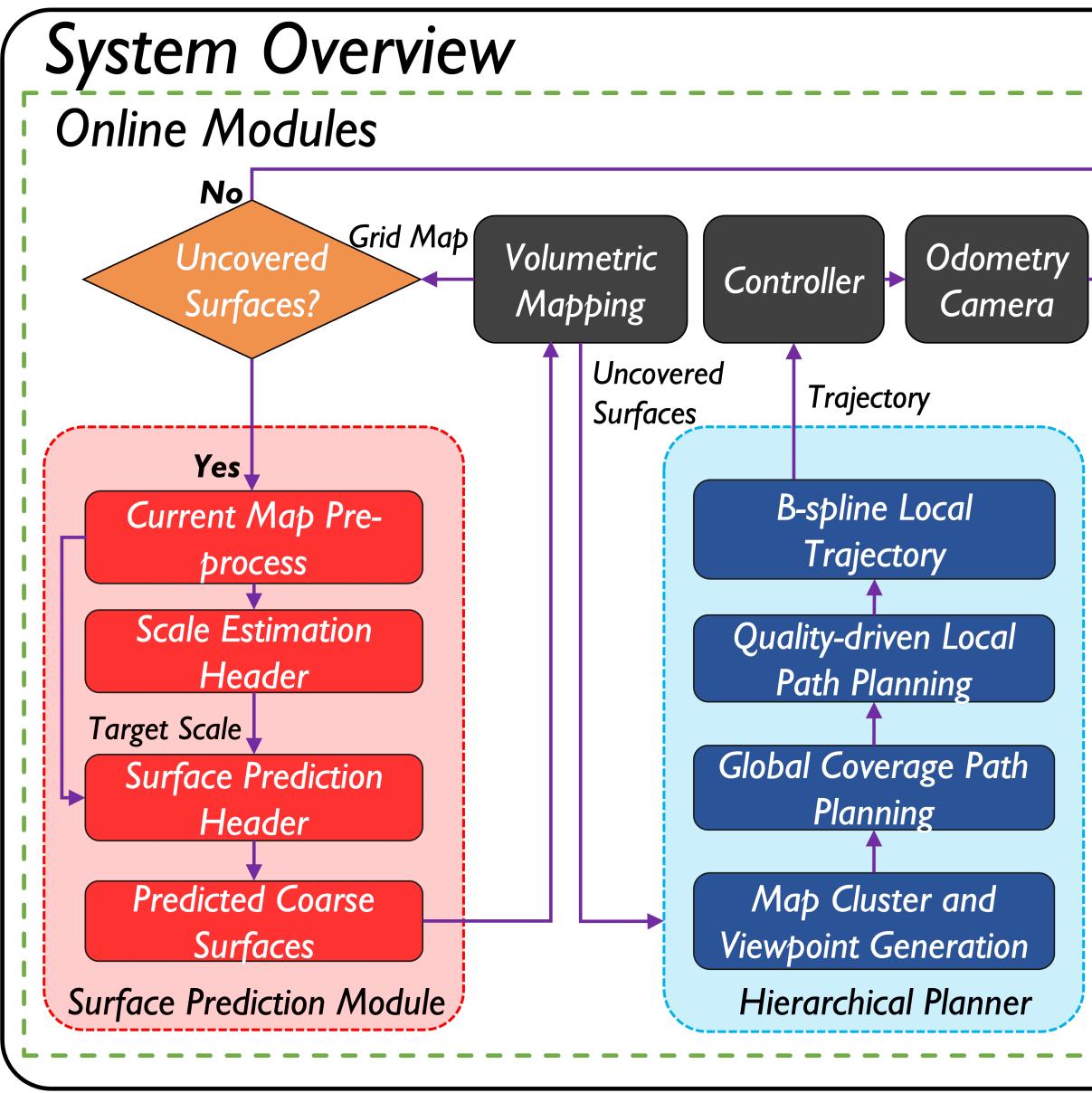


Surface Prediction Module (SPM) Existing Aerial Reconstruction Approaches Predict the whole surfaces of the target from partial map to decrease redundant flight. Surface Prediction Module (SPM) Scale Estimation Header Current Map Input Surface Prediction Header Coarse to Predicted Internal Predicted Surfaces Ground Truth Supervision System Overview Space **Hierarchical Planner Online Modules** Offline 3D **Global Coverage Path Planning** Recon Grid Map Volumetric Odometry Jncovered Controller Mapping Camera Uncovered Trajectory Surfaces Target Model Efficiently & Yes **Completely &** COLMAP B-spline Local Current Map Pre-Trajectory Fast process Scale Estimation Yes Quality-driven Local cover surfaces Header Path Planning End? Target Scale Global Coverage Path Surface Prediction Planning Header Image-Map Cluster and Predicted Coarse Quality-driven Local Path Planning pose Pair Viewpoint Generation Surfaces Database Surface Prediction Module Hierarchical Planner Dijkstra Graph Search quality Internal Space 📃 Covered Surface 🔲 External Space 📕 Uncovered Surface Clusters // Local Path 🗮 Viewpoint 🗮 Optimal Viewpoint Viewpoints Sampling Space 🔨 Triangulation Unit 🛛 🔨 Local Trajectory

