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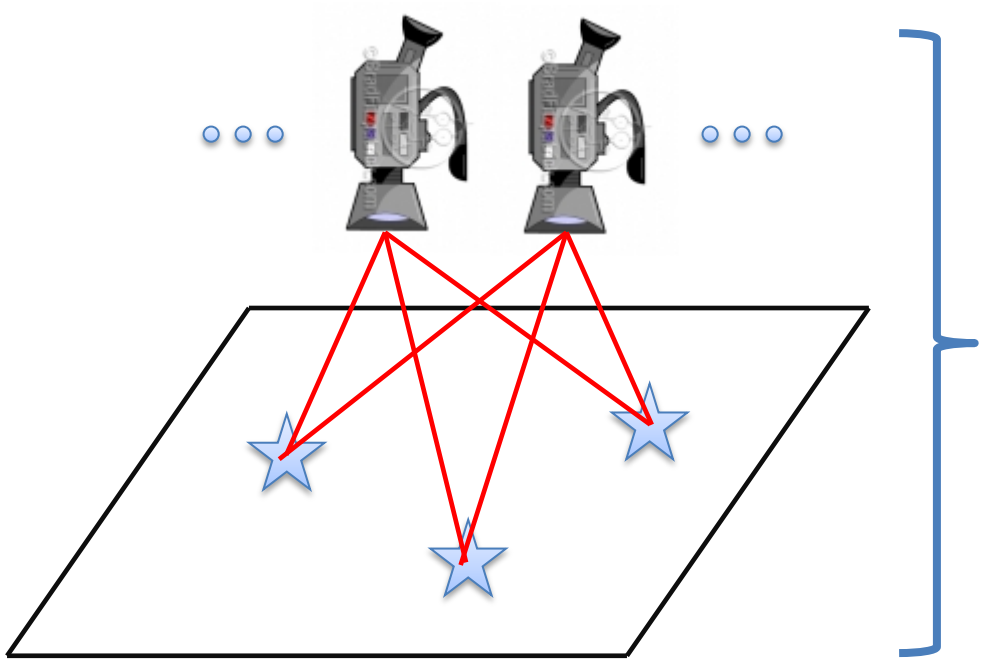
Monocular Visual SLAM with Active Contours

by Julian Straub

Simultaneous Localization and Mapping (SLAM)



Estimate:

Trajectory of Camera

+

Position of Features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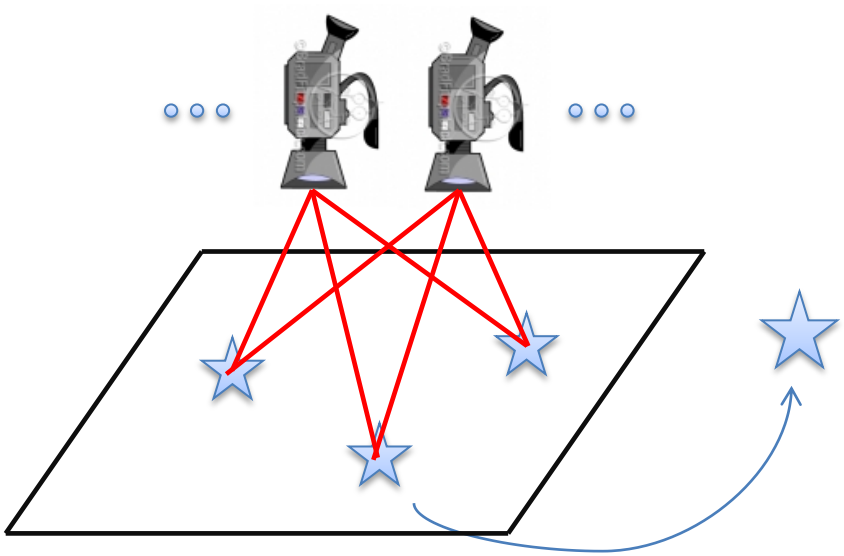


