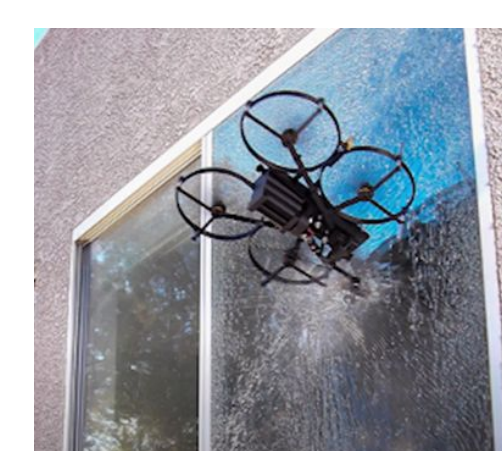


OVERVIEW

Mirror Mapping is Confusing

LiDAR fails to map mirror surface

Vision System Failure



Mirror disappears

Drone crashes

1

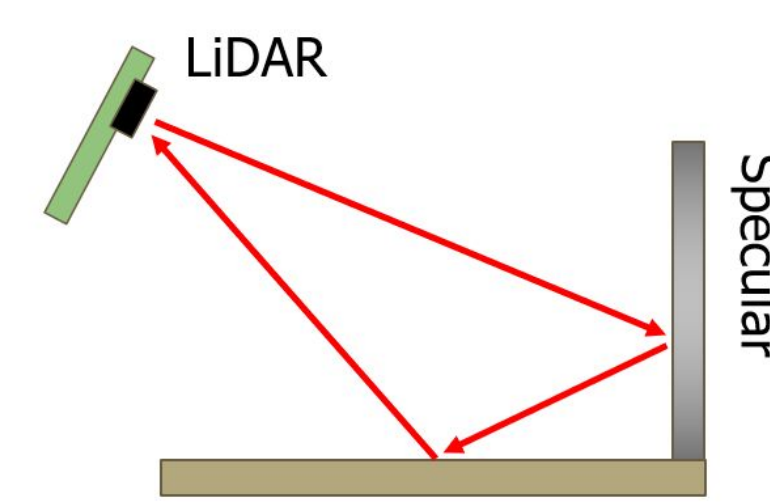
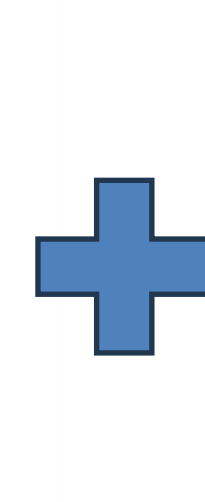
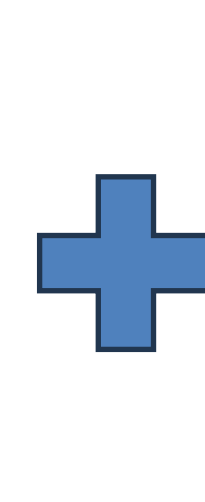
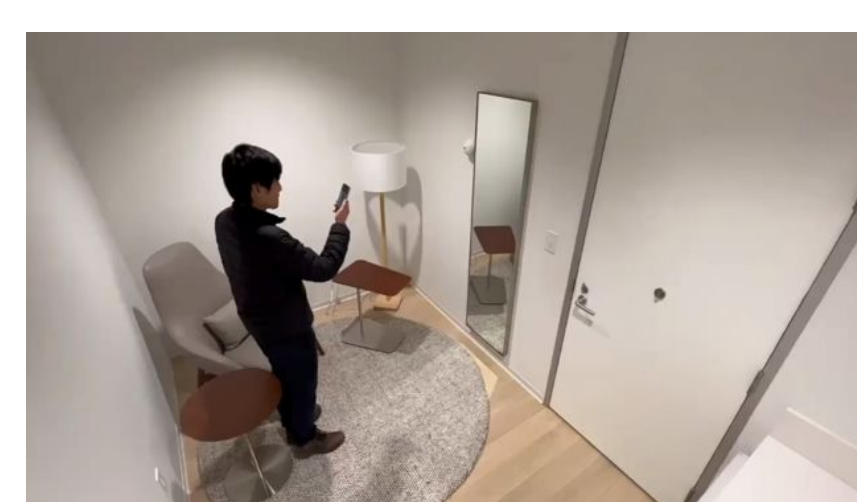
Virtual vs Reality