- **Task completion inefficiency**
- to exploration

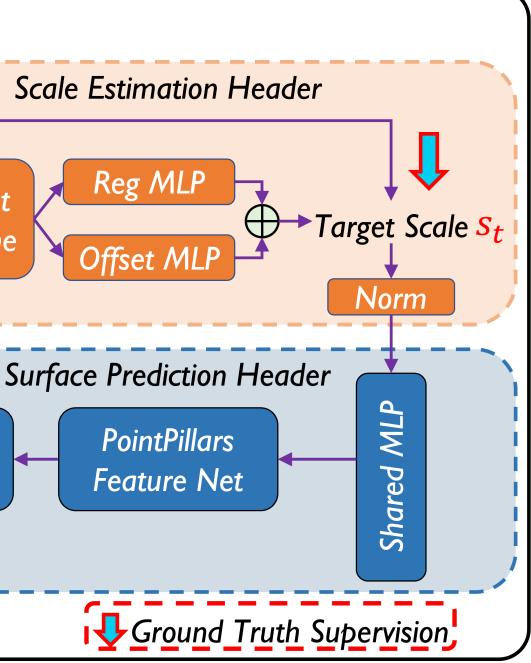
• *Explore-then-exploit* method: Need two scanning trails \rightarrow • Prior-based method: Planning entirely based on prior information \rightarrow Task cannot be fully automated • Exploration-based method: Distribute significant time to explore unknown regions \rightarrow Unsatisfactory efficiency due **Our Prediction-boosted Planning Framework 1)** A surface prediction module (SPM), which directly infers the complete target surfaces from partial reconstruction information and facilitates efficient global coverage of the target without wasting significant time on extra exploration. 2) A hierarchical planner based on SPM, which sufficiently considers MVS-related factors on the fly and global coverage,

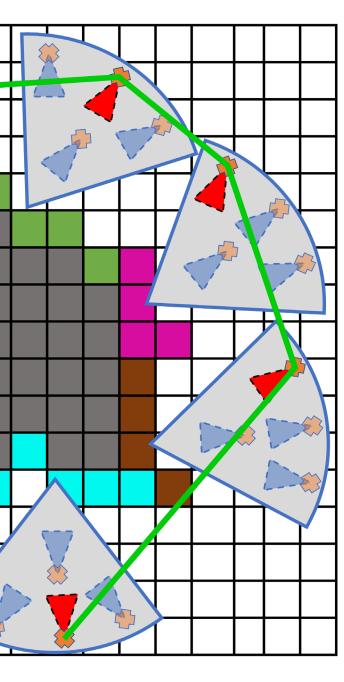


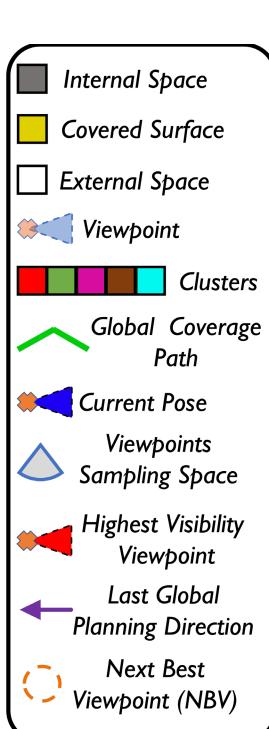
achieving higher reconstruction quality and efficiency.

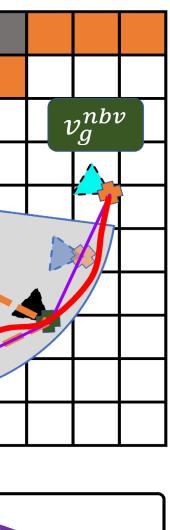
PredRecon: A Prediction-boosted Planning Framework for Fast and High-quality Autonomous Aerial Reconstruction Chen Feng², Haojia Li², Fei Gao³, Boyu Zhou^{1,#}, and Shaojie Shen²

¹Sun Yat-Sen University, ²The Hong Kong University of Science and Technology, ³Zhejiang University

