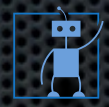

Robotics and
Embedded Systems

Applied Computer Vision for Robotics

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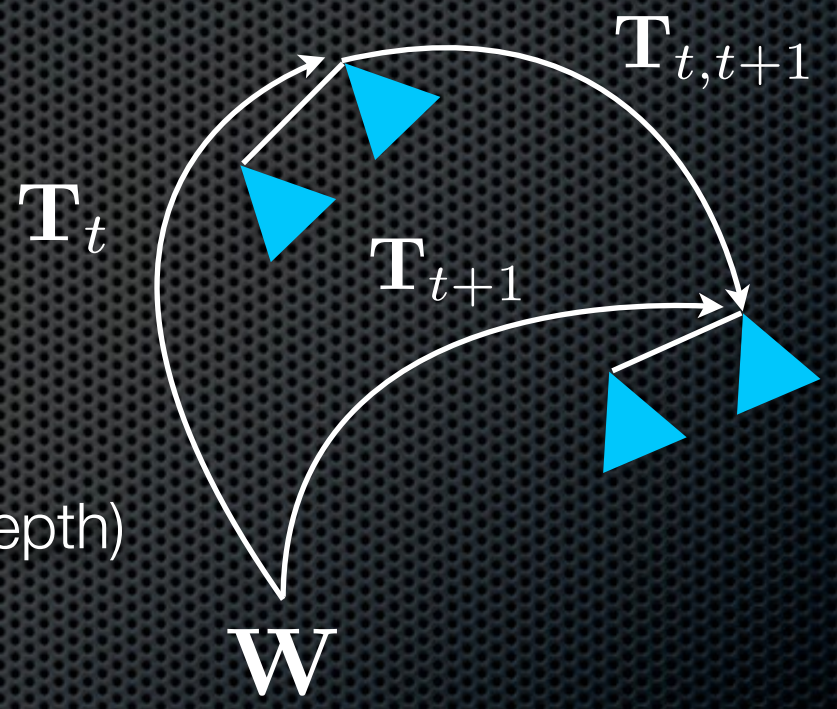
Stereo Visual Odometry

- Input: Calibrated Stereo
- Ouput: Motion Estimation

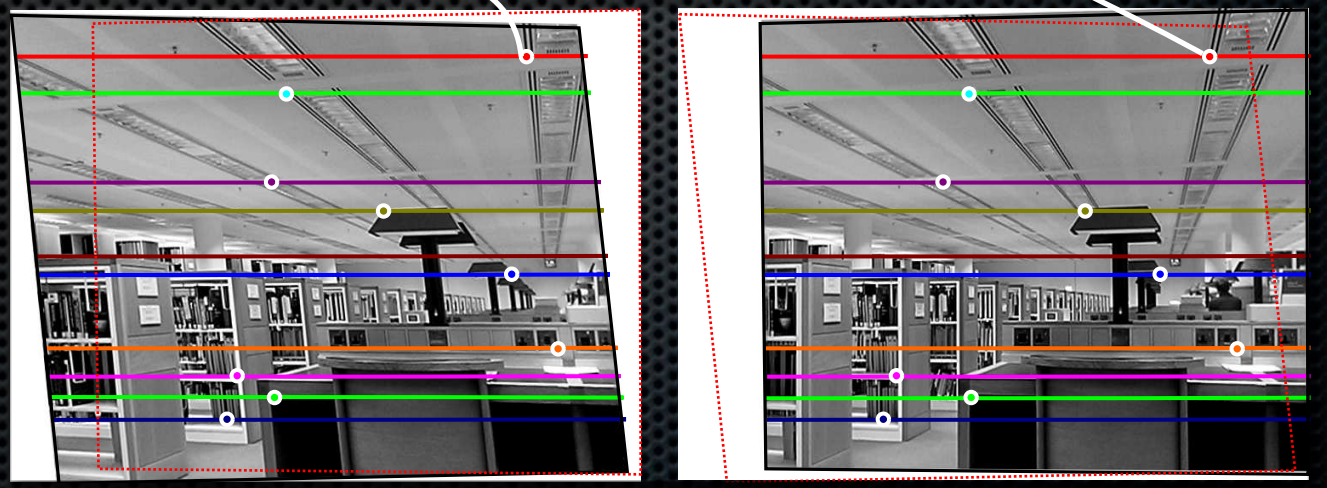


- Feature-based:
  - left-right matches ⇒ disparity (depth)
  - (t) - (t+1) matches ⇒ motion
  - 3D-3D Pose-From-Points

