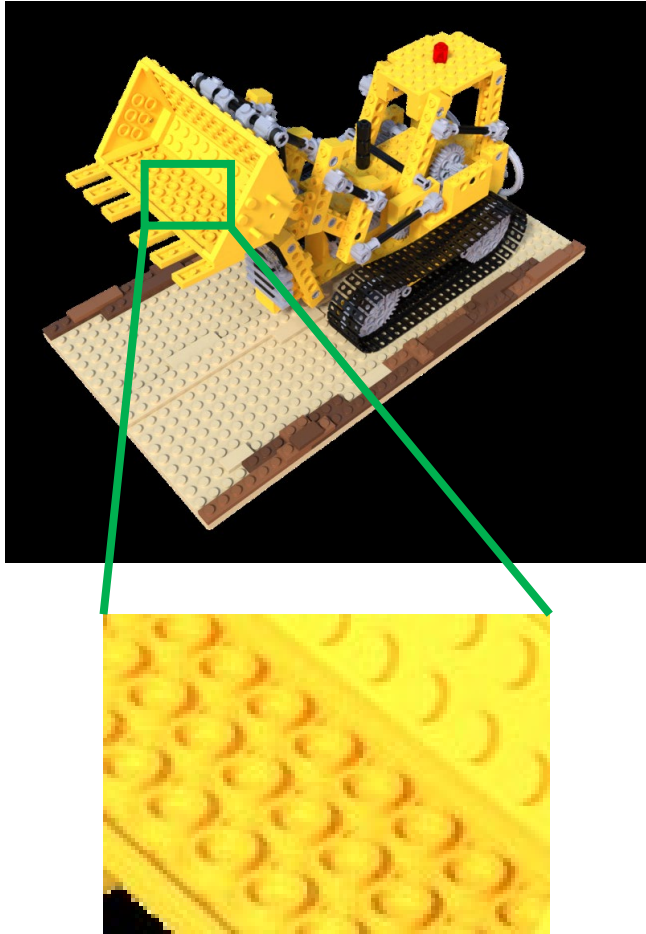164MB / 180FPS

3DGS
734MB / 134FPS

Efficient Storage
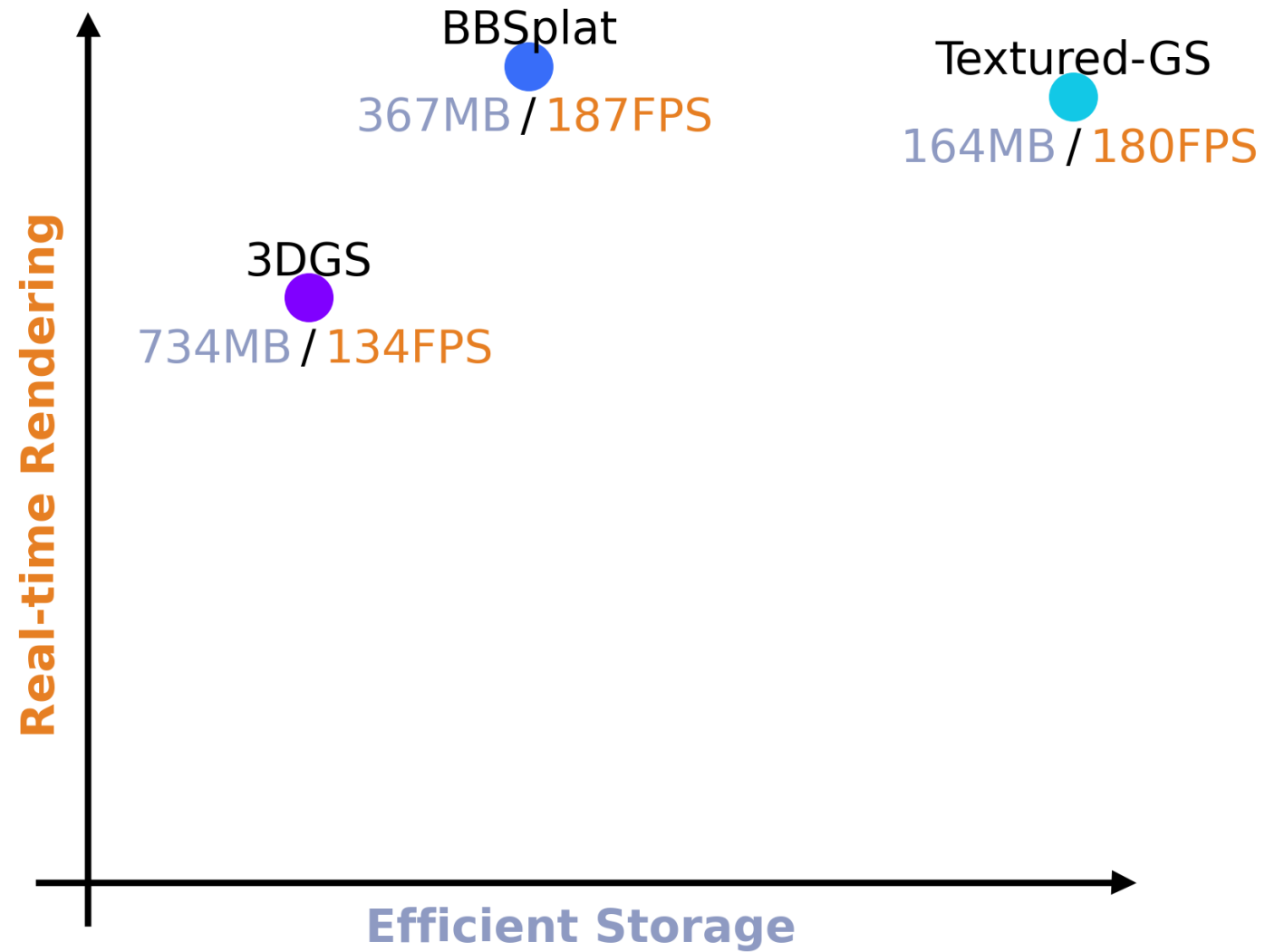
Textured-GS: Gaussian Splatting with Spatially Defined Color and Opacity

