Prior Guided Dropout for Robust Visual Localization in Dynamic Environments

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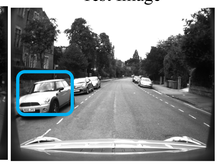
SenseTime Research

Introduction

Training Image

Test Image

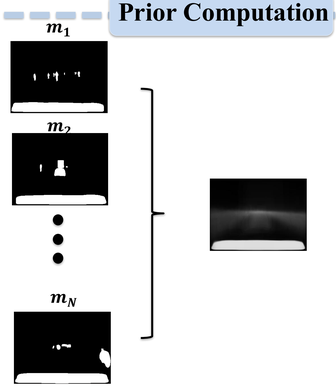


Foreground objects are different in training and test images, which introduces bias when learning a camera pose regressor and leads to unstable localization.

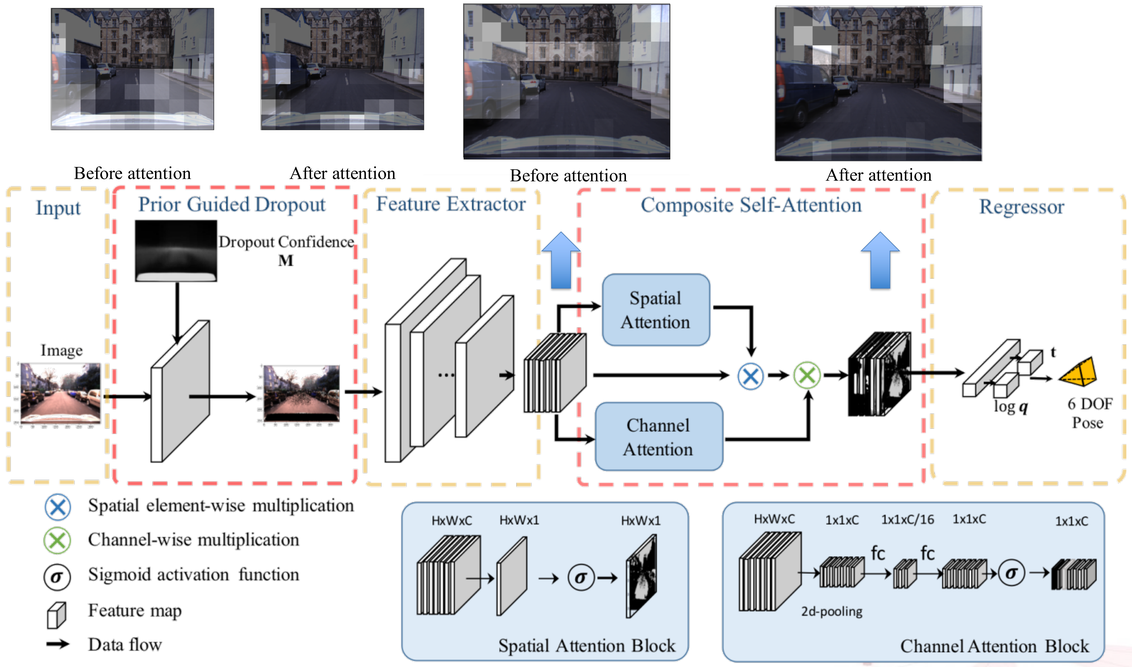
Movable objects in dynamic environments should not be treated as landmarks. We propose to improve the robustness of CNN-based pose regressor in dynamic environments through three steps:

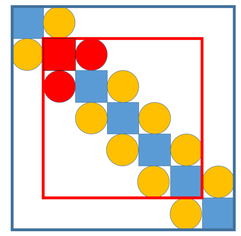
- Compute prior distribution for our proposed prior guided dropout.
- Train the pose regressor with a prior guided dropout module and a composite self-attention model, so that the regressor ignores distracting information from foreground objects and focuses on essential landmarks in the background for robust localization.
- Quantify the uncertainty of pose estimation from multiple hypotheses given by the proposed dropout method and feed the uncertainty measures into uncertainty-aware pose-graph optimization.

