Visual Odometry
• Papers :
• Points and Plane SLAM
• LSD
• SVO
• Features to use.
• Semantics to exploit.
• Depth Filtering
• Optimization
SVO

• Semi Dense Visual Odometry
• Sparse feature based model alignment, no feature matching.
• Depth using Bayesian filtering.

• Bayesian Update Step:
Implementation Details:

**USP:**
- Fast and Real-time on a CPU.
- Can handle arbitrary motion.

**Challenges:**
- Would not work in areas with varying depths
SVO: Fast Semi-Direct Monocular Visual Odometry

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### Tracking

- **New Image**
  - (640 x 480 at 30Hz)

- **Track on Current KF:**
  - estimate SE(3) transformation

    \[
    \min_{\xi \in \mathfrak{se}(3)} \sum_p \left\| \frac{r^2_p(p, \xi)}{\sigma^2_{r_p}(p, \xi)} \right\|_2
    \]

- **Tracking reference**

### Depth Map Estimation

- **Take KF?**
  - yes
  - Create New KF
    - propagate depth map to new frame
    - regularize depth map
  - Refine Current KF
    - small-baseline stereo
    - probabilistically merge into KF
    - regularize depth map
  - no
  - replace KF
  - refine KF

### Current KF

- [Images of depth maps]
• Details about method
• Dense tracking by whole image alignment.
• Semi-dense by reduction based on image information.
• Probabilistic depth map representation.
• Incorporation of stereo measurement uncertainty.
• Semi dense map.

• Semi dense map using depth at image gradients
• Geometric Error:

• Photometric
• Dense Tracking:
• Implementation Details:

• **USP**: Fast, Real-time on CPU
• Works in all environments.
• **Challenges**: Depth filtering.
Plane and Points SLAM

- Use semantics like Planes to localize.
- Points and planes are duals.
• Method:

• Bundle adjustment with points and planes.
• Implementation details

• **USP:**
  • Fast and Map reduction.
  • Accurate and semantically meaning full maps.

• **Challenges:**
  • Plane detection and segmentation.
• Results