Learning to Localize Using a LiDAR Intensity Map

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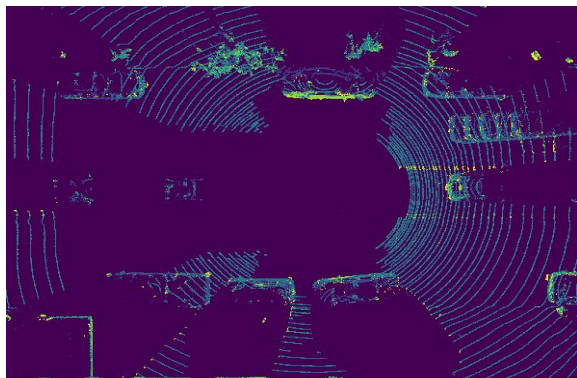**UNIVERSITY OF TORONTO**

Motivation & Challenges

- Localize w.r.t. a high-definition map with cm-level accuracy using LiDAR
- Enable use of high-definition maps for detection, prediction, etc.
- Several challenges must be overcome

Dynamic Objects

Degenerate geometry
with no useful cues

Different LiDAR Types

Probabilistic Framework

- Compute 3 DoF pose w.r.t. map (x, y, heading).
- Online: At every time step (t) perform a bayesian filtering step:

$$\text{Bel}_t(\mathbf{x}) = \eta \cdot \boxed{P_{\text{LiDAR}}(\mathcal{I}_t|\mathbf{x};\mathbf{w}) P_{\text{GPS}}(\mathcal{G}_t|\mathbf{x})} \boxed{\text{Bel}_{t|t-1}(\mathbf{x}|\mathcal{X}_t)}$$
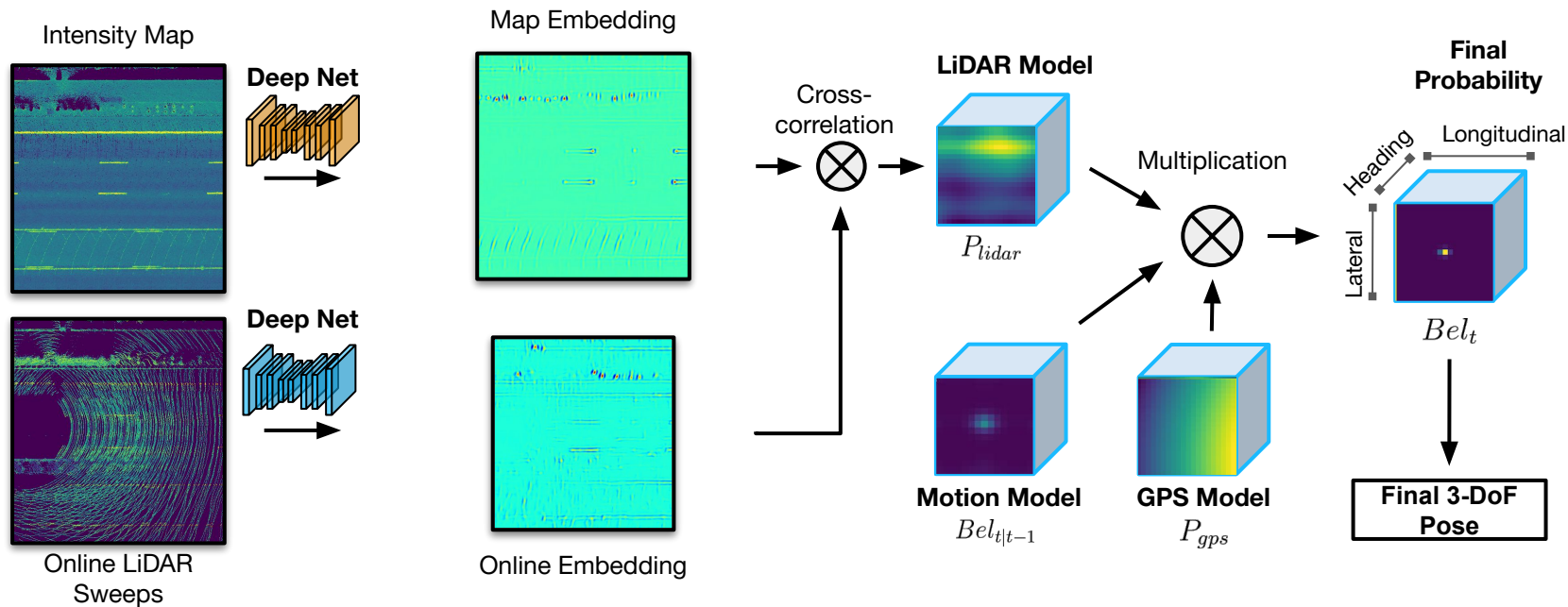
Pose