Disparity

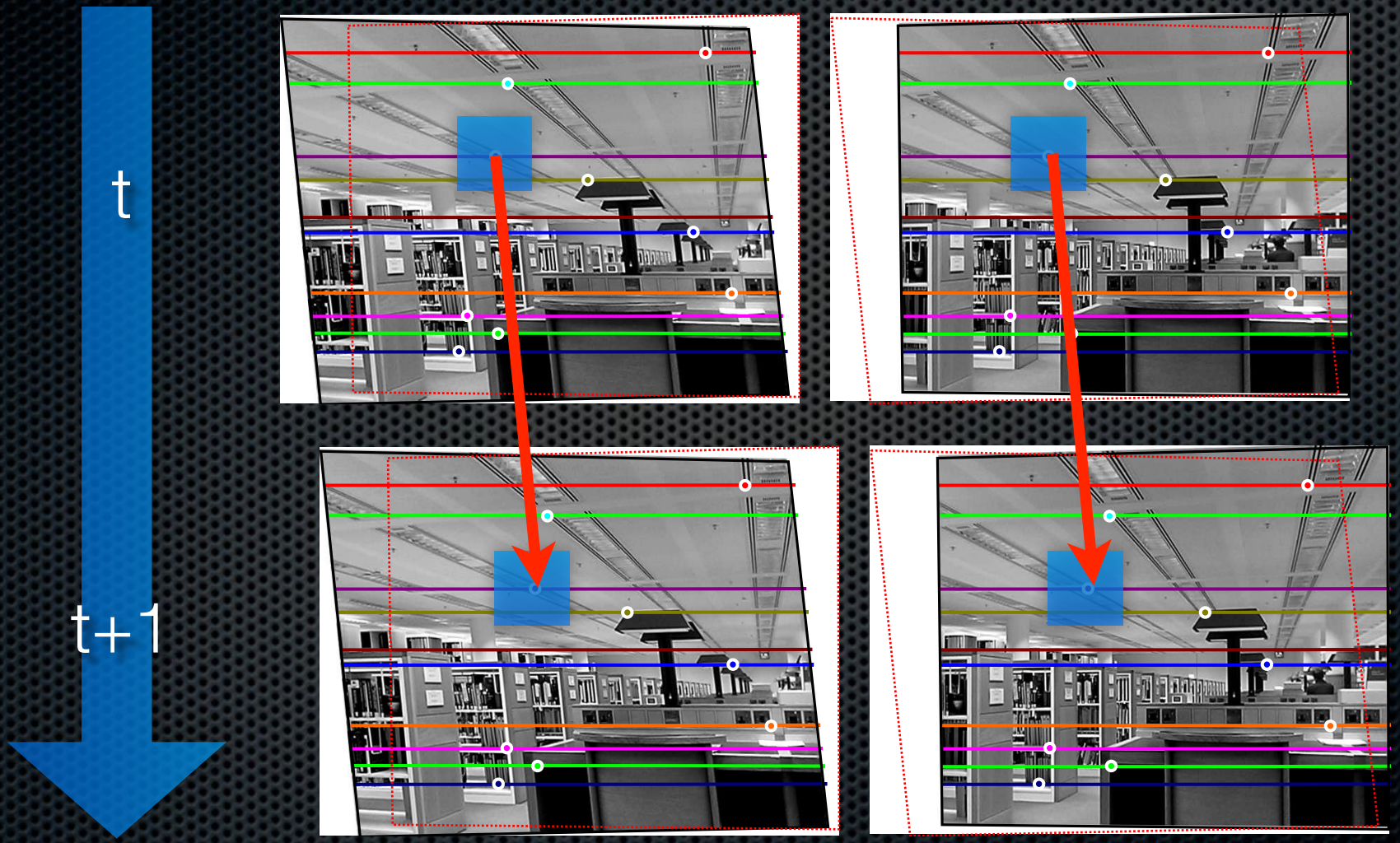
- Rectified Input ⇒ Epipolar Constraint
- Disparity: $d = x_l - x_r$

