#### To User

This instruction provides the parameter setting details for user to transfer this project to their own task.

There are two types of yaml files under the *./config* folder. The yaml files with the Benchmark or camera’s name contain the intrinsic and extrinsic parameters of the stereo camera, such as *euroc.yaml*. The rest files with the name *vo\_params\_XXXX.yaml* are used to set the system options and algorithm parameters.

###### Parameter list

We use the EuRoC benchmark evaluation file *vo\_params\_euroc.yaml* as example:

1. System parameters

* system.minimumKeypoint: the offset of valid points for keyframe updating (the valid points parameter of Algorithm 1&2 in the paper).
* system.maximumKeyframeShift: the offset of translation for keyframe updating (large motion parameter of Algorithm 2 in the paper).

1. Feature detection parameters

* feature.gridW and feature.gridH: the number of grids in width and height direction.
* feature.boundaryBoxSize: minimum distances between keypoints.
* feature.nFeatures: the maximum number of feature in each grid.

1. Stereo orientation prior parameters

* sopvo.sosAlphaForR: alpha in equation 1 in the paper.
* sopvo.sosBetaForT: beta in equation 1 in the paper.
* sopvo.reprojectionErrorPessimistic: Fig.5 in the paper.
* sopvo.reprojectionErrorOptimistic: Fig.5 in the paper.

###### Selection of parameters

**The selection of system parameters:**

system.minimumKeypoint:

The algorithm fundamentally uses 8-point method to compute the pose and the VO process usually lose some tracked points in next frame. So the minimum number of keypoint must greater than 8. But a large number is not practical because the environment might be featureless. The general selection is 20 to 30.

system.maximumKeyframeShift:

This parameter determines the updating frequency of keyframes. We can simply set it to 1m for general indoor navigation.

**The selection of feature detection parameters:**

feature.gridW and feature.gridH:

The number of the girds is dependent upon the size of the image. More grids might be better as the detected features distribute equality over the image view. But this will also reduce the efficiency of feature detection process. The recommended girding for a 640\*480 view is 2\*2.

feature.boundaryBoxSize:

Minimum pixel distances between two feature points. The recommended value is 5.

feature.nFeatures:

Max number of feature points in each grid. This value rely on the size of each grid and the CPU performance. Too many keypoints may slow down the VO process. Our method runs in real time on NUC when the number of feature points is around 200.

**The selection of stereo orientation prior parameters:**

sopvo.sosAlphaForR:

This is the Cayley parameter for the orientation restriction. In Cayley representation, 0.0087 is about 1 degree at Euler angle. The mapping between Cayley parameter and Euler angle can be computed by Equation 7 in the paper. We simply use 0.01, which is [1.1573,1.1342,1.1573] degrees on XYZ.

sopvo.sosBetaForT:

As we only restrict the orientation, the selection of this parameter is trivial, any number that is much larger than sopvo.sosAlphaForR should be okay.

sopvo.reprojectionErrorPessimistic:

The points whose reprojection errors below this threshold are definitely inliers. The typical value of this parameter is around 2. For high resolution image, the location accuracy of feature detection and tracking decease due to the nonconvexity of pixel level perception. So we can choose a larger value for this parameter when processing the high resolution inputs.

sopvo.reprojectionErrorOptimistic:

The points whose reprojection errors below this threshold are possibility inliers. The typical value of this parameter is around 5. The points whose reprojection errors are between the pessimistic and optimistic will be evaluated by stereo orientation prior process.