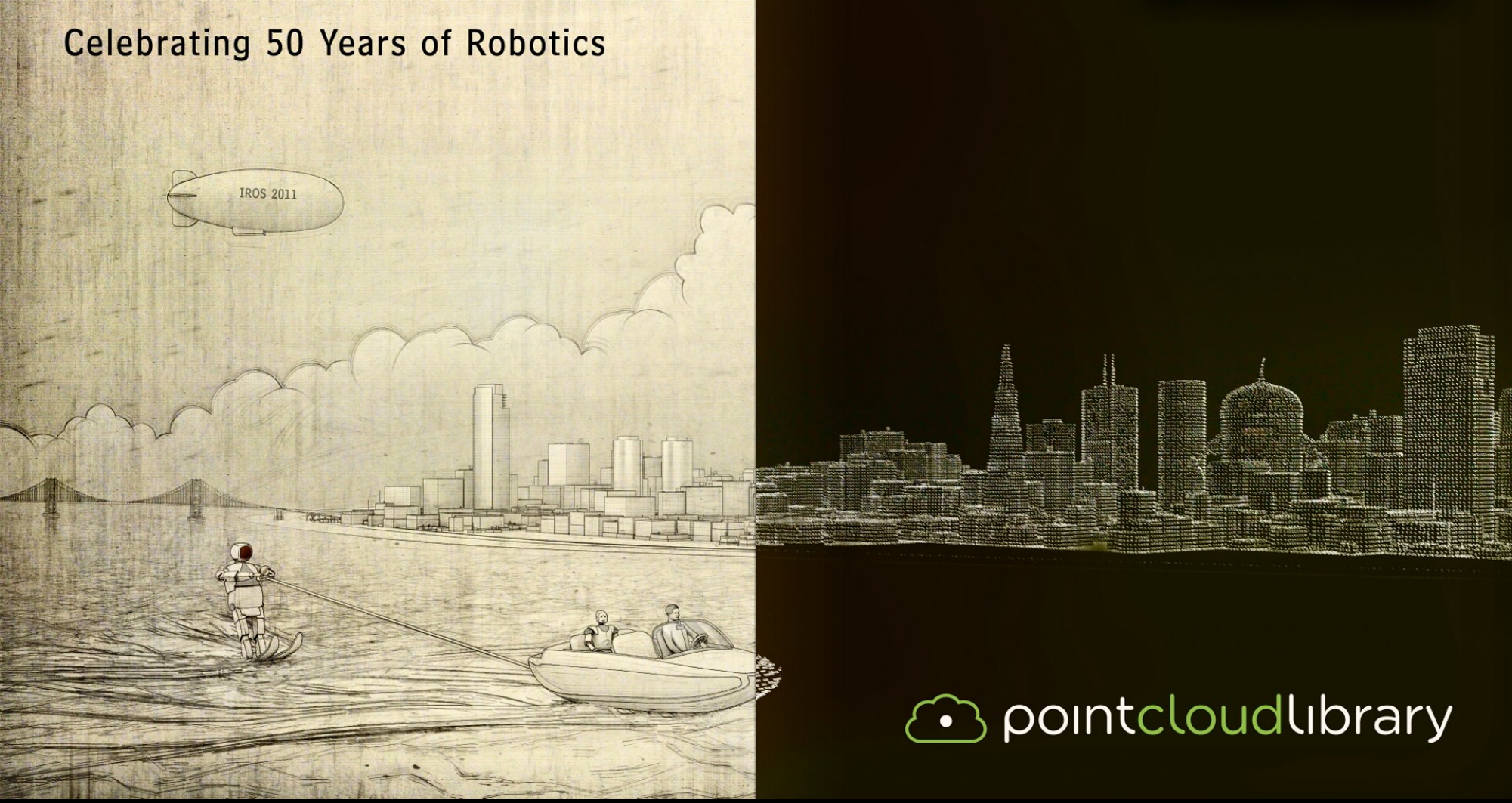

PCL :: Filtering

Filtering 25, 2011

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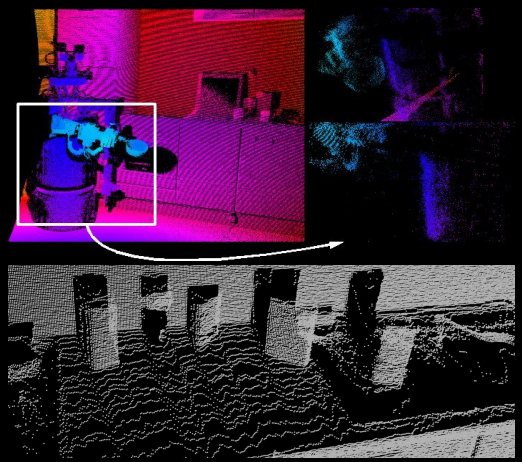
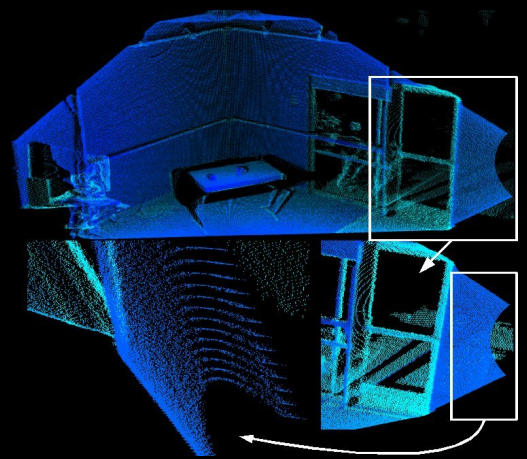
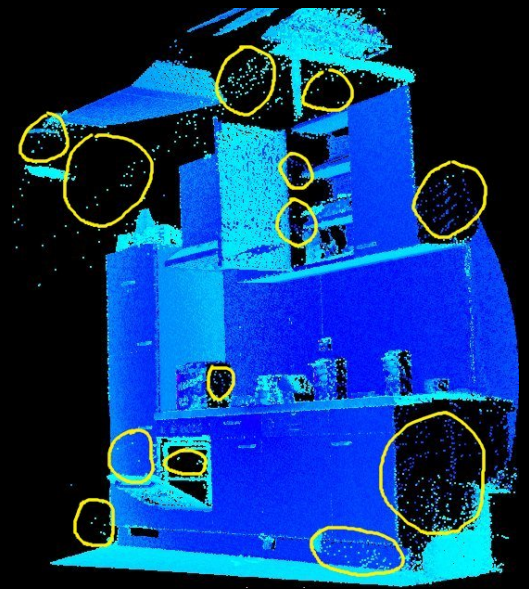
Introduction

Introduction

- irregular density (2.5D)
- occlusions
- massive amount of data
- noise







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Overview Filtering

Modifying the point cloud or point attributes.

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Modifying the point cloud or point attributes.

- Removing Points:
  - Conditional Removal
  - Radius/Statistical Outlier Removal
  - Color Filtering
  - Passthrough

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Overview Filtering

Modifying the point cloud or point attributes.

- Removing Points:
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- Downsampling:
  - Voxelgrid Filter
  - approximate Voxelgrid filtering

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Overview Filtering

Modifying the point cloud or point attributes.

- Removing Points:
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  - Radius/Statistical Outlier Removal
  - Color Filtering
  - Passthrough
- Downsampling:
  - Voxelgrid Filter
  - approximate Voxelgrid filtering
- Modifying Other Point Attributes:
  - Contrast
  - Bilateral Filtering

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The Filter class

All filters are derived from the **Filter** base class with following interface:

```
1   template<typename PointT> class Filter : public PCLBase<PointT>
2   {
3     public:
4       Filter (bool extract_removed_indices = false);
5       inline IndicesConstPtr const getRemovedIndices ();
6       inline void setFilterFieldName (const std::string &field_name);
