In a nutshell

- MR-Flow estimates
  - Segmentation of moving objects
  - 3D structure in the static parts
  - Optical Flow

- Reasoning about the geometry allows:
  - Better temporal integration
  - Regularizing surfaces instead of the flow
- Top performance, especially in occluded regions.

Code is available: https://github.com/jswulff/mrflow

**Introduction**

- Natural scenes are mostly static and do not move.
- The optical flow in static parts is determined by the depth and camera motion.
- In static parts, the depth is constant in time.
- Moving surfaces correspond to objects, and recent progress in semantic segmentation yield good object segmentation results.

Basic idea: We split the scene into the static background and moving objects, and impose strong constraints wherever appropriate.

**Semantic rigidity estimation**

- KITTI: Segment using DeepLabv3+ on KITTI; assign rigidity to classes.
- MPI-Sintel: Pre-trained semantic segmentation does not work. Instead, we re-train the CNN on ground-truth rigidity segmentation.

**Motion estimation in the static scene**

- SIM requires many frames, wide baselines ↔ Optical Flow: only few frames and small baselines are available.
- Instead of SIM, we use Plane-Parallel (Pfitzner et al. ECCV14).

- Definition of Parallax:
  - Parameter for the distance between cameras.

- To improve results, especially in occlusions, we compute the structure in forward and backward directions and merge both, followed by a variational refinement.

**Results**

- MPI-Sintel: Rank 1 on Clean, Rank 3 on Final.

**Future work**

- Combine geometry with end-to-end learning.
- Stronger temporal consistency in segmentation.
- Higher-level reasoning (e.g., object support).