San Francisco World: Leveraging Structural Regularities of Slope for 3-DoF Visual Compass

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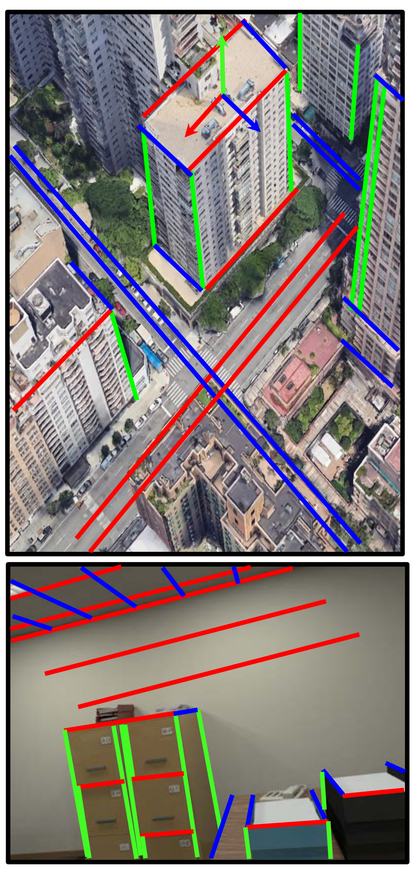
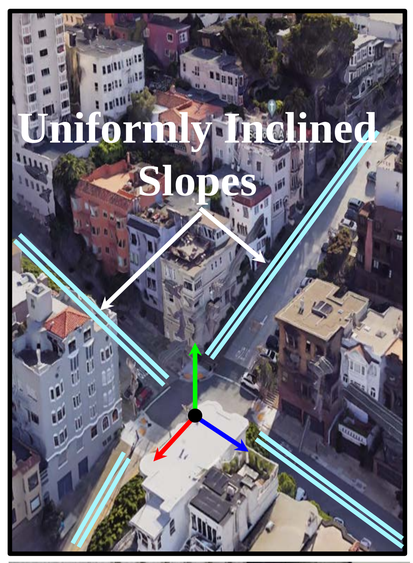
Source Codes and Datasets:

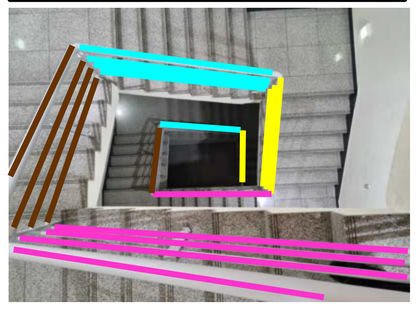
Motivation

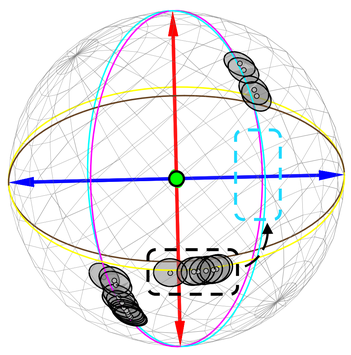
Manhattan World



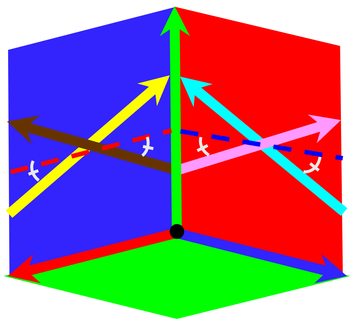
San Francisco World







- Repetitive Pattern on the Gaussian Sphere



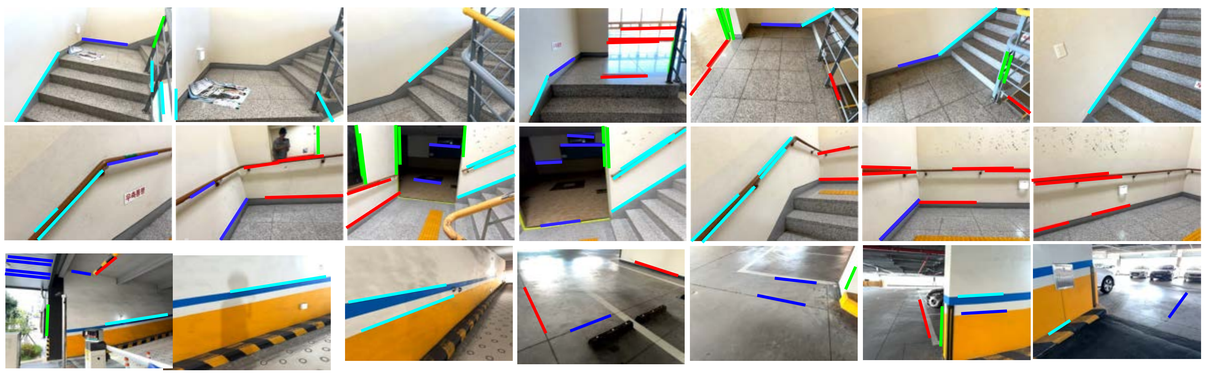
- Illustration of SFW

- We propose a novel San Francisco World (SFW) model characterized by repetitive four-direction slope angles,