BillBoard Splatting (BBSplat): Learnable Textured Primitives for Novel View Synthesis

11

Result

Speedy-Splat

69MB/872FPS

Real-time Rendering

Mobile-NeRF

Mini-Splatting

?

3DGS

instant-NGP

MipNeRF360

Efficient Storage

9MB/0FPS

Why

- Textured-GS has **no texture** due to aggressive densification

Why

2DGS   HDGS   Ground Truth

HDGS: Textured 2D Gaussian Splatting for Enhanced Scene Rendering

How

- **Textured Gaussian / Primitives**

- **Bigger Gaussian / Primitives**

- **Flexible Geometry**

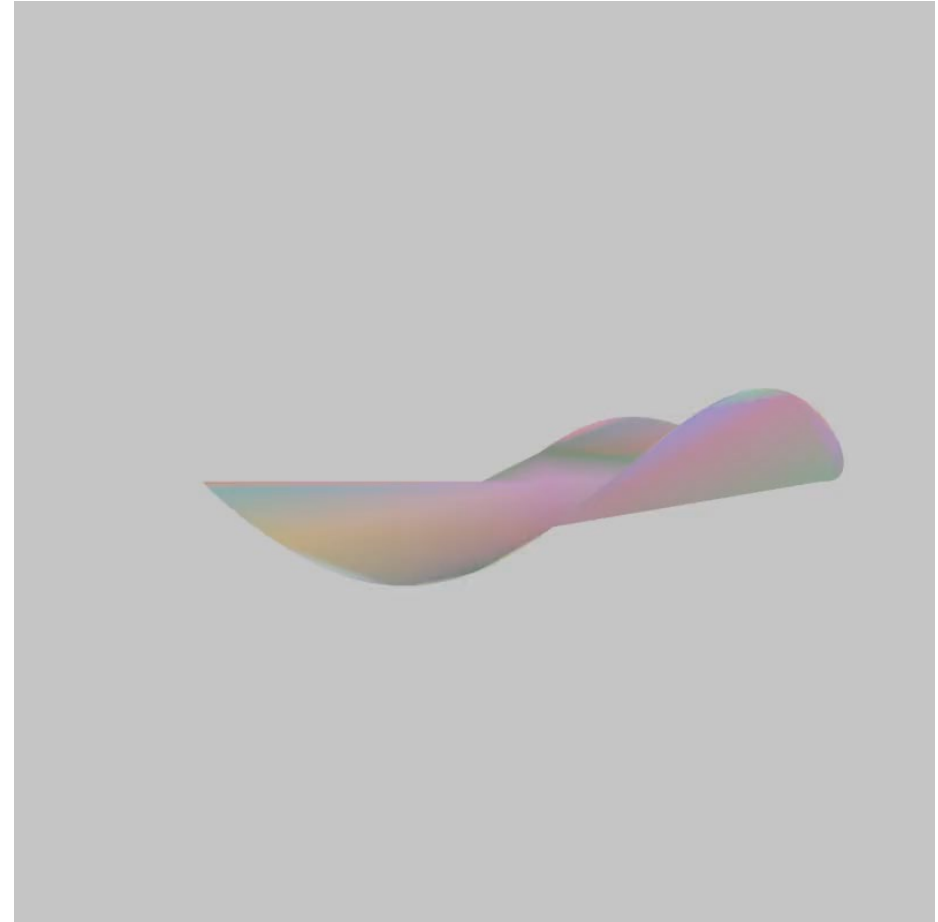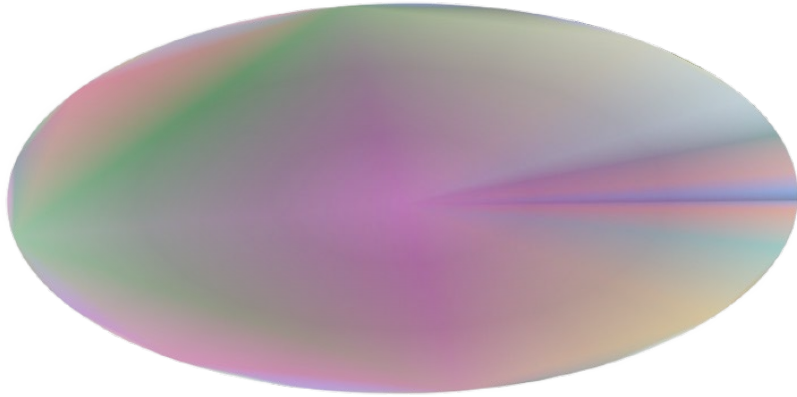- **Practical**: easy to integrate in

