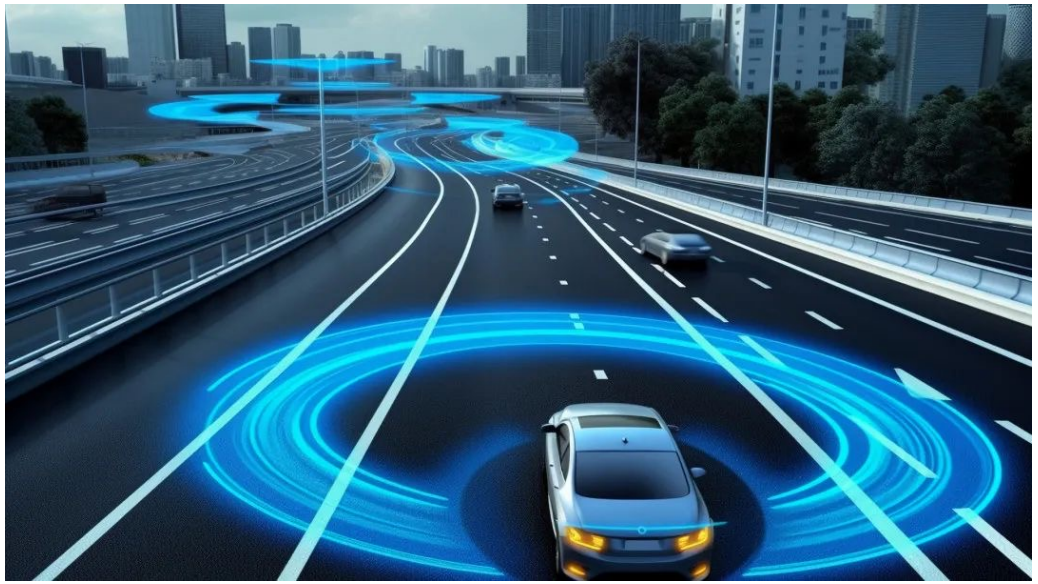
浙江大学
ZHEJIANG UNIVERSITY

基于3D Gaussians的动态三维街景建模

报告人：彭思达

自动驾驶及其对闭环仿真的需求



自动驾驶

国家智能制造发展的重点领域

自动驾驶及其对闭环仿真的需求