2

Unaccounted Multi-bounce

Setup

Handheld LiDAR scanning without manual calibration

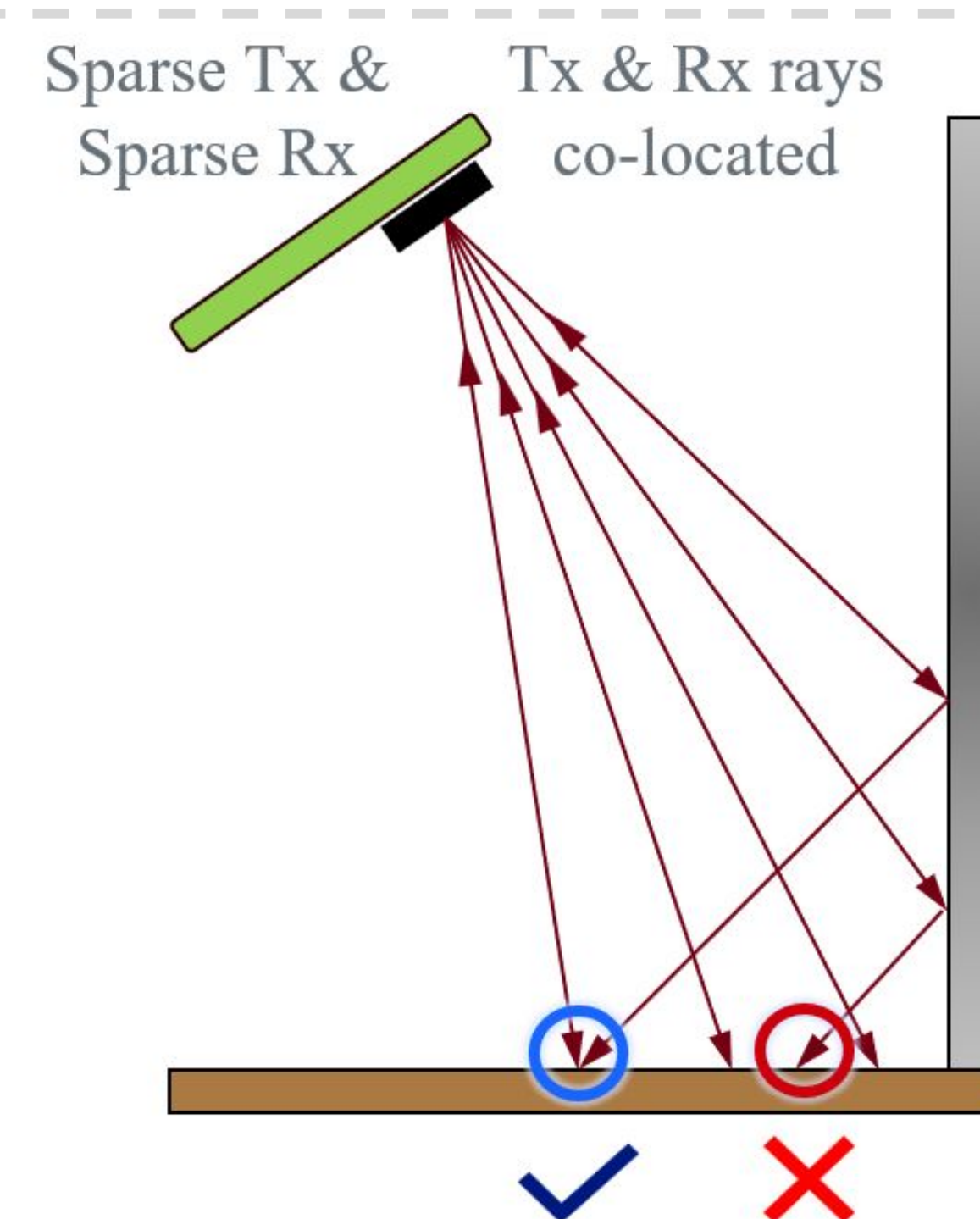


Normal room