7       inline std::string const getFilterFieldName ();
8       inline void setFilterLimits (const double &limit_min, const double &
            limit_max);
9       inline void getFilterLimits (double &limit_min, double &limit_max);
10      inline void setFilterLimitsNegative (const bool limit_negative);
11      inline bool getFilterLimitsNegative ();
12      inline void filter (PointCloud &output);
13  };
```

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Example: Passthrough Filter

Removes points where values of selected field are out of range.

```
1   // point cloud instance for the result
2   PointCloudPtr thresholded (new PointCloud);
3
4   // create passthrough filter instance
5   pcl::PassThrough<PointT> pass_through;
6
7   // set input cloud
8   pass_through.setInputCloud (input);
9
10  // set fieldname we want to filter over
11  pass_through.setFilterFieldName ("z");
12
13  // set range for selected field to 1.0 - 1.5 meters
14  pass_through.setFilterLimits (1.0, 1.5);
15
16  // do filtering
17  pass_through.filter (*thresholded);
```

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Example: Passthrough Filter

original pointcloud: robot1.pcd

passthrough on the z axis 1.0 m - 1.5m

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VoxelGrid Filter

Divides the space into discrete cells (voxels) and replaces all points within a voxel by their centroids.

```
1     // point cloud instance for the result
2     PointCloudPtr downsampled (new PointCloud);
3
4     // create passthrough filter instance
5     pcl::VoxelGrid<PointT> voxel_grid;
6
7     // set input cloud
8     voxel_grid.setInputCloud (input);
9
10    // set cell/voxel size to 0.1 meters in each dimension
11    voxel_grid.setLeafSize (0.1, 0.1, 0.1);
12
13    // do filtering
14    voxel_grid.filter (*downsampled);
```

