LM-Reloc: Levenberg-Marquardt Based Direct Visual Relocalization

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https://vision.in.tum.de/lm-reloc

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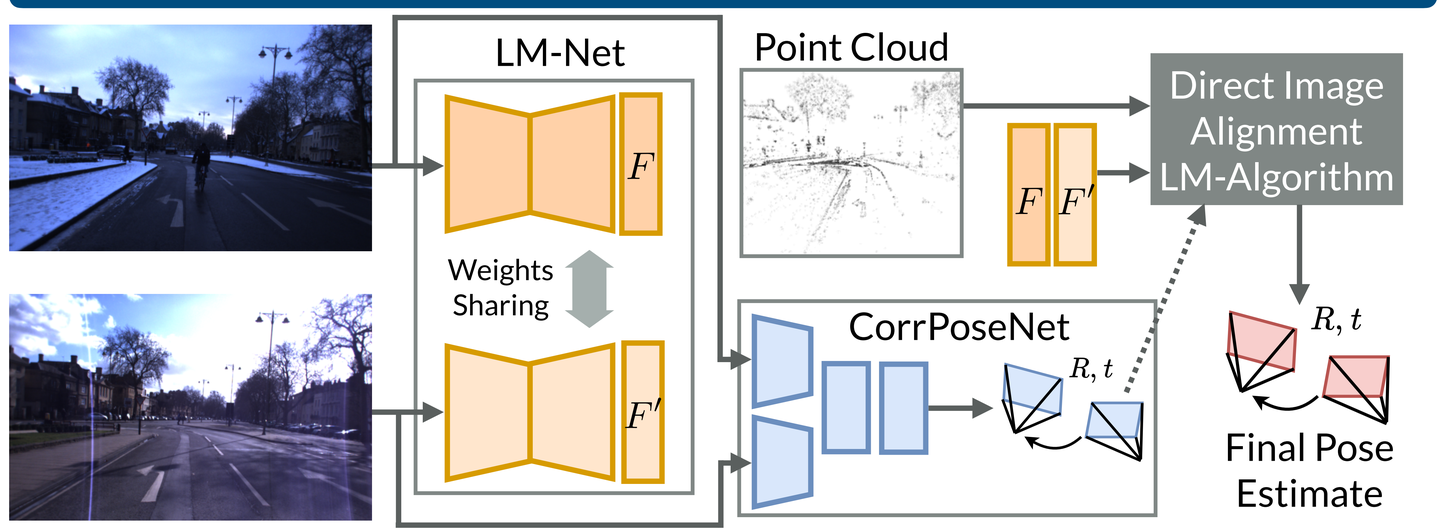
Contributions

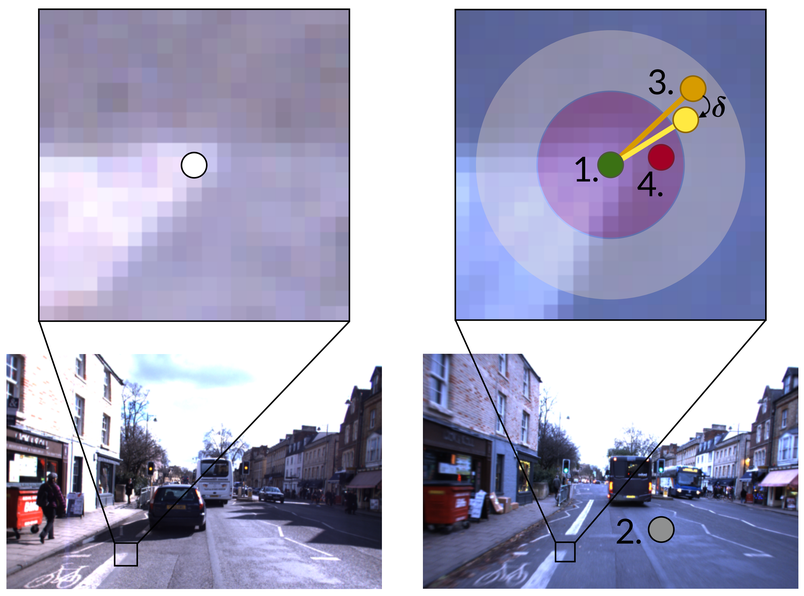
Direct pipeline for 6DoF pose estimation for relocalization without feature matching or RANSAC:

- **Novel loss formulation** and point sampling strategy to learn optimal features for the LM-algorithm
- **CorrPoseNet** to bootstrap the direct image alignment
- Extensive **evaluations** on the CARLA and Oxford RobotCar relocalization tracking benchmark

Method Overview



Novel Loss Formulation Optimal for Levenberg-Marquardt



Direct Image Alignment minimizes: $E(\mathbf{R}, \mathbf{t}) = \sum_{\mathbf{p}} \left\| F'(\mathbf{p}') - F(\mathbf{p}) \right\|_\gamma$

1. The point is at the correct location

➡ The residual should be small!

$$E_{\text{pos}} = \|F(\bigcirc) - F'(\bullet)\|^2$$

2. The point is an outlier

➡ The residual should be large!

$$E_{\text{neg}} = \|F(\bigcirc) - F'(\bullet)\|^2 > M$$

3. The point is relatively far

➡ Gradient shall point in right direction.

$$E_{\text{GD}} = \underline{\text{dist}_{\text{after}}} < \underline{\text{dist}_{\text{before}}} - \delta$$

4. The point is very close

➡ Now we should converge quickly.

$$E_{\text{GN}} = \text{Gauss-Newton Loss}$$

Experimental Results