NeRFs in Motion: Learning Light for Robotics

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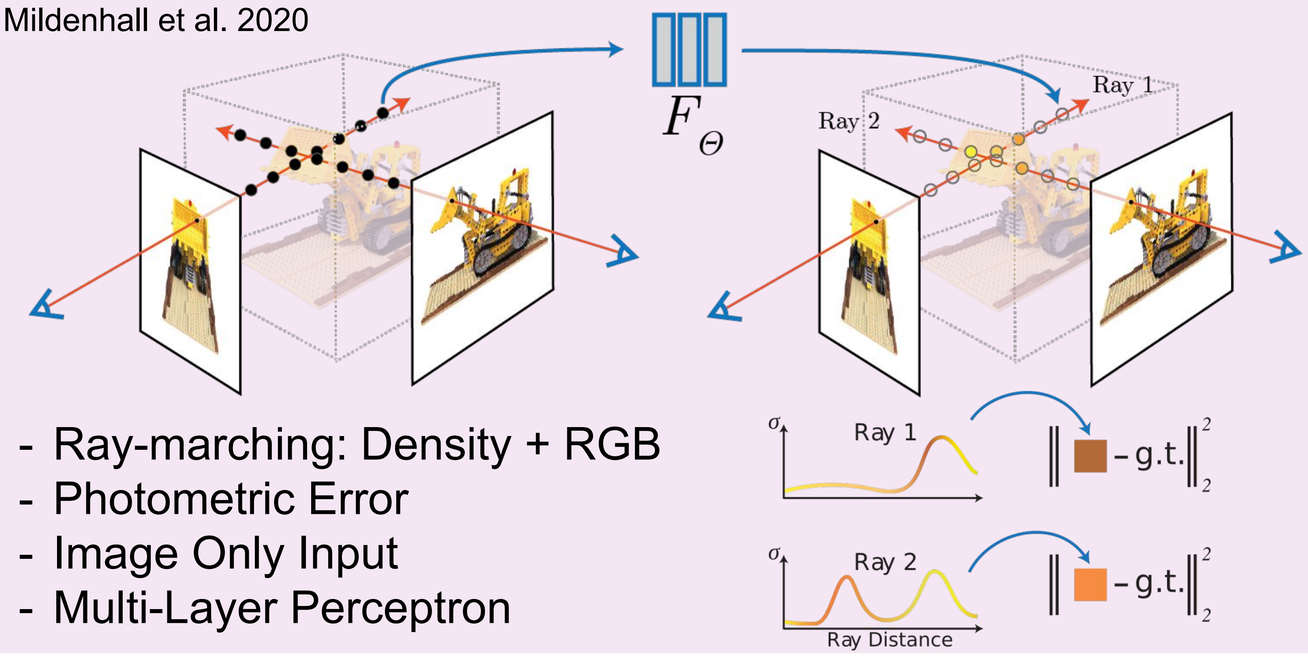
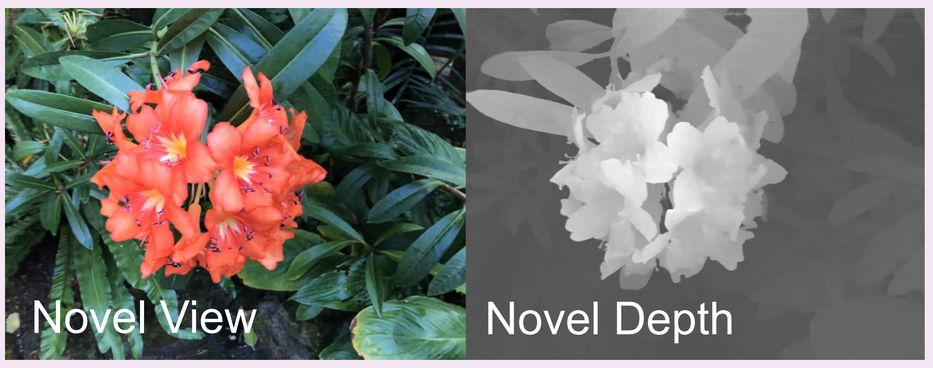
1. NeRF: Scenes in a Learnt Package