Contributions

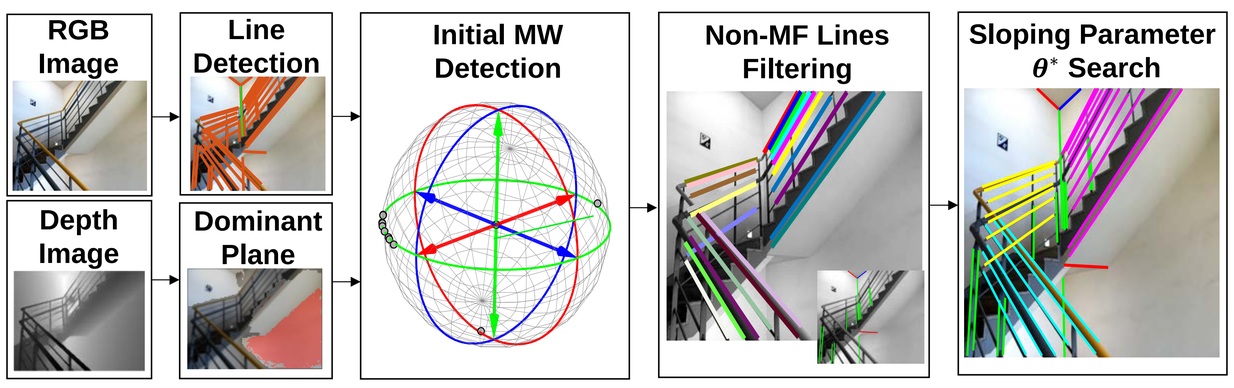
1. **A novel structural model, San Francisco world** (SFW) for structured environments with slopes
2. **Drift-free and accurate rotational motion tracking** for **3D inter-floor navigation**
3. **Extensive evaluations** on indoor/outdoor settings with slopes

