3D PUPPETRY LAUNCH FILES

We use launch files to setup the data feed from the Kinect and define parameter values. Here we dissect an example launch file (all_puppets_launch.launch) and explain the significance of each setting:

```
<!-- Launch this file to create new animations -->
<launch>
$(roscd kinect_tracker)
```

The following red text sets up the drivers for the Kinect, as well as the ROS package that segments the background and user's hand from the 3D point cloud:

```
<include file="$(find openni_launch)/launch/openni.launch"/>
<node name="dynamic_reconfigure" pkg="dynamic_reconfigure" type="dynparam" args="load
     /camera/driver $(find kinect_tracker)/launch/kinect_params.yaml" />
  <node pkg="volumecolorsegmenter" type="VolumeColorSegmenter"
        name="VolumeColorSegmenter" output="screen" respawn="false">
   <param name="color_model_name" value=
          "$(find kinect_tracker)/files/puppetrycolormodel_robin.txt"/>
```

NOTE: This file should be replaced with a new color model for the current user

```
   <param name="use_backsub_segmenter" value = "true"/>
   <param name="use_color_segmenter" value = "true"/>
   <param name="use_volume_segmenter" value = "false"/>
   <param name="publish_background" value = "true"/>
   <param name="cloud_skip" value = "2"/>
   <param name="depth_focal_length" value = "525.0"/>
   <remap from="incloud" to="/camera/depth_registered/points"/>
   <remap from="outcloud" to="/camera/rgb/points_seg"/>
</node>
```

The following blue text sets up the image-feature-based puppet identifier. It is crucial for tracking multiple puppets at the same time.

```
<node pkg="rth_SIFT" type="rth_SIFT" name="rth_SIFT" output="screen" respawn="false">
   <rosparam command="load" file="$(find openni_camera)/info/openni_params.yaml" />
   <param name="pose_feed_only" value="true"/>
   <param name="refresh_rate" value="60"/>
   <param name="pose_load_names" value = "fish_balanced,policecar_high,gallardo_high,
      mini_high,ambulance_balanced,boat_kinect_balanced,firetruck_balanced,
      duck_fireman_balanced,peter_griffin_balanced,duck_cop_balanced,
      DumpTruck,CementTruck,BullDozer,Prius_Final,CowgirlDuck_balanced,
      Dino_balanced,Gator_balanced,Penguin_balanced,TuxDuck_balanced,duck_chef_balanced" />
```

As new puppets are added, the base name of their SIFT templates must be added to this list.

```
   <param name="files_path" value="$(find kinect_tracker)/files/SIFT/"/>
   <param name="sift_first_octave" value="-1"/>
   <param name="sift_num_octaves" value="3"/>
   <param name="sift_dog_threshold" value="0.0066"/>
   <param name="sift_edge_threshold" value="100"/>
   <param name="sift_filter_width_factor" value="1.5"/>
   <param name="sift_num_feature_orientations" value="1"/>
   <param name="bin_cutoff" value="20"/>
```

These parameters were determined empirically. See the documentation for SiftGPU at http://cs.unc.edu/~ccwu/siftgpu/ for more details.

```
   <remap from="rgb_feed" to="/camera/rgb/image_color"/>
   <remap from="depth_feed" to="/camera/depth_registered/image"/>
</node>
```

The following green text sets up the main tracking program. Values that should be changed by a typical user are indicated in boldface type.

```
<node pkg="kinect_tracker" type="KinectTracker" name="KinectTracker"
   output="screen" respawn="false">

    <!-- PUPPET PARAMETERS -->
```

```
<param name="ply_names" value="fish_sub,policeCar_recolored_sub,gallardo_scan_sub,
   \mini_culled3_sub,ambulance_sub,boat_kinect_recolored_sub,
   firetruck_sub,duck_fireman_recolored_sub,peter_griffin_kinect_recolored_sub,
   duck_cop_sampled,DumpTruck_sampled,CementTruck_sampled,
   BullDozer_sampled,Prius_Sampled,CowgirlDuck_sampled,Dino_sampled,
   Gator_sampled,Penguin_sampled,TuxDuck_sampled,duck_chef_sampled"/>
```