Observation
(We learn the LiDAR term)

Predicted State

LiDAR Matching

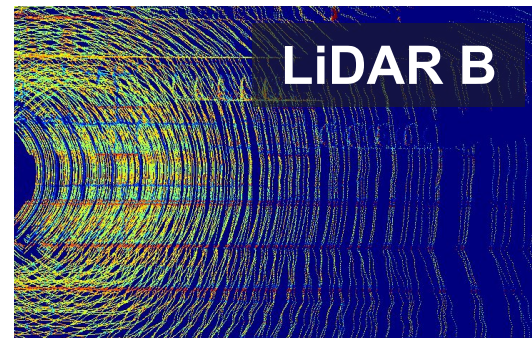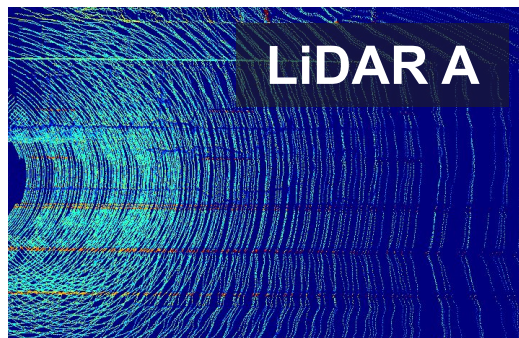- Operate in **bird's eye view** and **learn** LiDAR and map representation best suitable for matching.
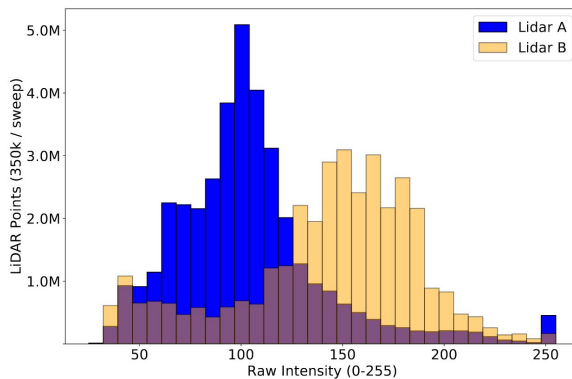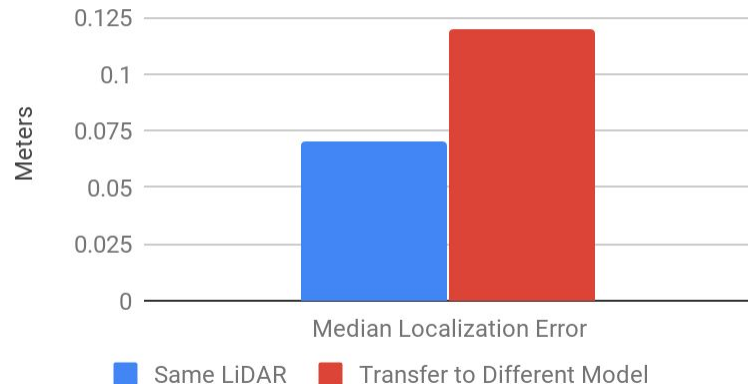
Results Overview

	Median	99th percentile
Lateral Error (cm)	3.00	16.24
Longitudinal Error (cm)	4.33	22.18
Total Error (cm)	6.47	25.01

Results: Transfer to a Different LiDAR

- Our method is also able to transfer reasonably well to a **different type of LiDAR** without retraining or any intensity calibration.

Thank you for your attention!