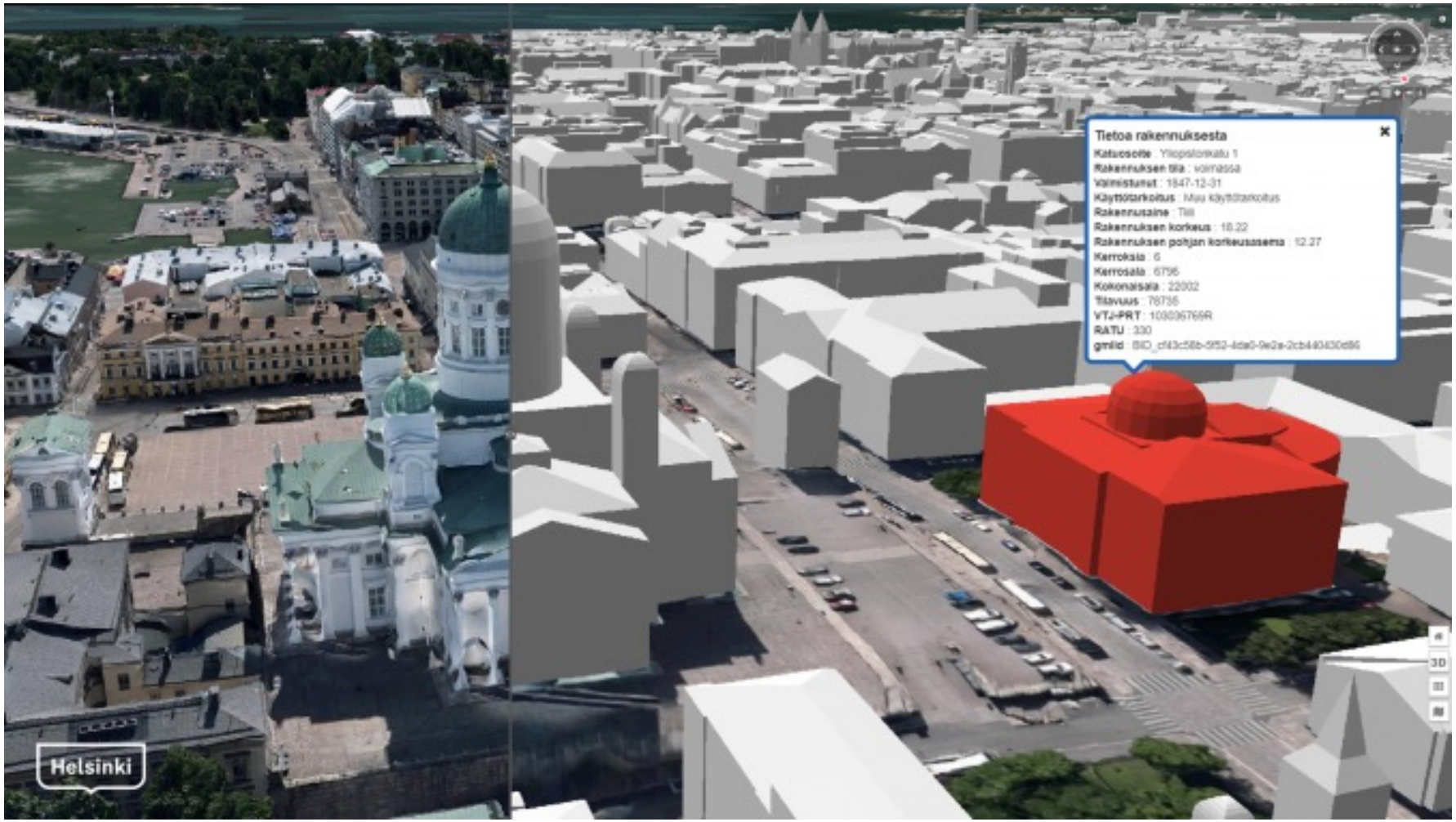
自动驾驶

国家智能制造发展的重点领域

面临的挑战：感知算法过拟合于车型，目前需要对每个车型采集相应的训练数据

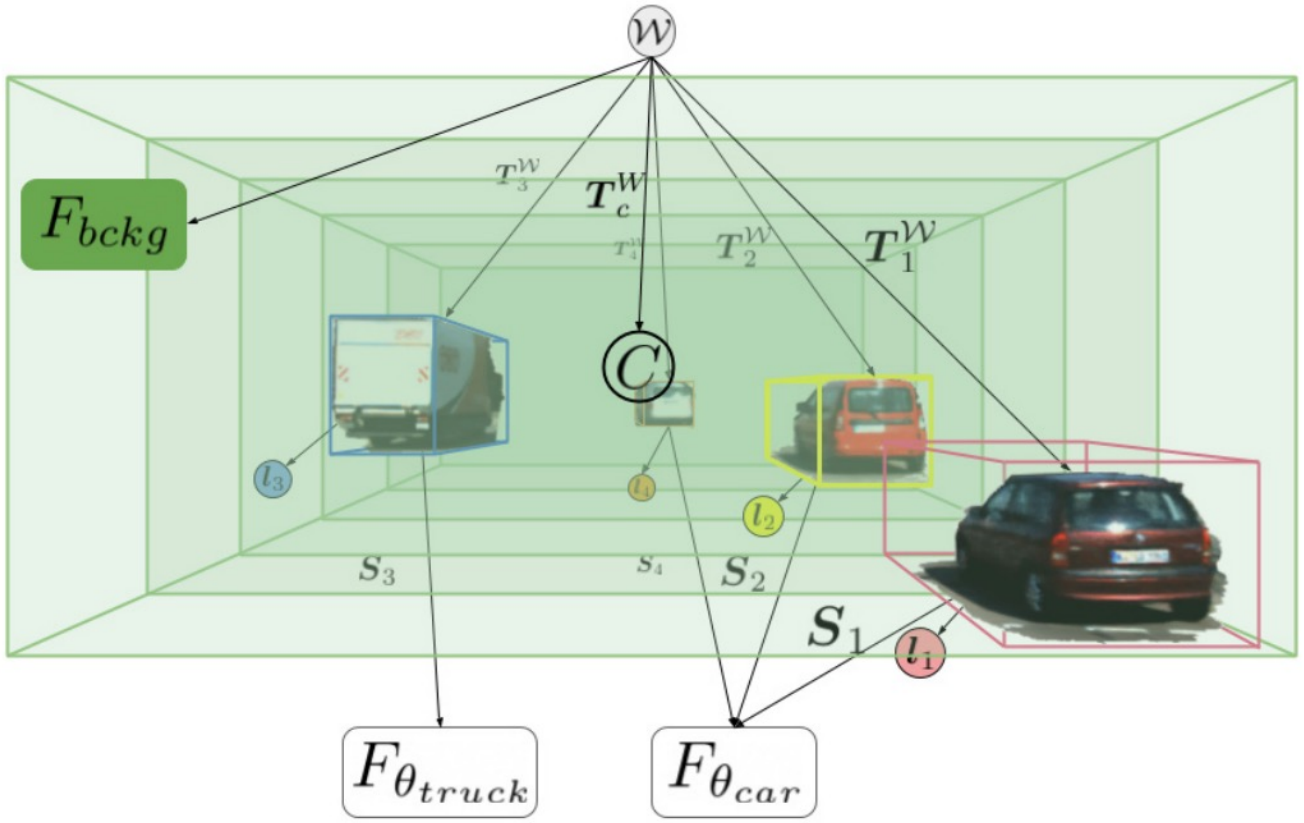
已有的工作：基于游戏引擎的城市建模