Lightning condition

Handheld LiDAR
with 2 echoes

1 Diffuse Surface
1 Specular Surface

Challenges



1

Multiplexing

Ambiguity about which pixels are reciprocal pairs

2

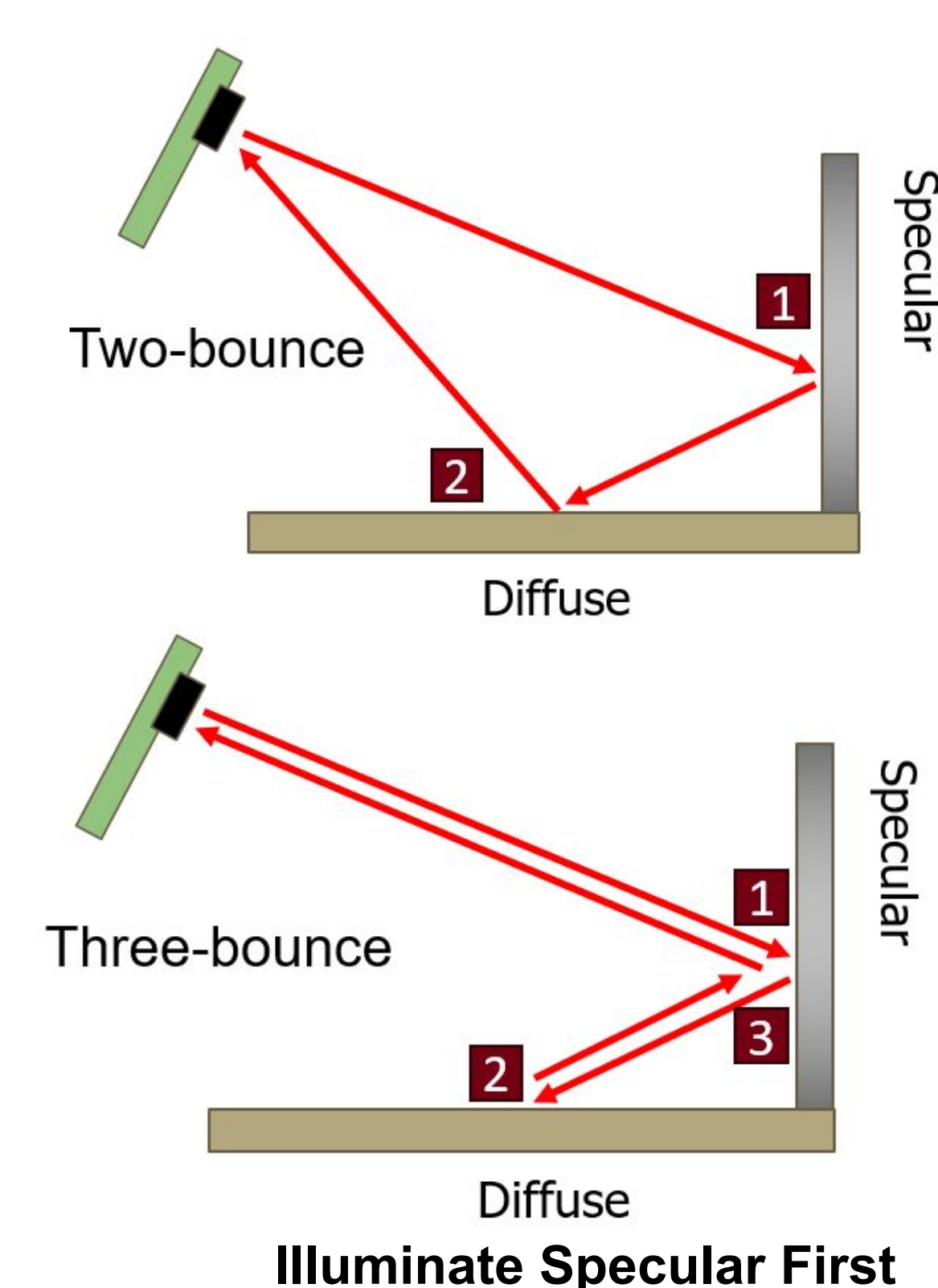
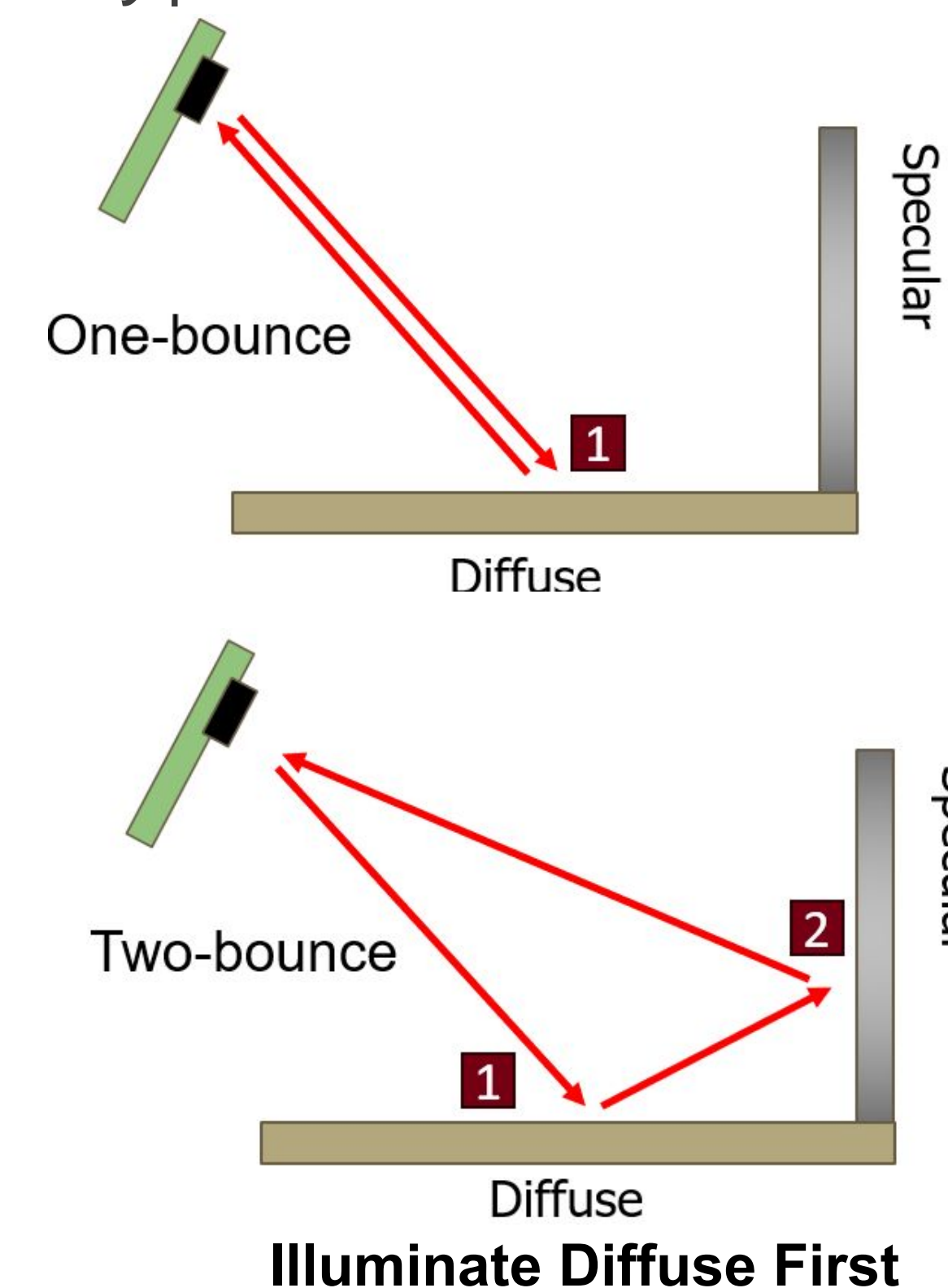
Co-located Emitter and Detector