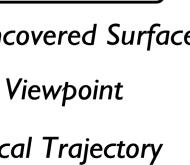


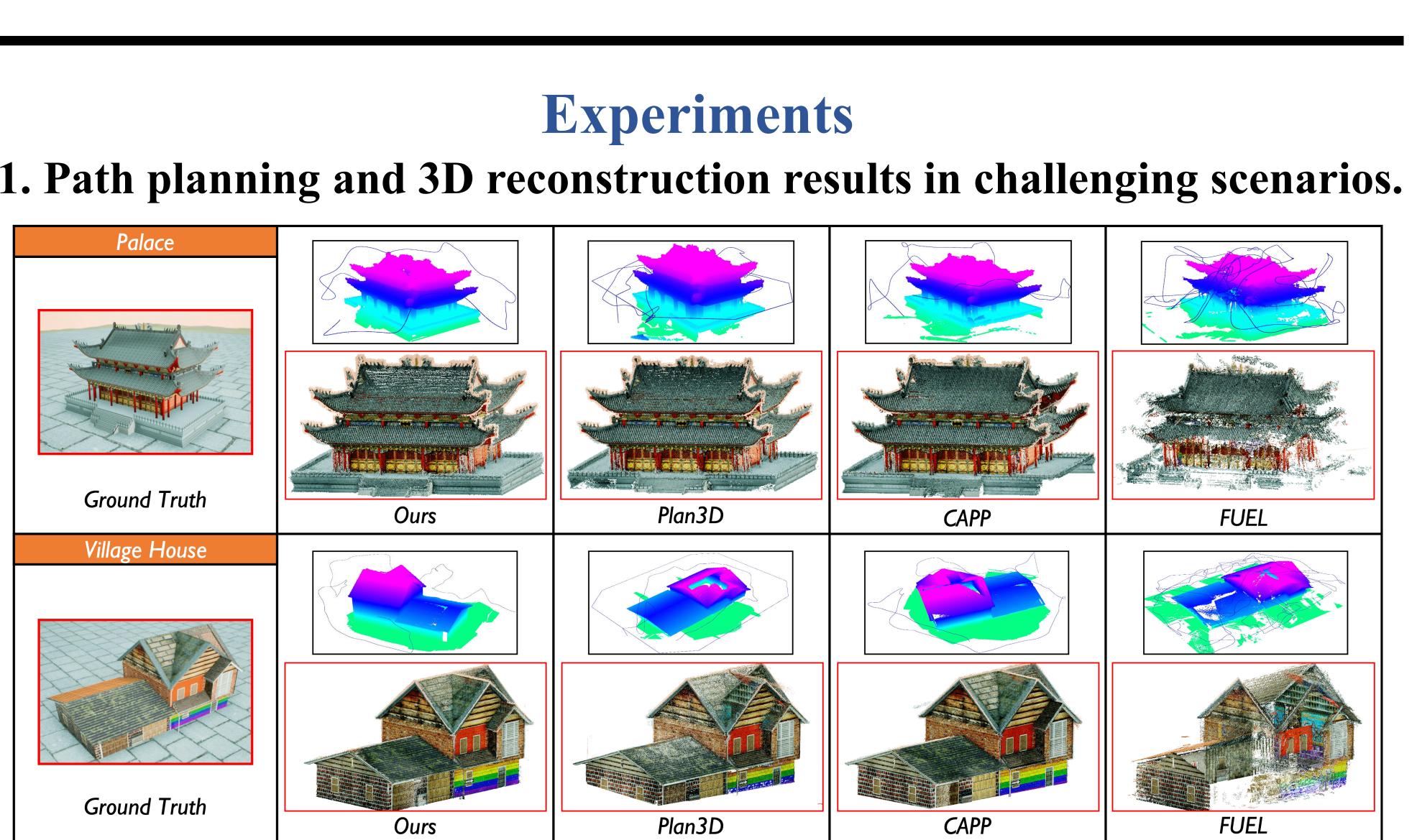






Generate path with higher reconstruction





Best efficiency (path leng and time) & reconstructi quality (F-score)

 $2(Precision \times Rec$ F - score =Precision + Rec

2. Real-time capability

	SPM	Global	Local	Traj.	Total
		Planning	Planning	Opt.	Comp.
Time (ms)	$\sim \! 26.8$	~93.5	~ 0.5	~ 3.7	$\sim \! 124.7$

3. Point cloud completion performance

Method	#Param(M)	L1_CD (1e-3m)	L2_CD (1e-4m)	F-score (%)	
our SPM	28.20	13.6404 / 9.4461	14.7100 / 3.9368	52.6050 / 68.6693	
PCN [15]	28.91	15.5221 / 10.4897	18.3987 / 4.7431	50.1210 / 65.7207	

Paper, code, and video are available: https://github.com/HKUST-Aerial-Robotics/PredRecon



gth tion	Palace	Method	Prior	Path	Time	Recall	Precision	F-score
			Model	Length (m)	(s)	(%)	(%)	(%)
		Plan3D [2]	×	375.5	507.7	74.48	82.57	78.32
		CAPP [1]	\checkmark	243.6	322.6	69.21	85.86	76.64
		FUEL [6]	×	371.1	469.8	40.31	38.38	39.32
		Ours	×	213.1	252.7	74.67	86.45	80.13
	Village House	Plan3D [2]	×	239.3	310.6	64.28	72.86	68.30
		CAPP [1]	\checkmark	193.4	242.3	80.30	84.60	82.40
		FUEL [6]	×	405.1	506.8	44.35	36.46	40.02
		Ours	×	153.2	184.6	84.54	83.13	83.83