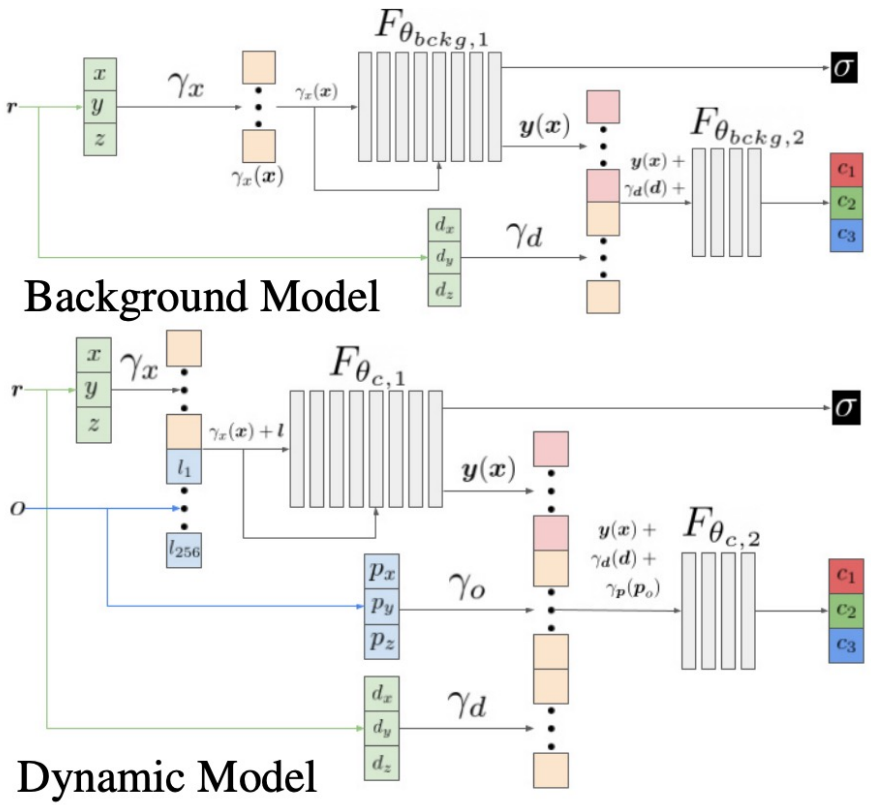
- 缺点：1）成本高；2）与目标环境存在domain gap



已有的工作：NeRF-based methods

使用NeRF建模前景车辆和静态背景





Neural Scene Graphs for Dynamic Scenes. CVPR 2021.