Distinguishing the type of bounce returned at the coinciding spot

Two-bounce is measured. Spot coinciding with pixel. Two-bounce is not measured. No coinciding pixel. (Measured in [0])

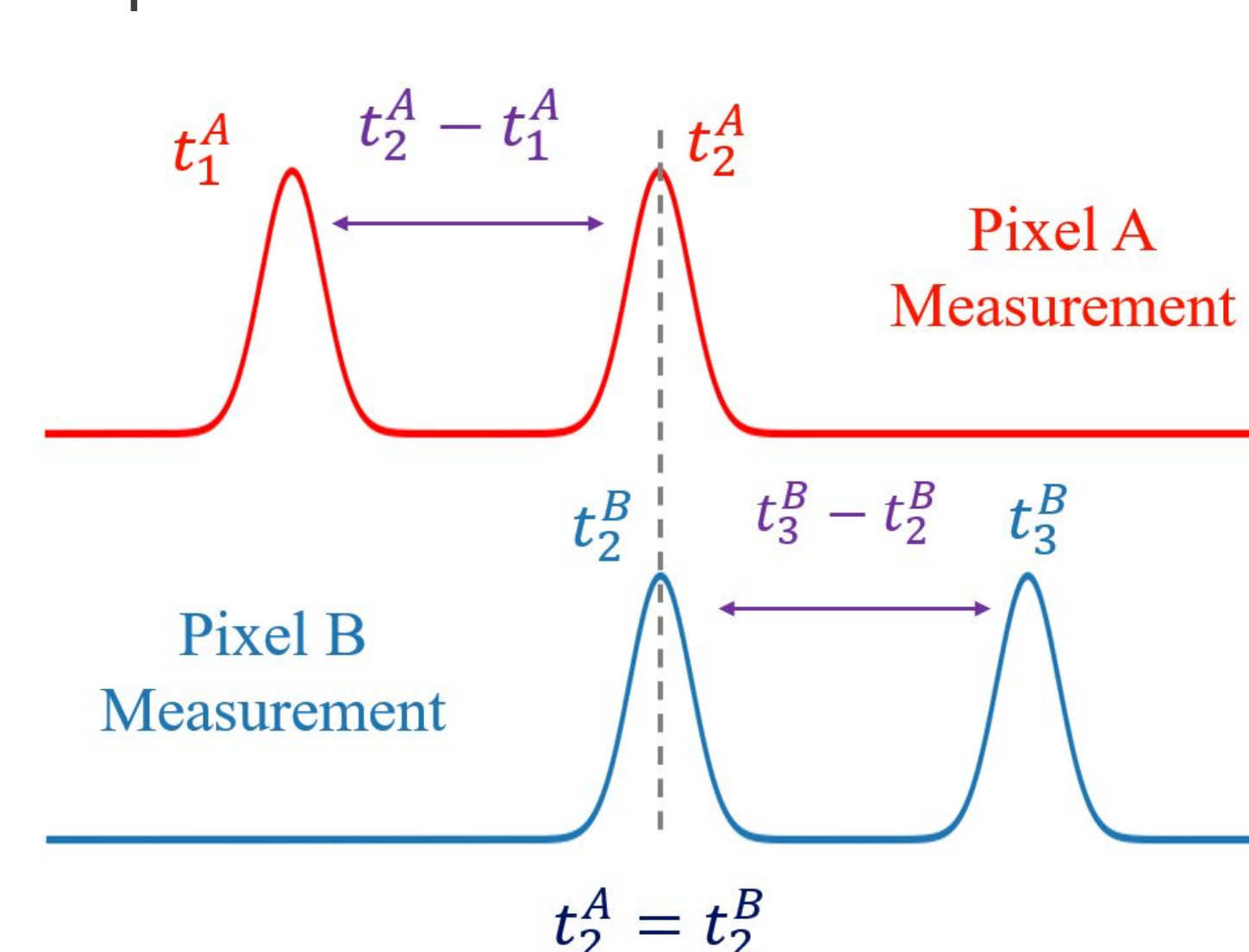