Mildenhall et al. 2020



- Ray-marching: Density + RGB
- Photometric Error
- Image Only Input
- Multi-Layer Perceptron



Mildenhall et al. 2020

A scene inside the weights of a neural network

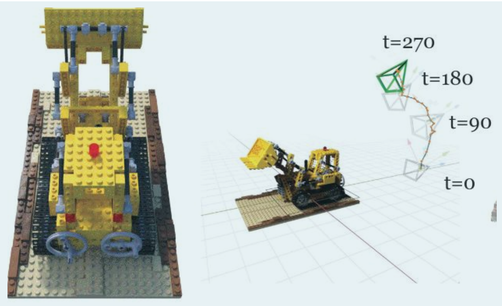
BACKGROUND

2. The NeRF Microcosm

- **Applied NeRF**
  - Bundle Adjustment (BARF, NeRF--, SCNeRF)
  - Pose Determination (iNeRF)
  - Few-Shot (pixelNeRF, InfoNeRF)

- **Changing the rendering model?**
  - NeRF++, Mip-NeRF, ↑ PSNR
  - Light Field Networks, ↓ Training/Inference

No applications to localisation and mapping for robotics in real-time



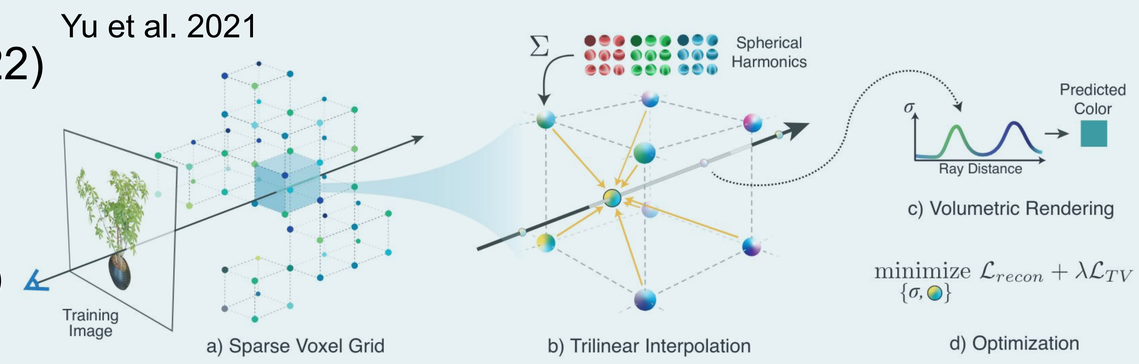
Observed Image w/ Unknown Pose | Iterative Pose Estimation w/ NeRF Model

Yen-Chen et al. 2020

- **Speed Increases**
  - Hash Encoding (Mueller et al. 2022)
  - Plenoxels (Yu et al. 2021)

- **SLAM?**
  - imap, NICE-SLAM require RGB-D
  - Small, controlled, static scenes

Yu et al. 2021



PRIOR WORK

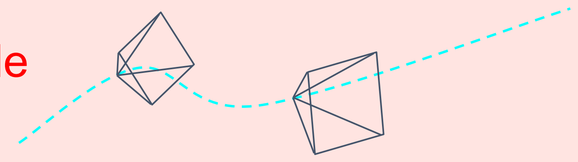
3. What's Special About Robotics?

Graphics: Discrete & Sparse

Fixed View Inputs

Robotics: Smooth & Linear

Controllable Scene Capture



GEOMETRY

NICE-SLAM, Zhu et al. 2021

How big of a scene can NeRF capture?

Are frequently traversed areas "baked" in?

SCALE

"Can we reduce sensing payloads by learning a scene?"

NeRF + IMU Fusion,
↓ Training/Inference

Growing MLPs for Large Scenes

SLAM inside NeRFs

OUR APPROACH

INSIGHTS

creating robots that see...