  frameworks
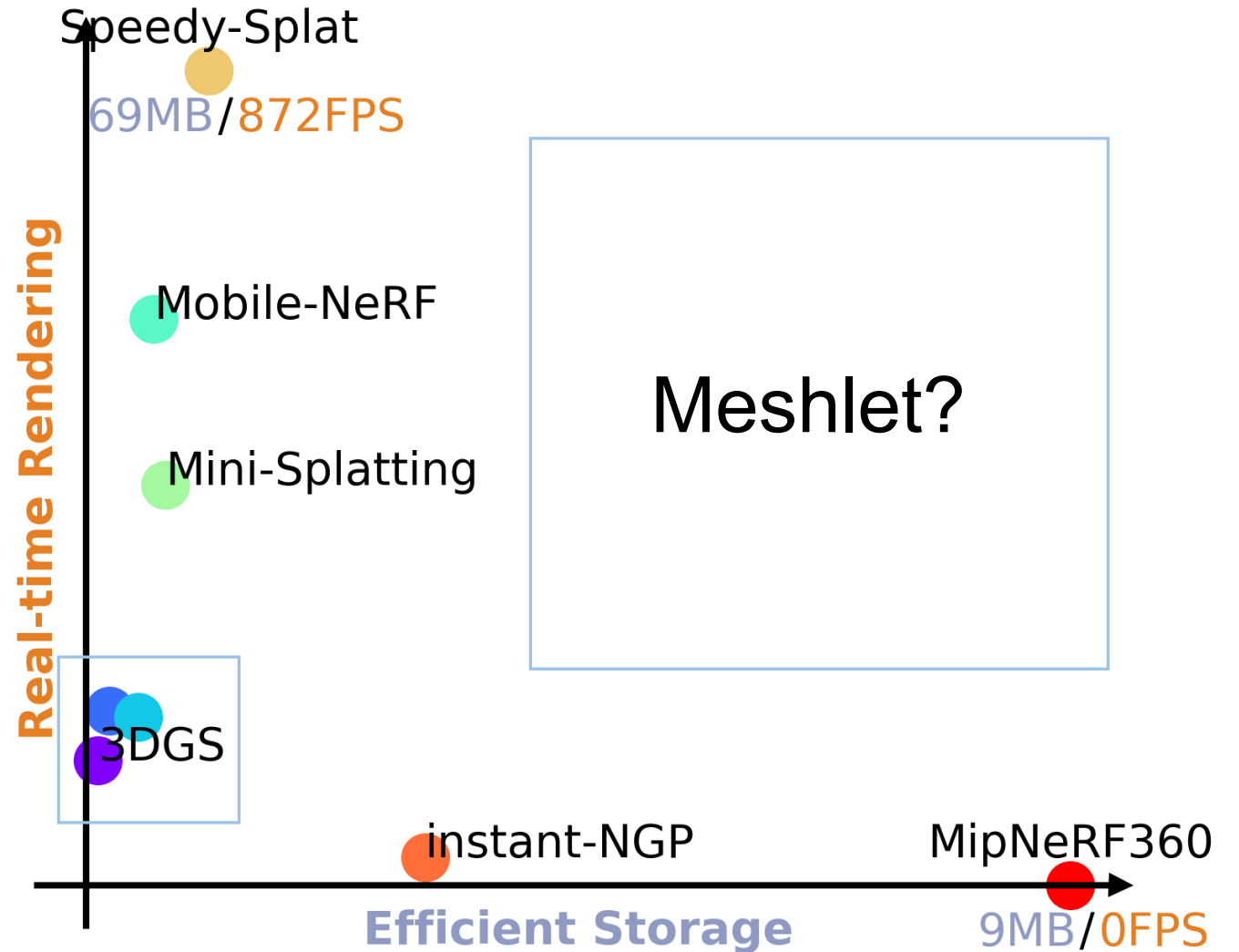
Meshlet:

- **Texture Map**

- **Efficient**

- **Practical**

How
Meshlet v.s. Gaussian

Potential Benefits

- **Ray Tracing**

- **Scene Editing**

- **Geometry Reconstruction**

- **Capability Enhancement**

Speedy-Splat

69MB/872FPS

Real-time Rendering

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Meshlet?

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Efficient Storage

9MB/0FPS

Thank you for listening!

Co-Author: **Anpei Chen, Binbin Huang**