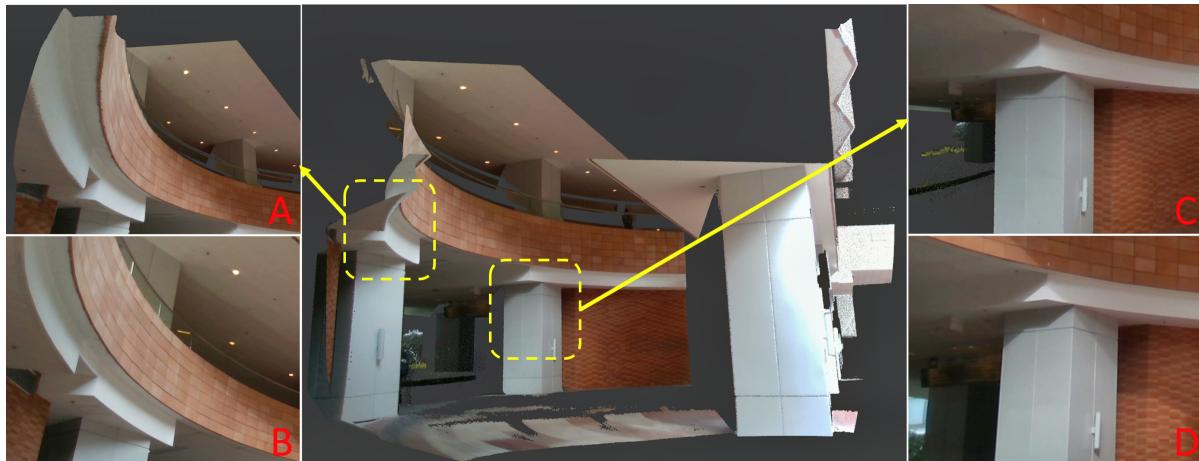


lidar_camera_calib

lidar_camera_calib is a robust, high accuracy extrinsic calibration tool between high resolution LiDAR (e.g. Livox) and camera in targetless environment. Our algorithm can run in both indoor and outdoor scenes, and only requires edge information in the scene. If the scene is suitable, we can achieve pixel-level accuracy similar to or even beyond the target based method.



An example of a outdoor calibration scenario. We color the point cloud with the calibrated extrinsic and compare with actual image. A and C are locally enlarged views of the point cloud. B and D are parts of the camera image corresponding to point cloud in A and C.

Info

New features:

1. Support muti-scenes calibration (more accurate and robust)

Related paper

Related paper available on arxiv:

[Pixel-level Extrinsic Self Calibration of High Resolution LiDAR and Camera in Targetless Environments](#)

Related video

Related video: <https://youtu.be/e6Vkkasc4JI>

1. Prerequisites

1.1 Ubuntu and ROS

Ubuntu 64-bit 16.04 or 18.04.

ROS Kinetic or Melodic. [ROS Installation](#) and its additional ROS pacakge:

```
sudo apt-get install ros-xxx-cv-bridge ros-xxx-pcl-conversions
```

1.2 Eigen

Follow [Eigen Installation](#)

1.3 Ceres Solver

Follow [Ceres Installation](#).

1.4 PCL

Follow [PCL Installation](#). (Our code is tested with PCL1.7)

2. Build

Clone the repository and catkin_make:

```
cd ~/catkin_ws/src  
git clone https://github.com/hku-mars/livox_camera_calib.git  
cd ../  
catkin_make  
source ~/catkin_ws/devel/setup.bash
```

3. Run our example

The exmaple dataset can be download from [OneDrive](#) and [BaiduNetDisk\(百度网盘\)](#).

3.1 Single scene calibration

Download [Our pcd and iamge file](#) to your local path, and then change the file path in **calib.yaml** to your data path. Then directly run

```
roslaunch livox_camera_calib calib.launch
```

You will get the following result. (Sensor suite: Livox Avia + Realsense-D435i)



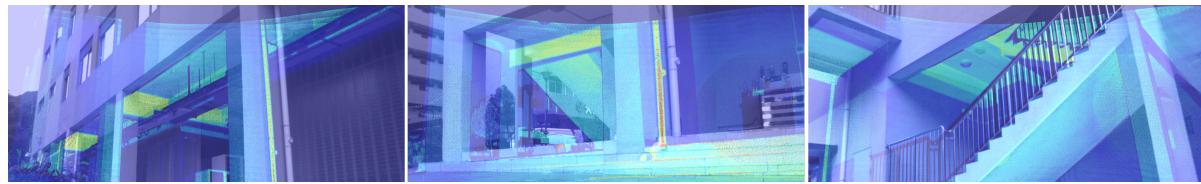
An example of single scene calibration.

3.2 Multi scenes calibration

Download [Our pcd and iamge file](#) to your local path, and then change the file path in **multi_calib.yaml** to your data path. Then directly run

```
roslaunch livox_camera_calib multi_calib.launch
```

The projected images obtained by initial extrinsic parameters. (Sensor Suite: Livox Horizon + MVS camera)



An example of multi scenes calibration. The projected image obtained by the initial extrinsic parameters

Rough calibration is used to deal with the bad extrinsic.



The projected image obtained by the extrinsic parameters after rough calibration

Then we finally get a fine extrinsic after final optimization.



The projected image obtained by the extrinsic parameters after fine calibration

4. Run on your own sensor set

4.1 Record data

Record the point cloud to pcd files and record image files.

4.2 Modify the calib.yaml

Change the data path to your local data path.

Provide the intrinsic matrix and distor coeffs for your camera.

4.3 Use multi scenes calibration

Change the params in **multi_calib.yaml**, name the image file and pcd file from 0 to (data_num-1).