已有的工作：NeRF-based methods

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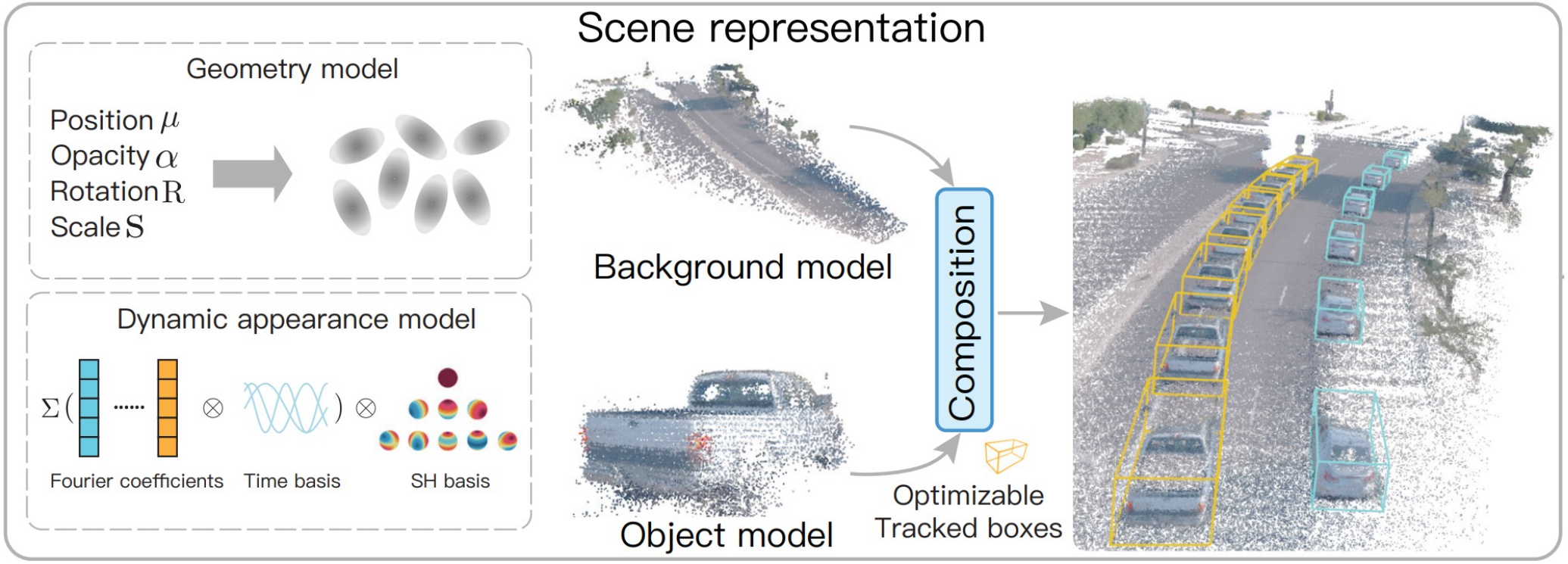
Neural Scene Graphs for Dynamic Scenes. CVPR 2021.