These are the PLY models that will be used to create the point clouds for each puppet. They typically have fewer points than the PLY models that are used for rendering:

```
<param name="display_ply_names" value="fish,policeCar_recolored,gallardo_small,
   mini_recolor_resize,ambulance,boat_kinect_recolored,firetruck,
   duck_fireman_recolored,peter_griffin_kinect_recolored,
   duck_cop_recolored,DumpTruck,CementTruck,BullDozer,Prius_Final,
   CowgirlDuck,Dino,Gator,Penguin,TuxDuck,duck_chef_recolored"/>
<param name="model_names" value="fish_sub,policeCar_recolored_sub,gallardo_scan_sub,
   mini_culled3_sub,ambulance_sub,boat_kinect_recolored_sub,
   firetruck_sub,duck_fireman_recolored_sub,
   peter_griffin_kinect_recolored_sub,duck_cop_recolored,DumpTruck,
   CementTruck,BullDozer,Prius_Final,CowgirlDuck,Dino,Gator,Penguin,
   TuxDuck,duck_chef_recolored"/>
```

Since we have two different 3D models for each puppet, it is useful to explicitly name each puppet.

```
<!-- BACKGROUND PARAMETERS -->
<param name="scene_names" value = "Covered_Bridge.ply,NewModernHouse_Valley_Exploded.dae,
    empty_intersection_expanded_one_sided_tri.dae,Living_Room.ply,
    stage.ply,house_large.ply,alley.ply," />
```

Users should add new background models to this list.

```
<param name="scene_scaling" value = "0.0225,0.0008,0.0004,0.10,0.0008,0.00020,0.0015" />
```

Each background needs a scaling factor to make it fit with the performance space and the puppet sizes. Meshlab could be also be used to do the scaling, in which case the scaling here should be set to 1.0.

```
<param name="scene_brightness" value = "0.0,0.0,1.0,0.0,0.0,0.0,0.0," />
```

Some backgrounds have dark textures. This parameter allows one to add lights to brighten them up.

```
<param name="background_image" value = "checkerboard_small.jpg"/>

<!-- ANIMATION PARAMETERS -->
<param name="playback_mode" value = "true" />
```

'True' enables kinect-based tracking. 'False' only allows animation playback.

```
<param name="load_performance" value = "In_name" />
```

Name of a recorded performance to be loaded and played.

```
<param name="save_performance" value = "Out_name" />
```

Name for a performance to be recorded and saved to disk. This base name is used for the exported list of puppet poses and the saved movies.

Take note of this warning:

```
<!-- The following parameters should only be changed for debugging purposes -->
<param name="icp_outlier_threshold" value = "0.20" />
```

When comparing corresponding points between the Kinect point cloud and the stored puppet cloud, we label some pairs as "outliers" if the distance between them exceeds a defined value (usually 1cm). If the percentage of corresponding pairs labeles as outliers exceeds `icp_outlier_threshold`, we declare that we have lost tracking of the puppet and stop rendering it until tracking has been reestablished.

```
<param name="multi_core_tracker" value = "true" />
```

Whether or not we want to use multiple parallel CPU threads. Critical to real-time performance.

```
<param name="use_cloud_normals" value = "true"/>
<param name="max_normal_difference_deg" value= "150"/>
```

Use similarity of normal vectors to help find corresponding points between the Kinect cloud and stored puppet cloud.

```
<param name="filter_correspondences" value= "true"/>
```

Segment the incoming Kinect point cloud according to puppet? Critical for tracking multiple puppets.

```
<param name="filter_distance_ratio" value= "1.2"/>
```

Some points in the Kinect point cloud are close to multiple puppets. If the ratio of a point's distances to the two nearest puppets falls under this value, declare it ambiguous and don't assign it to either puppet.

```
<param name="min_cloud_size" value = "125"/>
```

If the number of points in the incoming segmented point cloud assigned to a puppet falls below this value, we assume it has either been occluded or left the performance space. In the former case, we render it in its last known

position. In the latter case, we stop rendering it.

```
        <param name="use_SIFT" value = "true"/>
```

Use the rth_SIFT package for puppet identification? Critical for tracking multiple puppets.

```
        <param name="publish_clouds" value = "false"/>
```

For debugging. Publishes the segmented Kinect point clouds so they can be visualized in ROS' rviz program.

```
        <!-- The following parameters should never be changed-->
         <param name="files_path" value="$(find kinect_tracker)/files/"/>
        <param name="publish_outlier_clouds" value = "false"/>
        <remap from="incloud" to="/camera/rgb/points_seg"/>
        <remap from="outcloud" to="rgbd/cloud"/>
        <remap from="rgb_feed" to="/camera/rgb/image_color"/>
        <remap from="bw_feed" to="camera/rgb/image_mono"/>
        <remap from="depth_feed" to="/camera/depth_registered/image_rect"/>
    </node>
</launch>
```