Plane_Edge_SLAM

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OUTLINE

- 实验一：平面参数估计方法
- 实验二：w_{pk}加权
- 实验三：Visual Odometry (no final optimization)
- 实验四：Loop Closing and Map Optimization
- 实验五：VO runtime
- 实验六：Real scene experiment (尝试)

实验结果

Table: **实验一**：平面参数估计方法；指标：ATE(Absolute Trajectory Error) RMSE；参数设置：$\alpha = 1, \beta = 1$。

	LS	LS(noise)
fr1/desk	0.064m	**0.035m**
fr1/plant	0.061m	**0.049m**
fr2/desk	0.106m	**0.071m**
fr3/office	0.069m	**0.051m**
fr3/str_tex_near	**0.052m**	0.057m

实验结果

Table: 实验二：w_{pk}加权；指标：ATE(Absolute Trajectory Error) RMSE, RPE(Relative Pose Error) RMSE；参数设置：$\alpha = 1, \beta = 1$。

	weight	no-weight
fr1/xyz	**0.031m**	0.058m
	0.006m/0.68deg	0.008m/0.69deg
fr1/desk	**0.035m**	0.062m
	0.009m/1.04deg	0.012m/1.28deg
fr1/plant	**0.049m**	0.066m
	0.008m/0.94deg	0.009m/1.08deg
fr1/floor	0.085m	**0.068m**
	0.009m/0.53deg	**0.008m/0.50deg**
fr2/desk	**0.071m**	0.103m
	0.005m/0.50deg	0.009m/0.79deg
fr3/office	**0.051m**	0.094m
	0.004m/0.42deg	0.010m/0.65deg
fr3/str	**0.052m**	0.061m
	0.005m/0.61deg	0.006m/0.81deg
fr3/cabinet	**0.063m**	0.079m
	0.006m/0.91deg	0.007m/0.95deg

实验结果

Table: 实验三**(a)**：Visual Odometry (no final optimization)；指标：ATE(Absolute Trajectory Error) RMSE；参数设置：$\alpha = 1, \beta = 1$；对比算法：(1)CPA-SLAM[2] (no optimization), (2)STING-SLAM (no optimization).

	Plane-Edge	CPA-SLAM	STING-SLAM
fr1/desk	0.035m	**0.030m**	
fr1/plant	**0.049m**	0.073m	
fr2/desk	**0.071m**	0.095m	0.098m
fr3/office	**0.051m**	0.076m	

1 CPA-SLAM: Consistent Plane-Model Alignment for Direct RGB-D SLAM, ICRA, 2016.

2 CPA-SLAM: Consistent Plane-Model Alignment for Direct RGB-D SLAM, ICRA, 2016.

实验结果

Table: 实验三**(b)**：Visual Odometry (no final optimization)；指标：RPE(Relative Pose Error) RMSE；参数设置：$\alpha = 1, \beta = 1$；对比算法：(1)Semi-Dense VO[4], (2)STING-SLAM.

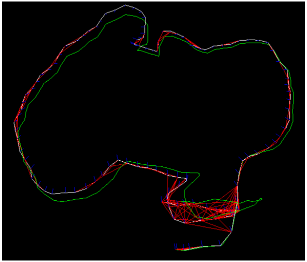
	Plane-Edge	Semi-Dense VO	STING-SLAM
fr1/xyz	**0.006m/0.68deg**	0.041m/1.53deg	0.022m/0.77deg
fr1/floor	**0.009m/0.53deg**	0.012m/0.74deg	
fr2/xyz	**0.002m/0.21deg**	0.004m/0.32deg	
fr2/rpy	**0.002m/0.20deg**	0.004m/0.35deg	
fr2/desk	**0.005m/0.50deg**	0.012m/0.56deg	0.048m/1.57deg
fr3/cabinet	**0.006m/0.91deg**	0.034m/2.69deg	0.011m/1.02deg
fr3/office	**0.004m/0.42deg**	0.010m/0.67deg	

[3] Semi-Dense Visual Odometry for RGB-D Cameras Using Approximate Nearest Neighbour Fields, ICRA, 2017.