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VoxelGrid Filter

811.0 FPS

487.6 FPS

voxelgrid with 0.1m voxel size in each dimension

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Radius Outlier Removal

Removes all points with less than a given number of neighbors within a radius

```
1     // point cloud instance for the result
2     PointCloudPtr cleaned (new PointCloud);
3
4     // create the radius outlier removal filter
5     pcl::RadiusOutlierRemoval<pcl::PointXYZRGB> radius_outlier_removal;
6
7     // set input cloud
8     radius_outlier_removal.setInputCloud (input);
9
10    // set radius for neighbor search
11    radius_outlier_removal.setRadiusSearch (0.05);
12
13    // set threshold for minimum required neighbors neighbors
14    radius_outlier_removal.setMinNeighborsInRadius (800);
15
16    // do filtering
17    radius_outlier_removal.filter (*cleaned);
```

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Radius Outlier Removal

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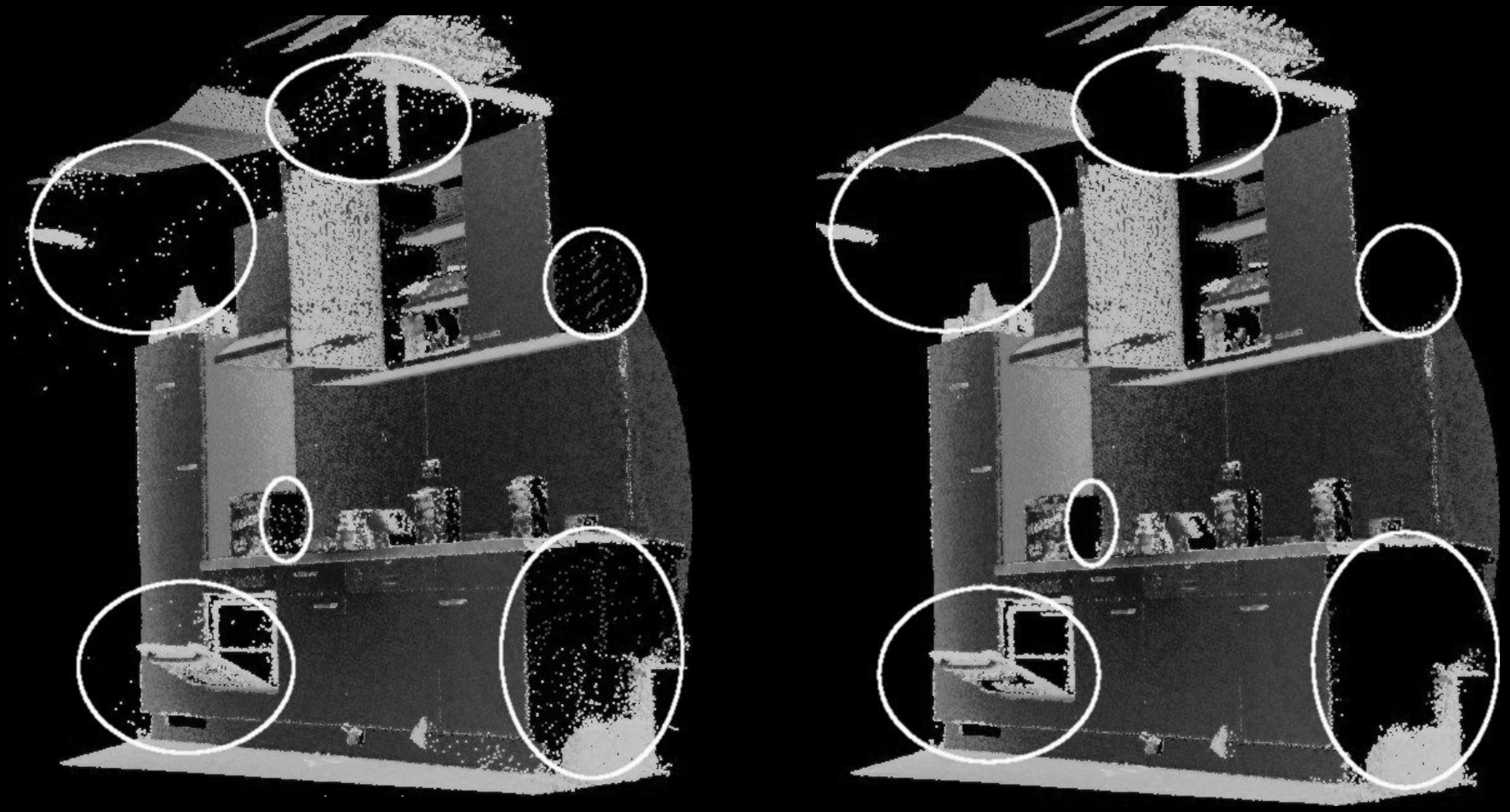
Radius Outlier Removal



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Practical Exercise

Open the file test_filtering.cpp

```
pcl::console::printinfo ("-t mindepth,maxdepth ..... Threshold depthn");
pcl::console::printinfo ("-d leafsize ..............  Downsamplen");
pcl::console::printinfo ("-r radius,minneighbors ..... Radius outlier removaln");
pcl::console::printinfo ("-s output.pcd ..............  Save outputn");
…
cloud = thresholdDepth (cloud, mindepth, maxdepth);
…
cloud = downsample (cloud, leafsize);
…

cloud = removeOutliers (cloud, radius, (int)minneighbors);
```