Prior Computation

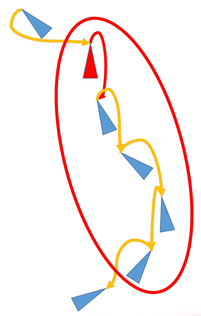


Architecture



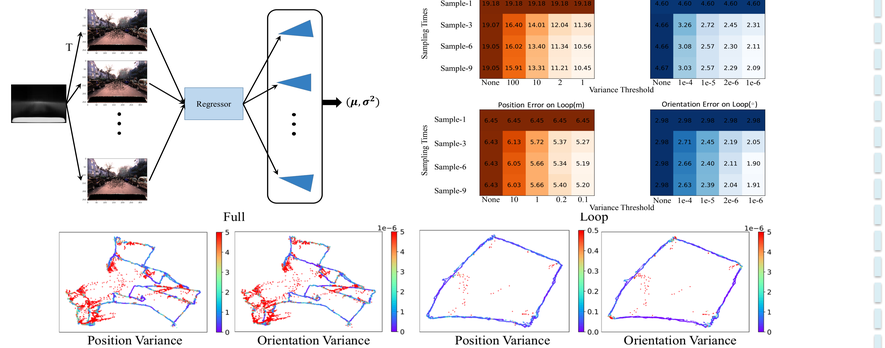


Information matrix

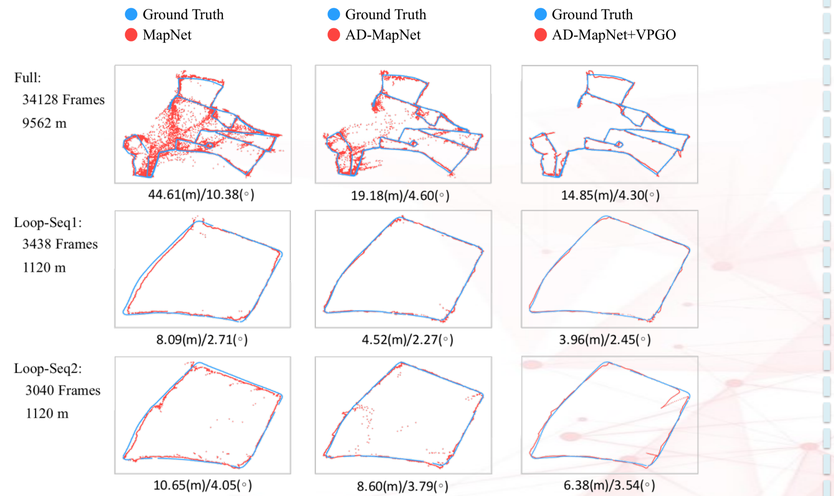


Sliding window PGO

Uncertainty



Experiments



Scene	DSAC	ORBSLAM2	DBoW3	Stereo VO	PoseNet	MapNet	AD-MapNet
Full	N/A	N/A	222.49m,33.80°	80.32m,13.73°	46.61m,10.45°	44.61m,10.38°	**19.18m,4.60°**
Loop	N/A	N/A	7.88m,3.87°	22.42m,45.50°	7.90m,3.53°	9.29m,3.34°	**6.45m,2.98°**
Average	N/A	N/A	115.19m,18.84°	51.37m,29.62°	27.26m,6.99°	26.95m,6.86°	**12.82m,3.79°**

Scene	PoseNet	A-PoseNet	D-PoseNet	AD-PoseNet	AD-PoseNet+CPGO	AD-PoseNet+VPGO
Full	46.61m,10.45°	62.46m,11.95°	38.56m,10.45°	33.82m,6.77°	**27.35m**,6.88°	27.37m,**6.18°**
Loop	7.90m,3.53°	12.55m,4.63°	7.57m,3.61°	6.40m,3.09°	7.04m,3.03°	**6.49m,2.80°**
Average	27.26m,6.99°	37.51m,8.29°	23.07m,7.09°	20.11m,4.93°	17.20m,4.96°	**16.93m, 4.49°**

Scene	MapNet	A-MapNet	D-MapNet	AD-MapNet	AD-MapNet+CPGO	AD-MapNet+VPGO
Full	44.61m,10.38°	30.02m,6.97°	32.64m,10.07°	19.18m,4.60°	18.84m,13.73°	**14.85m,4.30°**
Loop	9.29m,3.34°	8.41m,3.41°	9.72m,3.77°	6.45m,2.98°	6.37m,3.12°	**5.10m,2.96°**
Average	26.95m,6.86°	19.22m,5.19°	21.18m,6.92°	12.82m,3.79°	12.61m,8.43°	**9.98m,3.63°**

- The D-* and A-* ones denotes the model only applied with the prior guided dropout or self-attention module in training, and the models who named with prefix 'AD' are armed with both prior guided dropout and self-attention module.
- Our uncertainty-aware PGO method (*+VPGO) is also evaluated by comparing with the version (*+CPGO) adopted by Brahmbhatt *et al*.