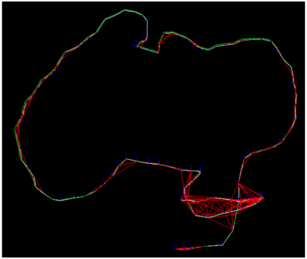
[4] Semi-Dense Visual Odometry for RGB-D Cameras Using Approximate Nearest Neighbour Fields, ICRA, 2017.

- Loop Closing
  - For our application we chose a metrical nearest neighbour search, because we operate in space restricted indoor environments and our visual odometry is sufficiently accurate. We search loop closure candidates in a sphere with predefined radius around the keyframe position
- Map Optimization
  - We represent the map as a graph of camera poses, where every vertex is a pose of a keyframe. The edges represent relative transformations between the keyframes. Valid loop closures become new edges in the graph. Afterwards, the error can be corrected by solving a non-linear least squares optimization problem. The error correction is distributed over the edges in the loop.
- Ref.
  - 3-D Mapping With an RGB-D Camera, TRO, 2014.
  - Dense Visual SLAM for RGB-D Cameras, IROS, 2013.

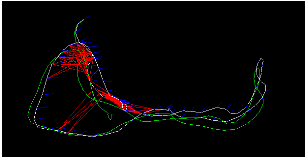
实验结果



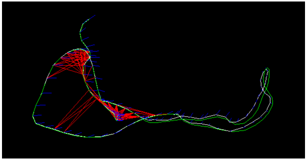
(a)fr3/office: Results of VO.



(b)fr3/office: After map optimization.



(c)fr1/desk: Results of VO.



(d)fr1/desk: After map optimization.

Figure:

实验结果

Table: 实验四：SLAM结果对比；指标：ATE(Absolute Trajectory Error) RMSE；参数设置：$\alpha = 1, \beta = 1$；对比算法：(1)CPA-SLAM[7], (2)ElasticFusion[8], (3)STING-SLAM。

	Plane-Edge	CPA-SLAM	ElasticFusion	STING-SLAM
fr1/xyz	**0.010m**	0.011m	0.011m	0.011m
fr1/desk	0.021m	**0.018m**	0.029m	
fr1/plant	**0.013m**	0.029m	0.022m	
fr2/xyz	**0.008m**	0.014m	0.011m	
fr2/desk	**0.032m**	0.046m	0.071m	0.053m
fr3/office	**0.015m**	0.025m	0.017m	

5 CPA-SLAM: Consistent Plane-Model Alignment for Direct RGB-D SLAM, ICRA, 2016.

6 ElasticFusion: Real-Time Dense SLAM and Light Source Estimation, IJRR, 2016.

7 CPA-SLAM: Consistent Plane-Model Alignment for Direct RGB-D SLAM, ICRA, 2016.

8 ElasticFusion: Real-Time Dense SLAM and Light Source Estimation, IJRR, 2016.

实验结果

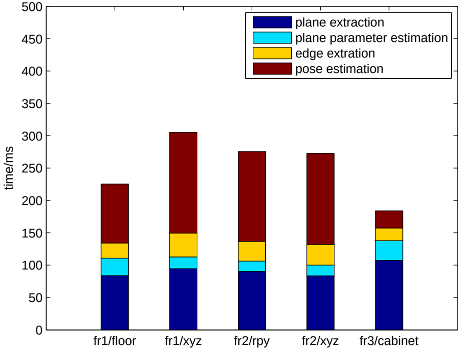
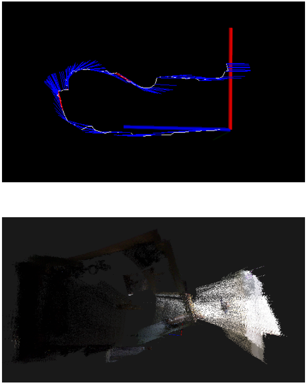
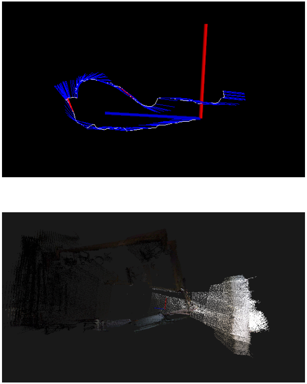


Figure: 实验五: Average runtime of VO.

实验结果



(c)Results of VO.



(d)After map optimization.

Figure: 实验六： Real scene experiment.