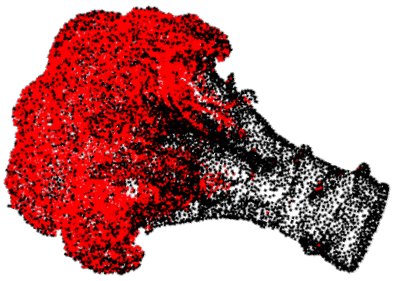
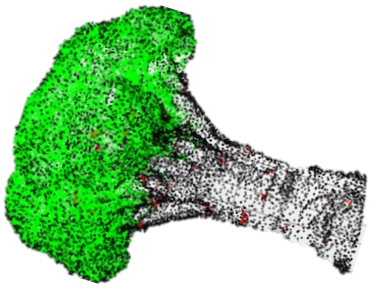
(a) Crown segmentation

(1) original point cloud

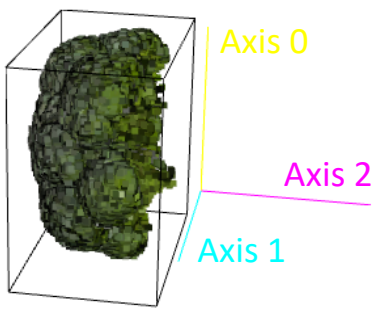


(2) RGB KMeans cluster

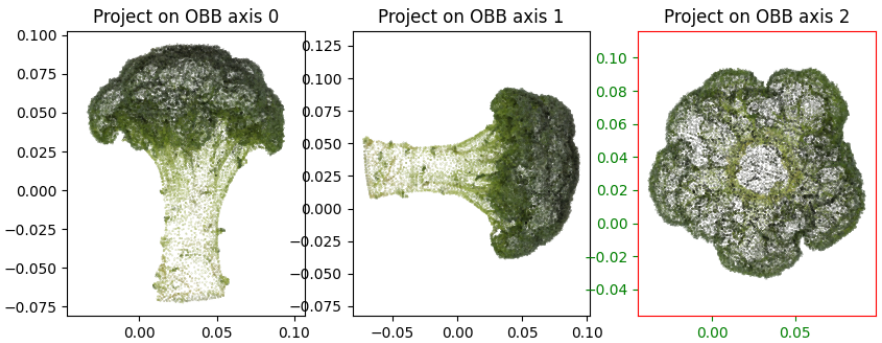


(3) DBSCAN remove noises

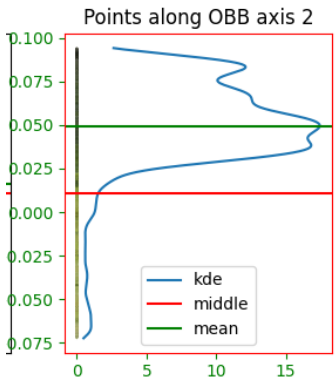
(b) Direction correction



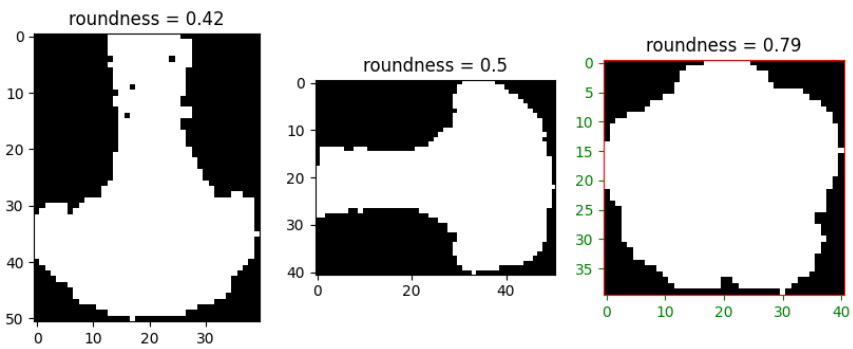
(4) Bounding box vectors



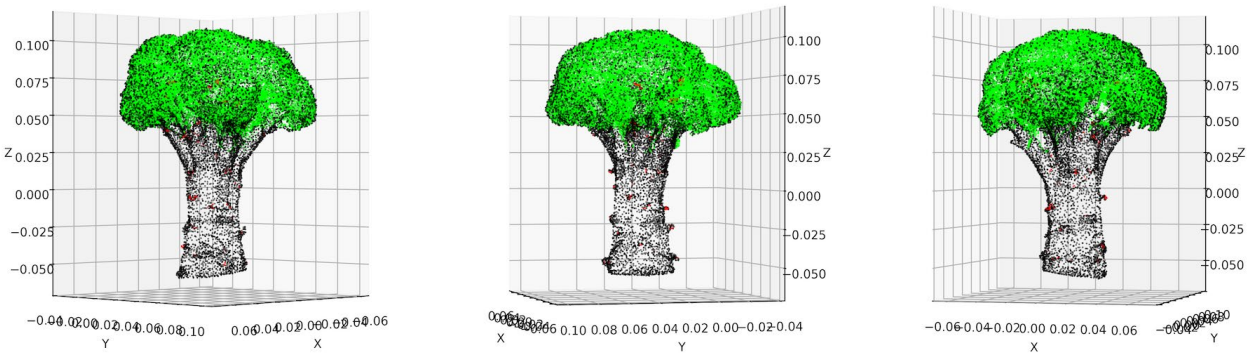
(5) Project broccoli head along vector directions



(7) Judge positive direction

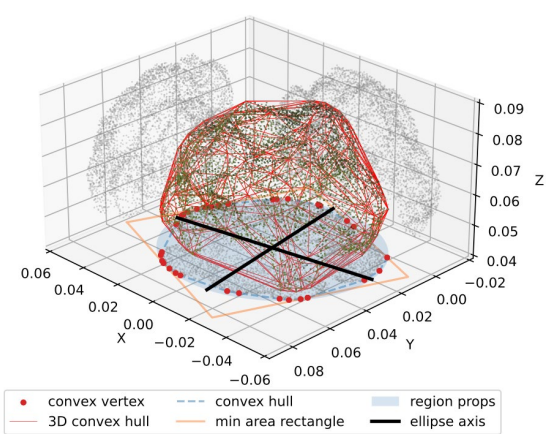


(6) Use the highest roundness as top vector



(8) Rotate broccoli head top to z-axis positive direction

(c) Traits calculation



(9) Crown traits visualization

```
traits_dict = {
    'id': [],
    # crown parameter
    'crown_height(m)': [],
    'center.x(m)': [], 'center.y(m)': [],
    'min_rect_width(m)': [], 'min_rect_length(m)': [],
    'crown_2dconvex_area(cm2)': [], 'projected_leaf_area(cm2)': [],
    'centroid.x(m)': [], 'centroid.y(m)': [],
    'long_axis(m)': [], 'short_axis(m)': [], 'orientation(degree)': [],
    'crown_3dconvex_volume(cm3)':[],
    'crown_3dconcave_volume(cm3)':[],
    'crown_3dconcave_alpha':[],
    'crown_roundness': [],
    # head parameter
    'head_height(m)': [],
    'head_3dconcave_volume(cm3)':[],
    'head_3dconcave_alpha':[]
}
```

(10) Final output trait lists