我们的解决思路

基于**组合式的三维高斯**表示动态三维场景



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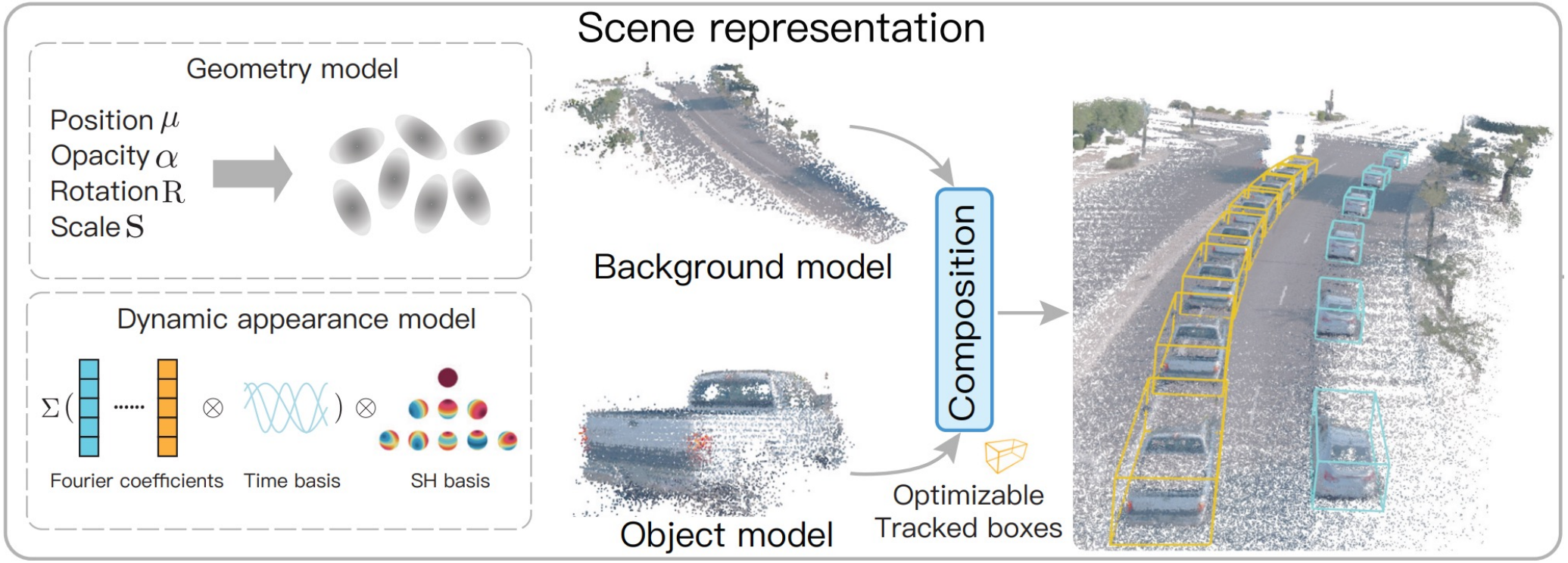
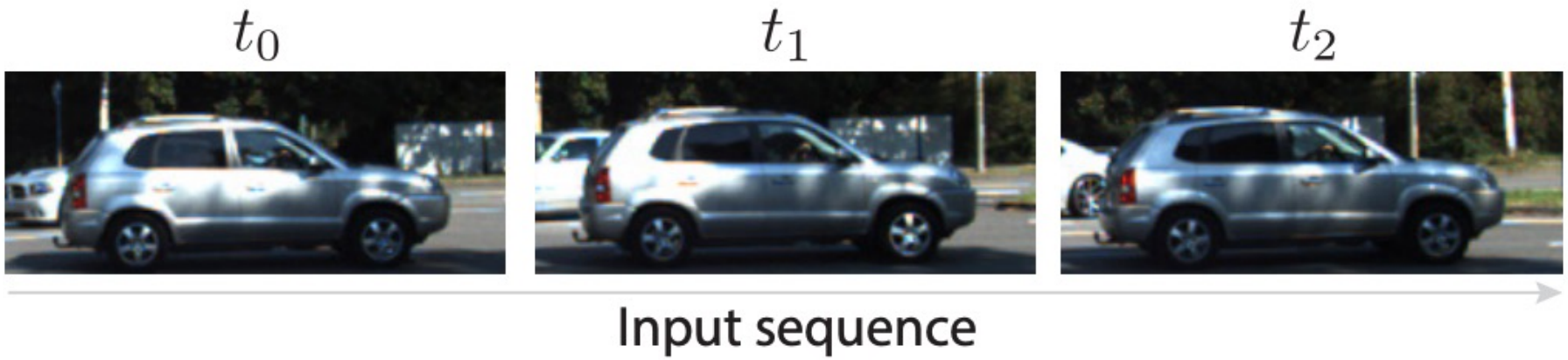


