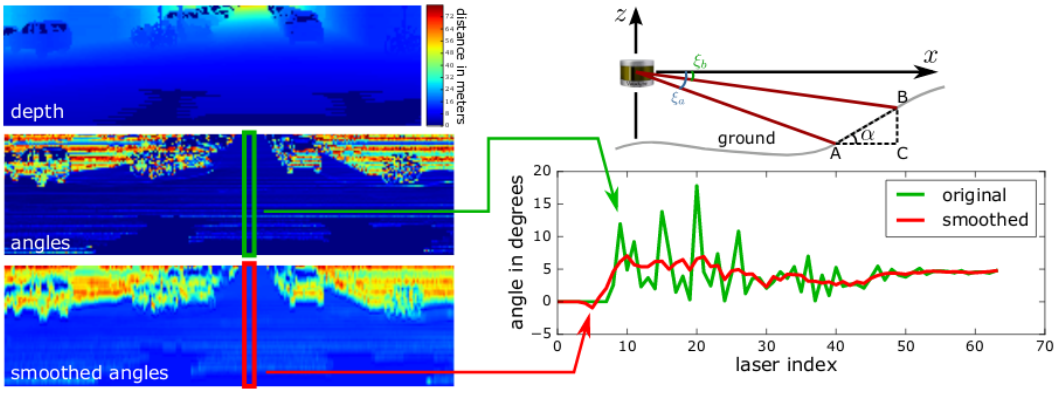
task1-论文解析与原代码解析

论文原理解析

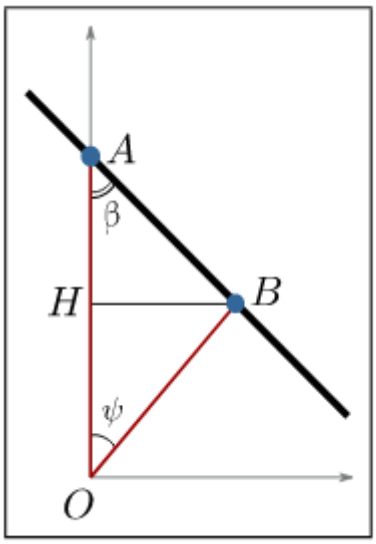
- 将3D点云先投影成前视图,
- 计算延col角度差值,并平滑.然后根据角度阈值去除地面

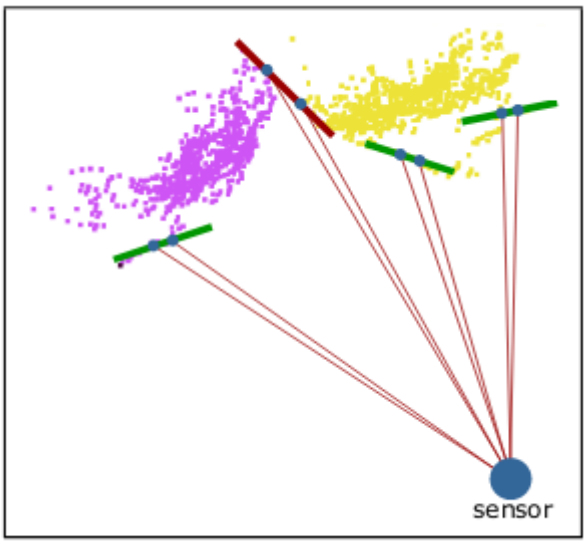


Algorithm 1 Ground Labelling

```
procedure LABELGROUND(R)
    M ← [α^r_{r−1,c}], matrix of angles α computed with Eq. (1).
    for c = 1 ... R_cols do
        if M(0, c) not labelled then
            LabelGroundBFS(0, c);
procedure LABELGROUNDBFS(r, c)
    queue.push({r, c})
    while queue is not empty do
        {r, c} ← queue.top()
        {r, c} ←labelled as ground
        for {r_n, c_n} ∈ neighbourhood{r, c} do
            if |M(r, c) − M(r_n, c_n)| < 5° then
                queue.push({r_n, c_n})
        queue.pop()
```