BACKGROUND

Types of Multi-bounce Returns



METHODOLOGY

Reciprocal Pair



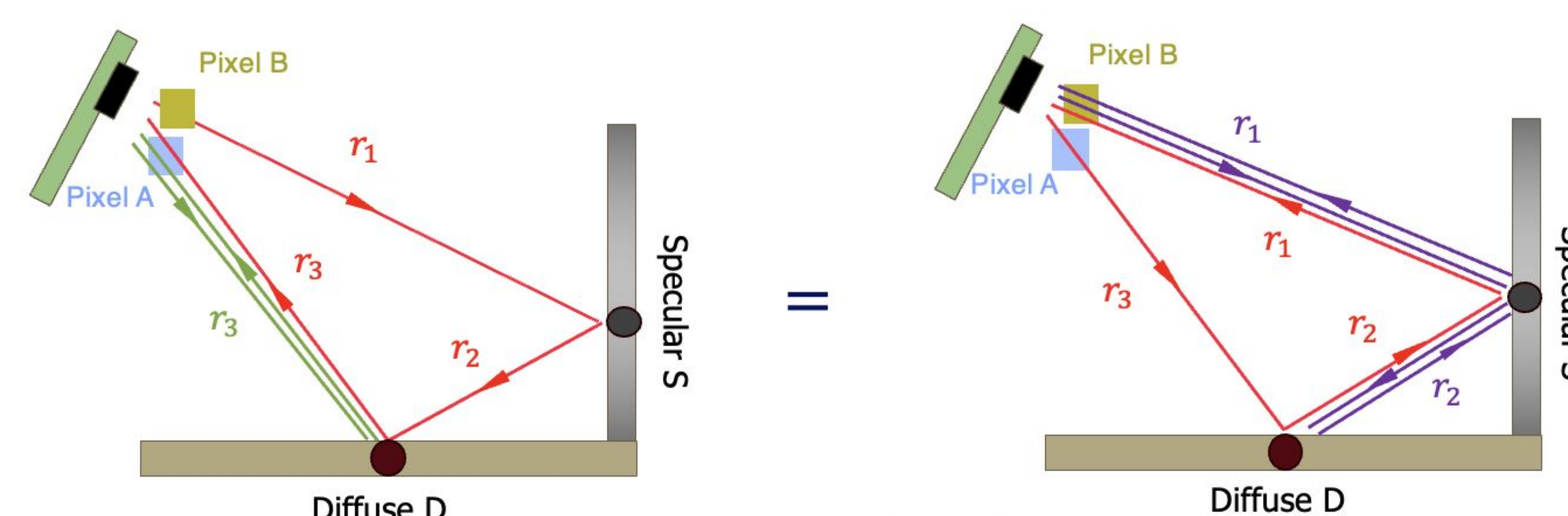
Constraint 1: Peak Match

$$t_2^A = t_2^B$$

Constraint 2: Path Diff Match

$$t_2^A - t_1^A = t_3^B - t_2^B$$