Our GIST-SFW RGBD Dataset

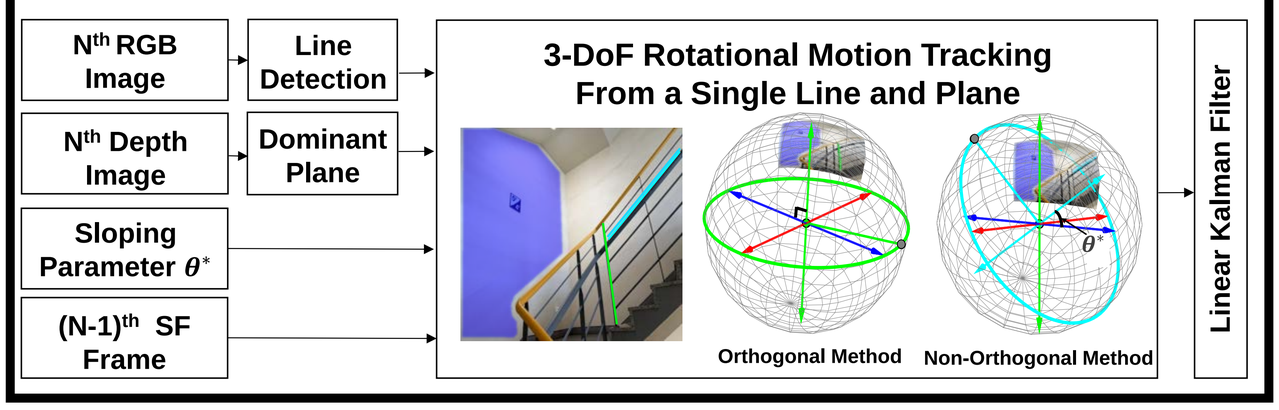


- We establish the first dataset of sequential RGB-D images collected in SFW

San Francisco World Detection

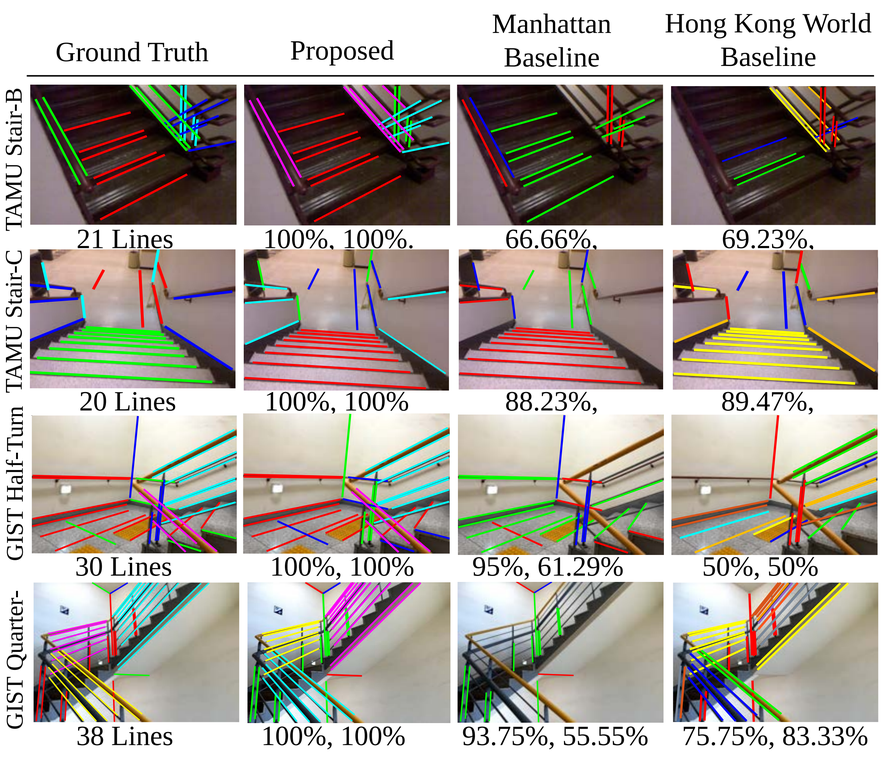


Visual Gyroscope in SFW



Evaluations

- **Vanishing Point Detection & Line Clustering**



- **Quantitative Results of Our Rotational Motion Tracking**

Table I. Absolute Rotation Error Comparison on our GIST-SFW Dataset (unit: degree)

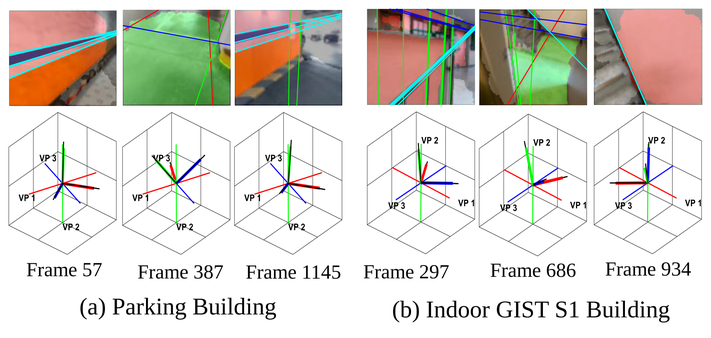
Experiment	Proposed	ManhattanSLAM	ORB-SLAM3	DROID-SLAM	LIMAP	Traveling Rotation
Half-Turn Stair 1	**0.68**	6.91	6.56	2.81	1.12	180°
Half-Turn Stair 2	**1.19**	18.23	12.40	3.33	1.38	360°
Quarter-Turn Stair 1	**0.96**	10.46	6.56	2.81	1.12	180°
Quarter-Turn Stair 2	**1.21**	12.21	15.98	5.76	1.41	360°
In-Place Rotation	**1.18**	20.11	20.26	10.23	×	1800°

Table II. Runtime Comparison on GIST-SFW Dataset

	Proposed	ManhattanSLAM	ORB-SLAM3	DROID-SLAM	LIMAP
Time (s)	0.061	0.128	0.070	0.119	0.208

Table III. Results on Various Indoor/Outdoor Scenes

Sequence	ARE
(a) Parking Building	1.62°
(b) Indoor GIST S1 Building	1.79°
(c) Outdoor Fire Escape Staircase	2.09°
(d) Outdoor Pedestrian Bridge	2.32°



(a) Parking Building (b) Indoor GIST S1 Building

- Takeaways: Remember our San Francisco World model, enabling 3D inter-floor navigation! 😀