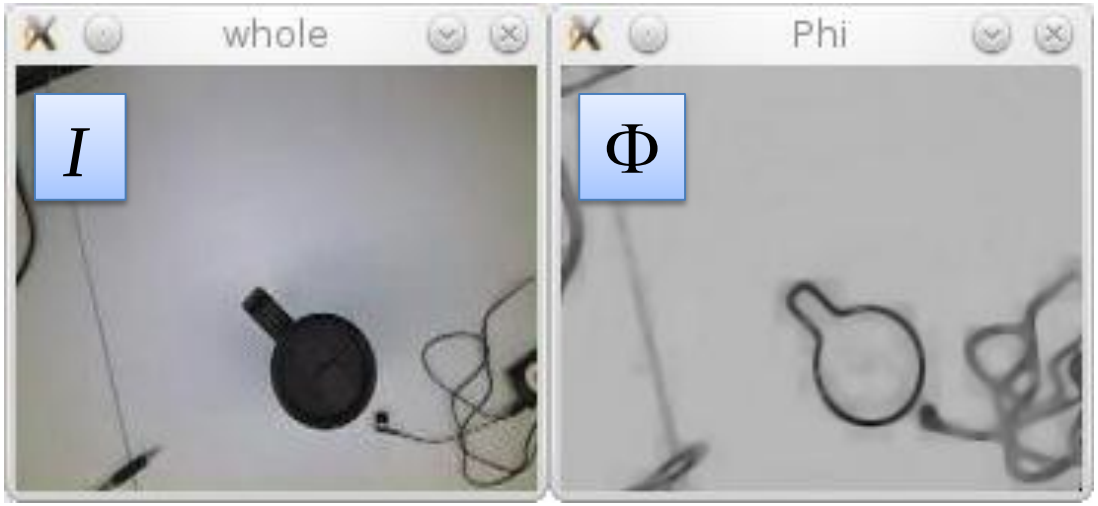
?

- Regions
  -> Active Contours

- Corner Features
  -> SIFT, SURF, FAST

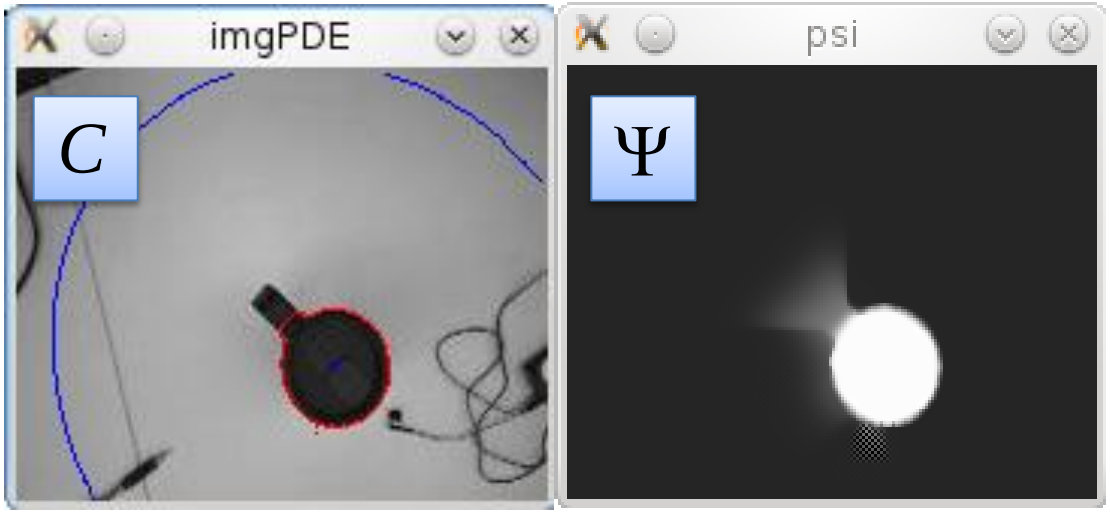
Extract regions surrounded by high gradients

$$E = \int_C \Phi ds \quad \text{where} \quad \Phi = \frac{1}{1 + \|\nabla I\|}$$



=> Gradiant descent flow: $C_t = \Phi C_{SS} - \nabla\Phi$

$$\Psi_t = \hat{\Phi}\|\nabla\Psi\| \cdot \nabla \bullet \left(\frac{\nabla\Psi}{\|\nabla\Psi\|}\right) + \nabla\hat{\Phi} \bullet \nabla\Psi$$



Initialize Contour

Evolve Contour: $C_t = \Phi C_{SS} - \nabla\Phi$

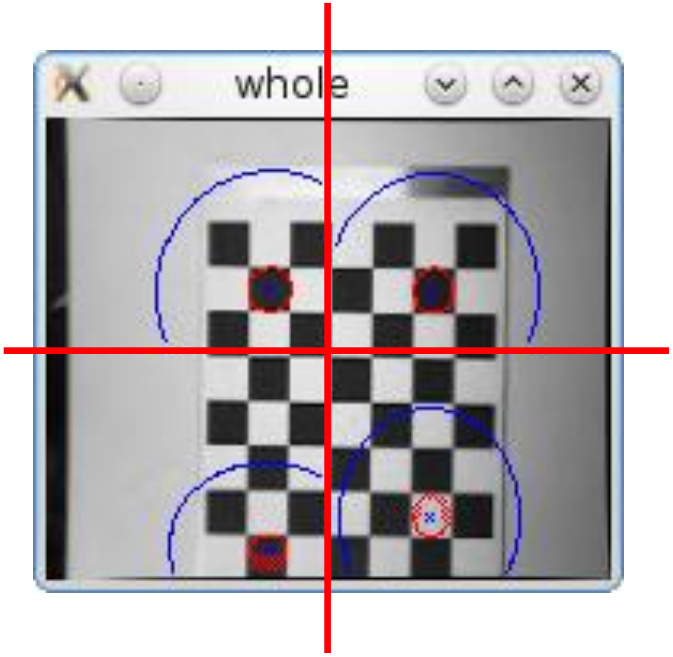
- Central and upwind differences
- Fast distance transform to compute extensions