Reciprocal Pair - Path Diff Match



$$ct_2^A - ct_1^A = r_1 + r_2 + r_3 - r_3 - r_3 = r_1 + r_2 - r_3$$

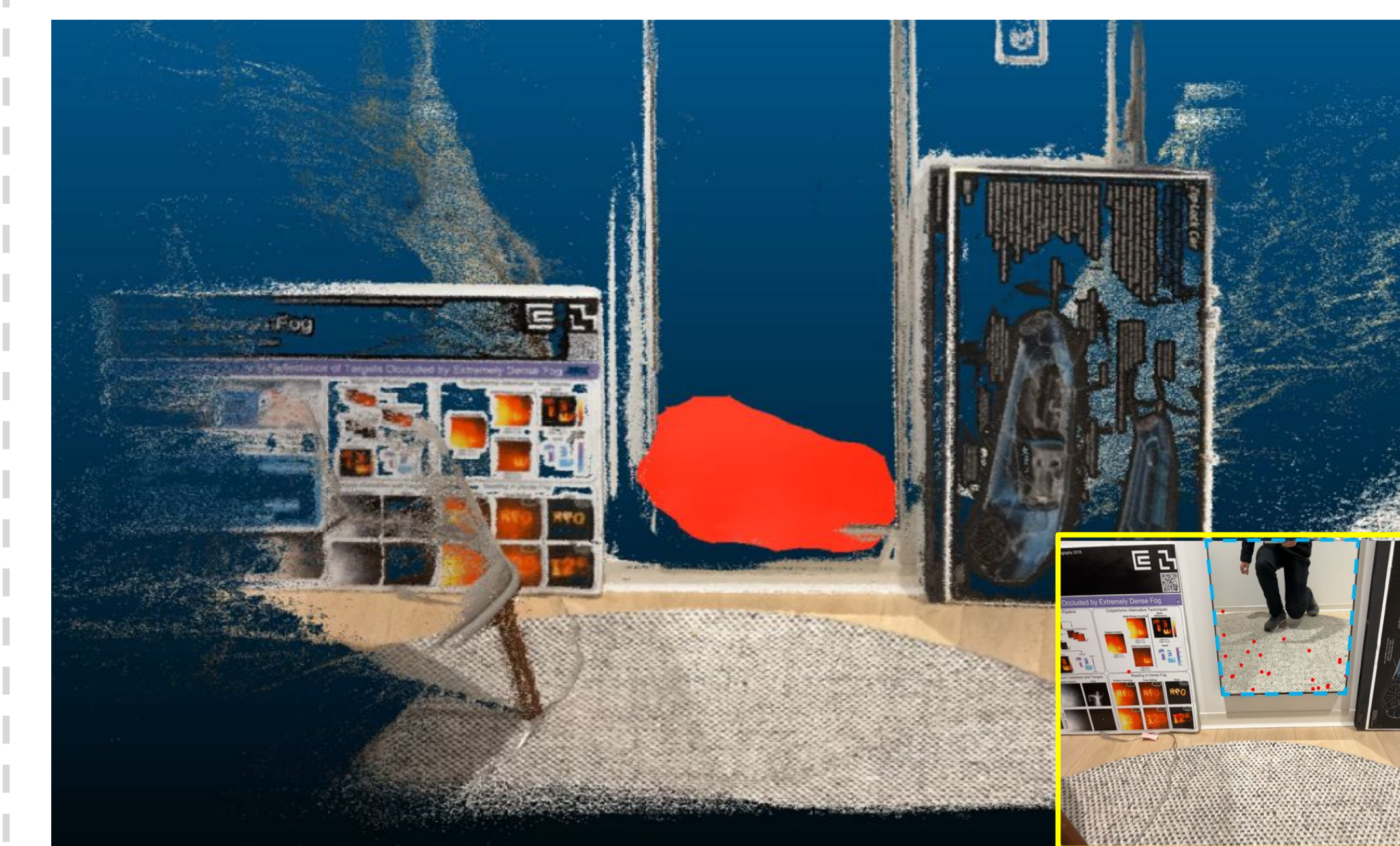
$$ct_3^B - ct_2^B = r_1 + r_2 + r_2 + r_1 - r_1 - r_2 - r_3 = r_1 + r_2 - r_3$$