- 计算延row角度差值,并平滑.然后根据角度阈值对点云进行聚类





Algorithm 2 Range Image Labelling

```
procedure LABELRANGEIMAGE(R)
    Label ← 1, L ← zeros(R_rows × R_cols)
    for r = 1 ... R_rows do
        for c = 1 ... R_cols do
            if L(r, c) = 0 then
                LabelComponentBFS(r, c, Label);
                Label ← Label + 1;
procedure LABELCOMPONENTBFS(r, c, Label)
    queue.push({r, c})
    while queue is not empty do
        {r, c} ← queue.top()
        L(r, c) ← Label
        for {r_n, c_n} ∈ Neighbourhood{r, c} do
            d_1 ← max(R(r, c), R(r_n, c_n))
            d_2 ← min(R(r, c), R(r_n, c_n))
            if atan2 (d_2 sin ψ) / (d_1 − d_2 cos ψ) > θ then
                queue.push({r_n, c_n})
        queue.pop()
```

可调参数

1. 地面去除角度阈值 2. 点云聚类角度阈值 3. 最大聚类点数 4. 最小聚类点数
   可在qt界面下调试后,使用pcl可视化效果.感觉聚类效果有限.

原代码解析

以下详细说明各代码作用:

- depth_clustering
  - examples
    - ros_nodes: 两个ros节点
      - save_cluster_node.cpp: 订阅点云,保存聚类结果
      - show_objects_node.cpp: 订阅点云,显示聚类结果bbox
    - simple_nodes
      - show_objects_kitti.cpp: 输入bin点云路径,显示bbox结果.参数:--path, --angle <int>(Below this value, the objects are separated)
      - show_objects_moosmann.cpp: 输入图片点云路径, 显示bbox结果.参数同上.
  - src: 所有原理实现
    - clusters: 聚类(其中包括角度聚类和欧式距离聚类)
    - communication: 定义抽象父类(无功能性)
    - ground_removal: 地面移除
    - image_labelers
    - projections: 3D点云投影
    - qt: qt界面,编译后运行可执行文件 qt_gui_app
    - ros_bridge: 实现话题订阅
    - utils: 文件读取,bbox等工具
    - visualization: 可视化与点云保存

task2-每帧聚类结果全部保存到文件夹下

Solution1-基于ROS

- 代码说明
  基于源码ws/src/depth_clustering/examples/ros_nodes/save_clusters_node.cpp,只需修改第75行订阅topic.
  建立点云发布节点,以sense_msg::PointCloud格式发布来即可
- 运行步骤
  rosrun depth_clustering save_clusters_node --num_beams 64

Solution2-qt界面打开bin文件夹

- 代码说明
  基于源代码qt_gui_app修改,在中间过程添加保存代码.
  以下对image_based_cluster.cpp的修改做以说明(修改处皆以//=====开头注明,不需要保存时需要手动注释):

```
//39行,添加
#include <pcl/io/pcd_io.h>
```

```
//154行
  std::string _prefix = "clusters";
auto folder_name = _prefix + "_" + WithLeadingZerosStr(folder_counter++);

  boost::filesystem::path dir(folder_name);
  size_t cloud_counter = 0;
  if (boost::filesystem::create_directory(dir)) {
    for (const auto &kv : clusters) {
      const auto &cloud = kv.second;
      auto cloud_name = dir.string() + "/cloud_" +
                        WithLeadingZerosStr(cloud_counter++) + ".pcd";
      pcl::io::savePCDFileBinary(cloud_name, *(cloud.ToPcl()));
    }
  }
```

- 运行步骤
  - 直接替换路径ws/src/depth_clustering/src/clusterers下的image_based_cluster.cpp文件
  - ws/devel/lib/depth_clustering下运行./qt_gui_app
  - qt界面选择bin文件类型,open folder到bin文件夹
  - 先不play,用第一帧设置聚类参数
  - 点击player开始(也可只生成单独一帧,不play直接输入帧数)
  - 点云聚类结果pcd将保存到ws/devel/lib/depth_clustering下

task3-点云聚类结果图

- C++PCL可视化
  读取问文件夹下的所有聚类结果,使用pcl用不同的颜色展示.
  代码在./code/task3/multi_visualize.cpp,有详细的注释.直接运行即可
- 可视化效果
  调了下参数,感觉影响不大.近处的地面去除和车顶棚分离的效果比较明晰.