$$Z = \frac{f \cdot B}{d}$$

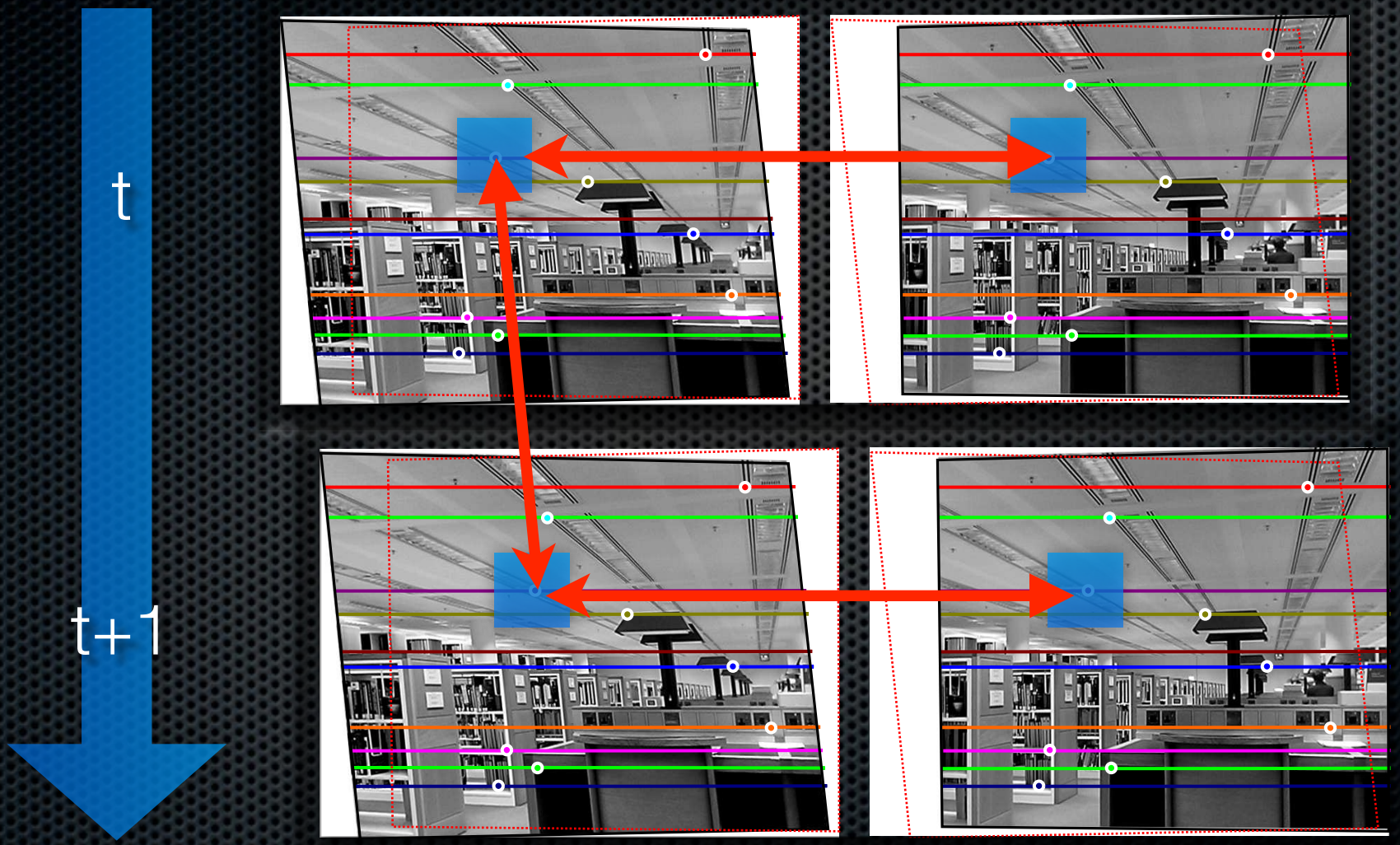


[1] R. Szeliski, Computer Vision: Algorithms and Applications, 1st ed. New York, NY, USA: Springer-Verlag New York, Inc., 2010.