😄 三维高斯的好处：建模能力强；渲染快；训练快。

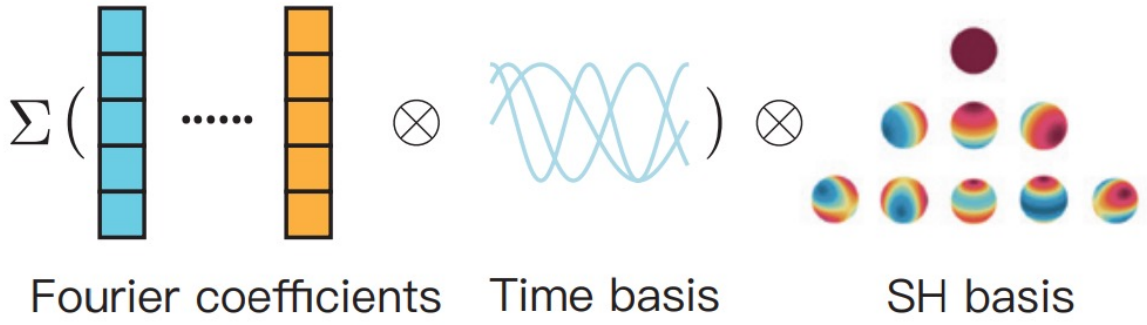
Key designs: 1) Dynamic Appearance Model