Load next Frame

Dilate Contour:

$$C_t = -N$$

- Upwind entropy difference



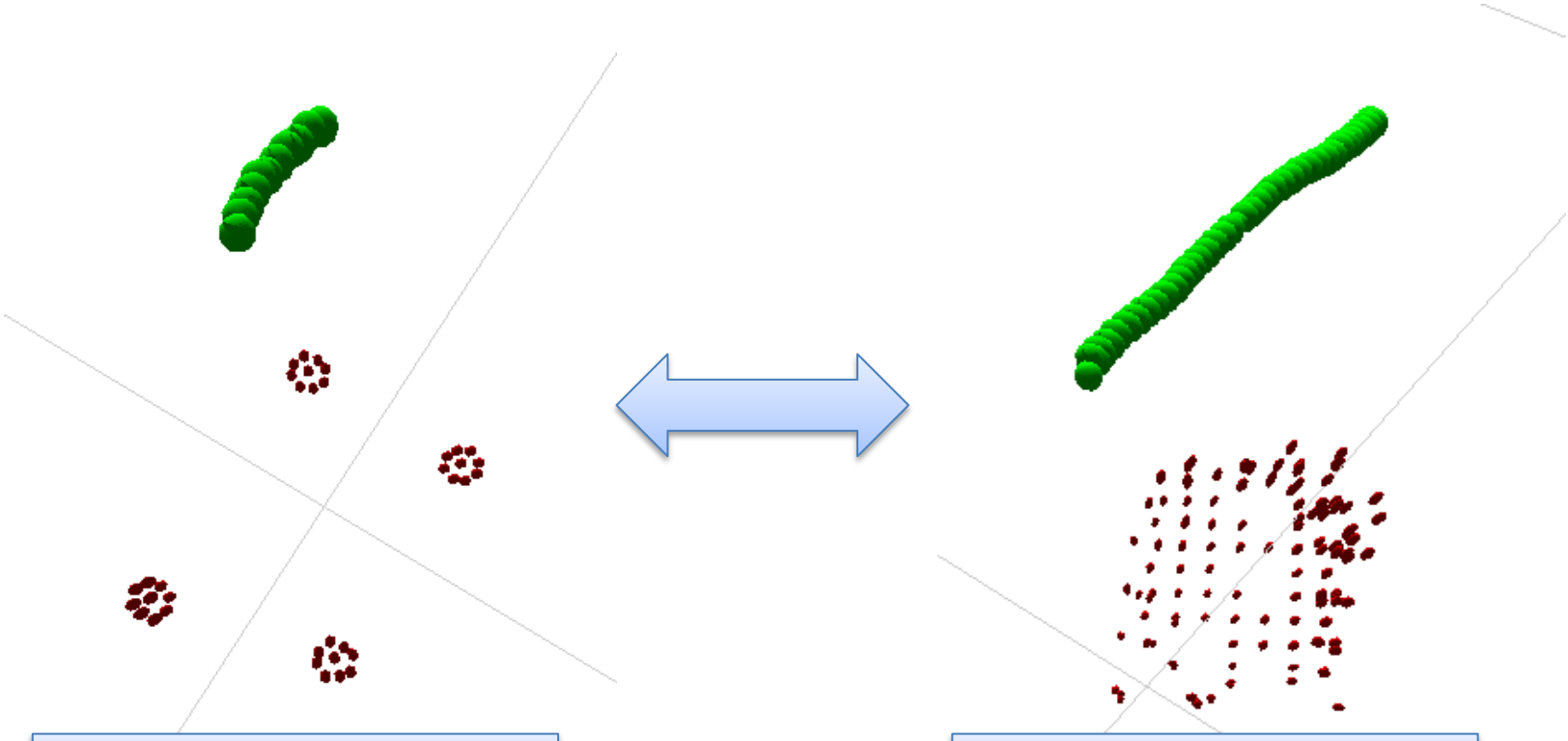
SLAM Solver

Track contours in 4 sub-frames individually

Projected estimates of contours after 10 frames

Active Contours

Corner Features(SURF)



about 1 frame/min

about 10 frames/min

Active Contours for Monocular SLAM

Pro

- More information than corner features
- Stable features
- Easy data-association

Con

- High computational cost
- Initialization of contours
- Frames need to have distinc regions

Future Work

- Extract motion information from shape changes
- Automated initialization of contours
- Speed computations up

Questions?

Thoughts?

Thanks!