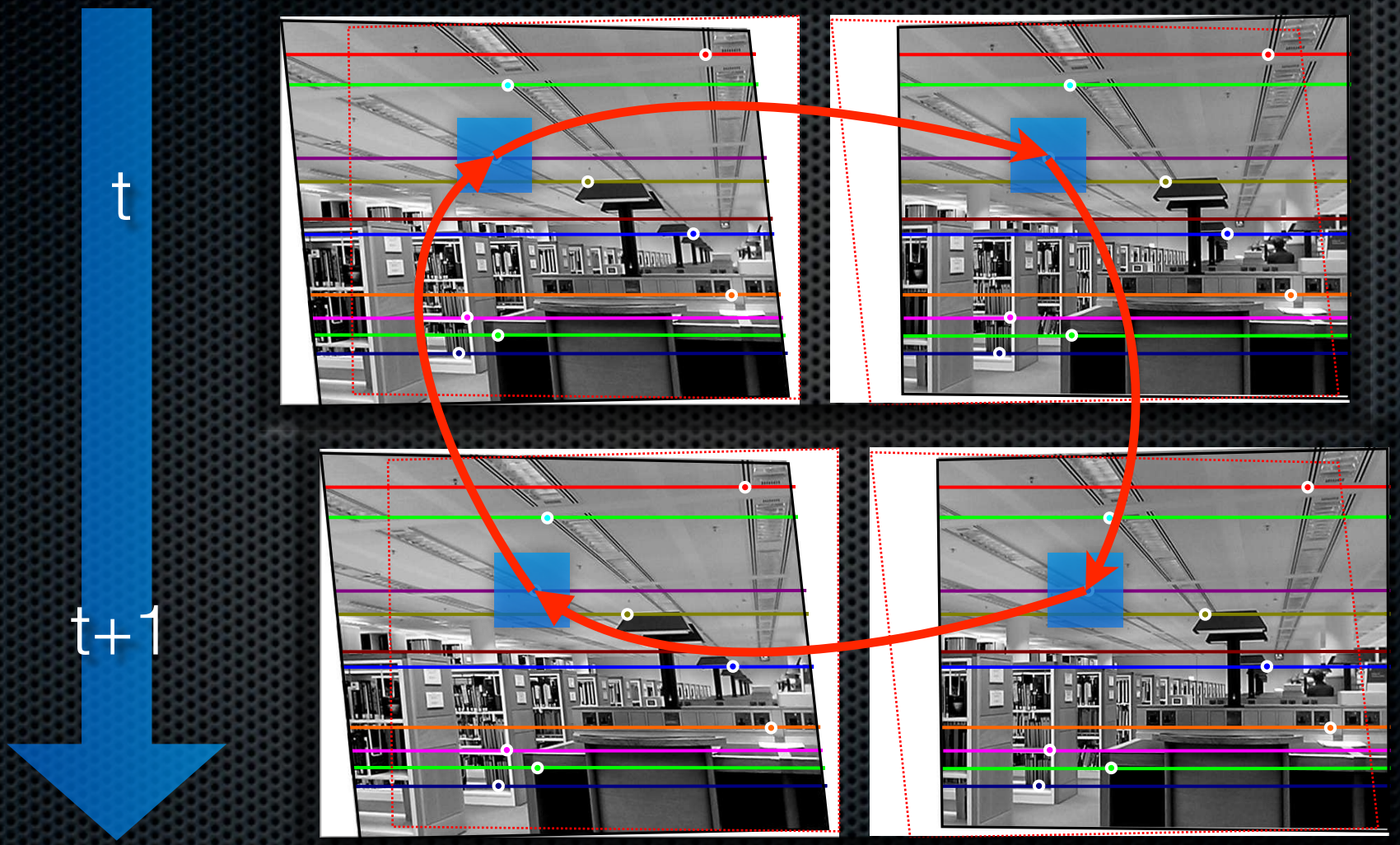
Frame-By-Frame Tracking



Reciprocal Tracking

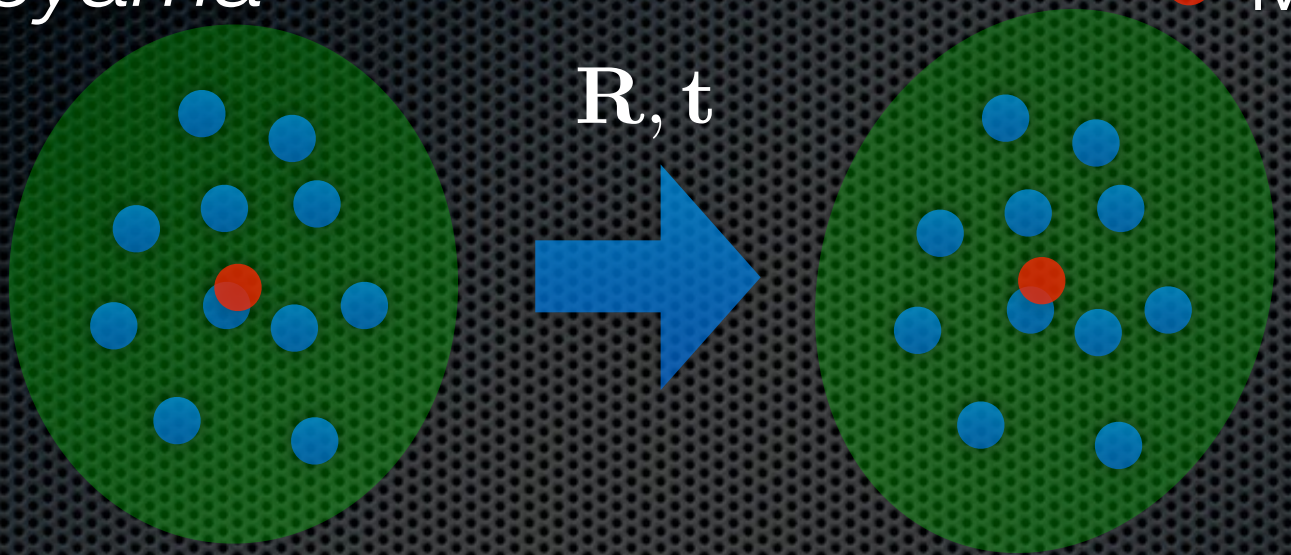


Circular Tracking



Pose from 3D-3D Matches

Umeyama



- Rotation: SVD of correlation matrix of demeaned points
- Translation: $\bar{\mathbf{x}} - \mathbf{R}\bar{\mathbf{y}}$
- http://cis.jhu.edu/software/lddmm-similitude/umeyama.pdf

[1] S. Umeyama, “Least-Squares Estimation of Transformation Parameters Between Two Point Patterns,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 13, no. 4, pp. 376–380, 1991.

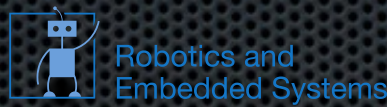
Goal

- Calculate 3D point for each time step
- Use 3D points and their corresponding 3D point from the previous time step to calculate the motion
- 3D point estimation and association over time not robust
  ⇒ need strategy to find reliable correspondences
  ⇒ embed into RANSAC framework

Optional: RGBD

- Use bag files of RGB-D Datasets: http://vision.in.tum.de/data/datasets/rgbd-dataset/download
- Replace “stereo” part by access to the depth image to obtain the depth for a feature

Visualization



- Feature Matches
- 3D trajectory
- 3D flow
- PointClouds
- checkout rviz Visualization: http://www.ros.org/wiki/rviz/DisplayTypes/Marker