面临的问题：物体外观光照变化

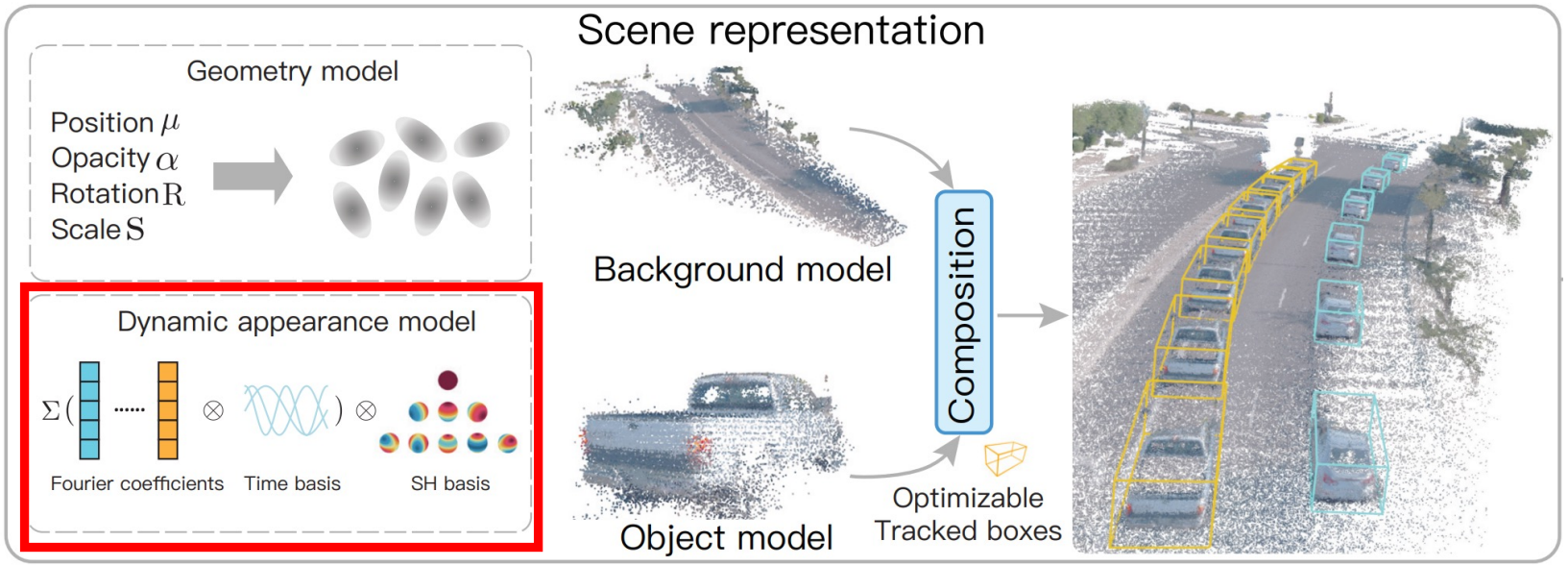


Key designs: 1) Dynamic Appearance Model

给球谐函数的基函数中增加Time basis，实现球谐系数的时变



$$z_{m,l} = \sum_{i=0}^{k-1} \boldsymbol{f}_i \cos\left(\frac{i\pi}{N_t} t\right)$$



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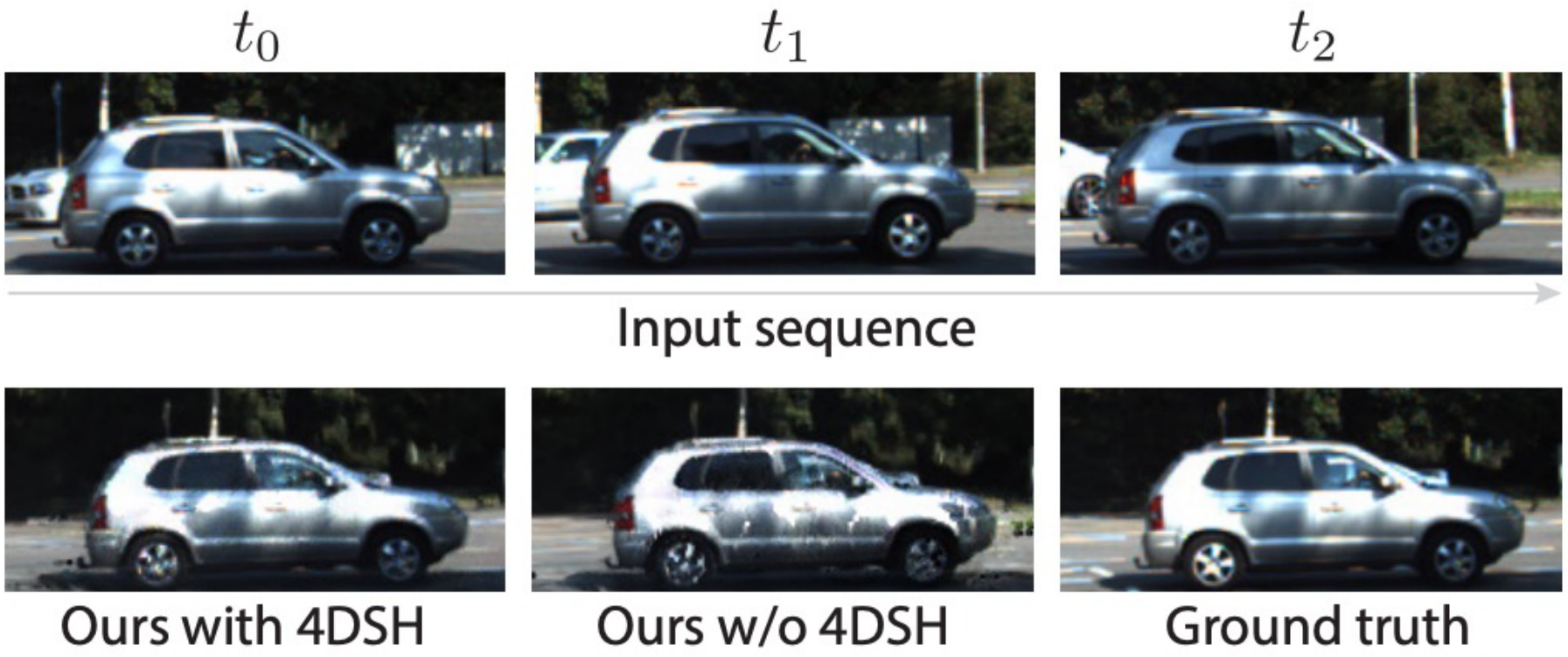
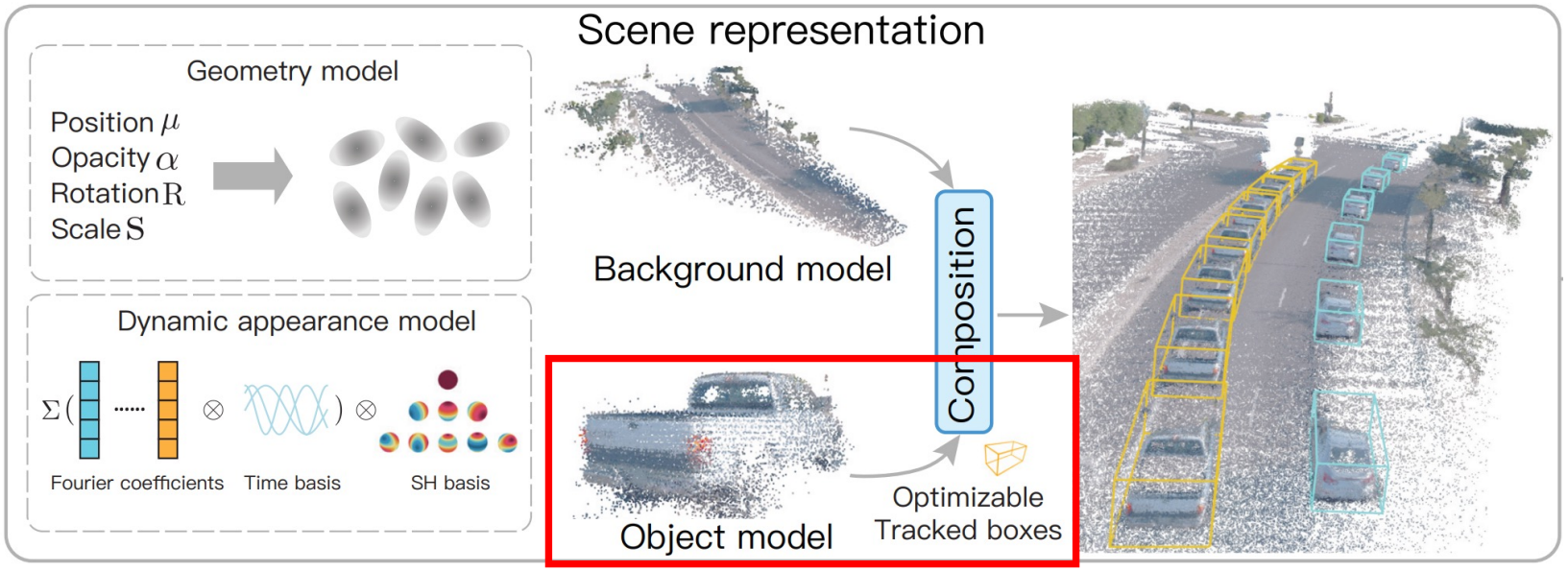


Key designs: 2) Tracking Pose Optimization

- 为Tracking Pose增加可学习的参数：R、T

$$\mathbf{R}'_t = \mathbf{R}_t \Delta \mathbf{R}_t,$$
$$\mathbf{T}'_t = \mathbf{T}_t + \Delta \mathbf{T}_t,$$



Key designs: 2) Tracking Pose Optimization

实验对比：1）量化比较

	3D GS [16]	NSG [33]	MARS [55]	Ours
PSNR↑	29.95	30.23	31.37	**34.54**
PSNR*↑	17.74	22.05	23.07	**25.16**
SSIM↑	0.907	0.866	0.904	**0.936**
LPIPS↓	0.140	0.331	0.246	**0.091**
FPS↑	**227**	0.47	0.68	133

Table 1. **Quantitative results on the Waymo [44] dataset.** The rendering image resolution is 1066 × 1600. "PSNR*" denotes the PSNR of moving objects.

实验对比：2）与EmerNeRF的可视化比较

更多的渲染结果

Applications: 1) Object Decomposition

Applications: 2) Scene Editing

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谢谢！