Constraint 2: Path Diff Match

$$t_2^A - t_1^A = t_3^B - t_2^B$$

RESULTS

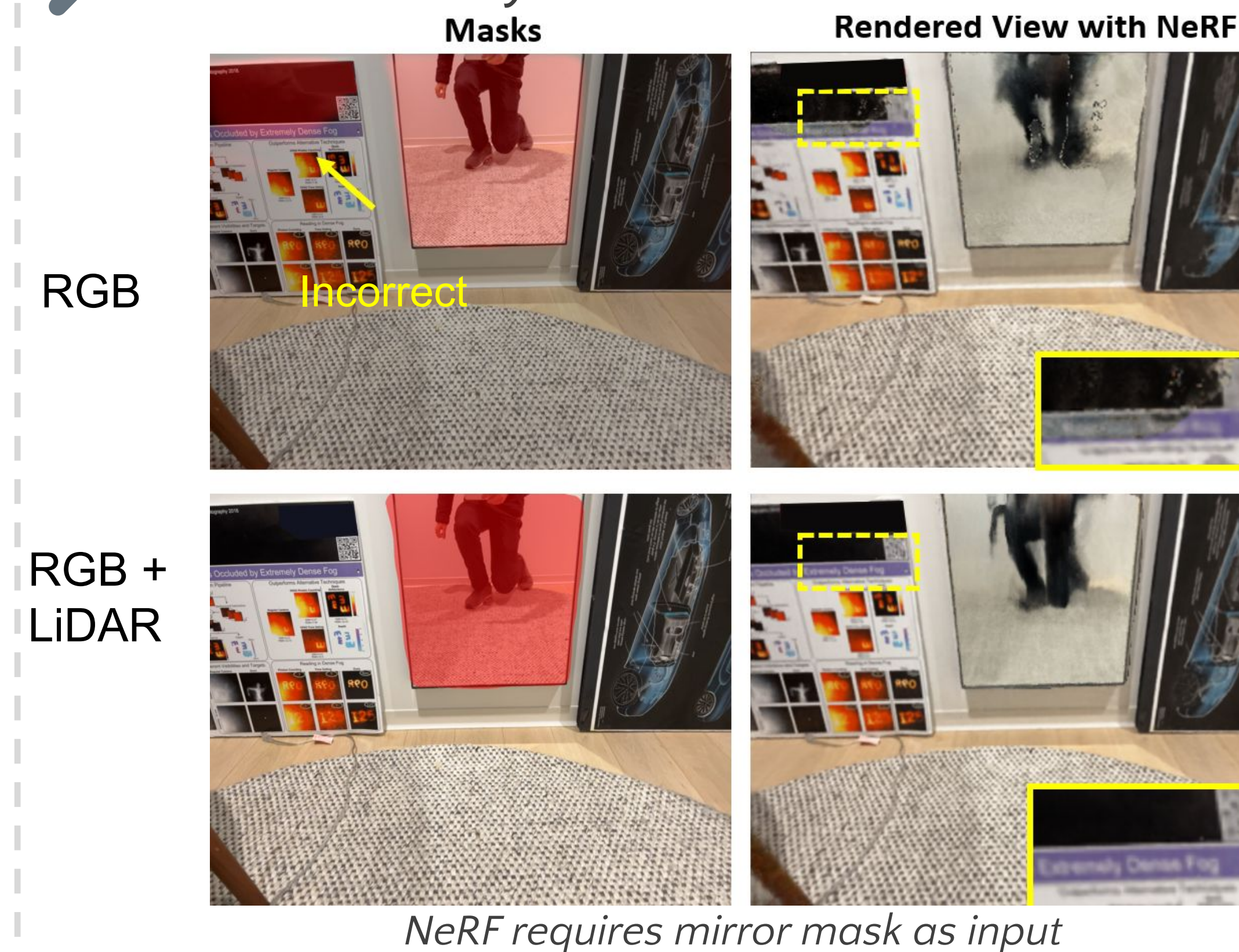
3D Reconstruction



Segmentation

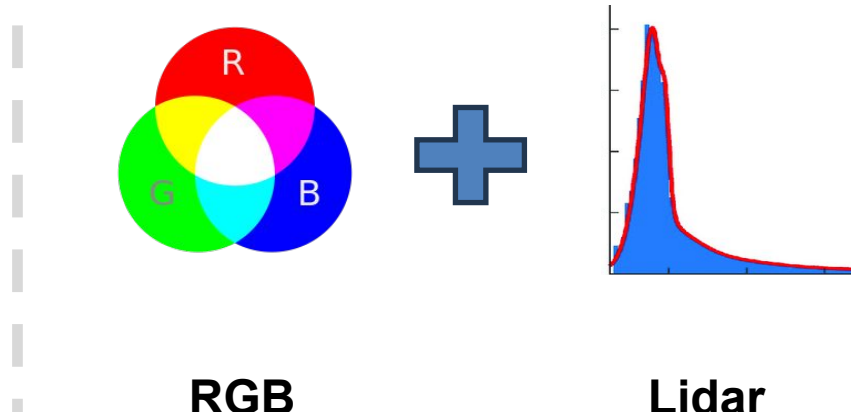


Novel View Synthesis with NeRF

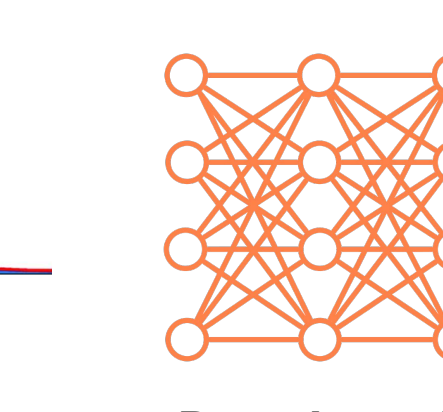


FUTURE DIRECTIONS

Sensor Fusion



Data Priors



Modeling

