Classification Parameters Guide

November 18, 2024

The **Classification Tool** in 3Dsurvey operates in two primary steps: **1. Marking the Points** and **2. Filtering the Points**. This guide explains the parameters involved in each step and how they influence the classification process.

1 List of Parameters

- **Terrain Elevation**: Sets the allowable vertical difference when comparing the elevation of neighboring cells. A higher value allows more variation in elevation, enabling more points to be classified as part of the ground surface.
- **Terrain Slope**: Defines the maximum slope angle difference between cells. A larger slope value allows steeper variations, allowing more points to be considered as ground surface.
- **Regular Grid Mesh Cell Size**: Determines the size of each cell in the grid mesh. Smaller sizes (usually not that usefull) capture more detail but may require more processing time, while larger sizes process faster with less detail.
- **Smoothing Factor**: Controls the amount of smoothing applied to the terrain data. Higher values create a smoother surface by reducing small variations.
- **Smoothing Max Distance**: Limits the distance over which smoothing is applied. This ensures that smoothing affects only nearby points, preserving larger terrain features.

2 Classification Process

The process of point classification is as follows:

1. **Parameter Selection**: First, select your classification parameters, including **Regular Grid Mesh Cell Size**, **Smoothing Factor**, and **Smoothing Max Distance**. Once the parameters are set, initialize the process by clicking `Next`. Upon initiation, a **regular grid mesh** is automatically created based on the selected parameters. This mesh organizes the point cloud data for efficient processing.
2. **Terrain Region Selection**: In **Classification Step 1**, you will be prompted to **select some of the largest terrain regions** across different areas of the point cloud. This manual selection helps the software identify and classify the main ground surfaces. The selected points are highlighted in RED to indicate they are classified as ground surface points.
3. **Point Filtering**: The software filters points by comparing the manually selected cells with their neighboring cells using the **Terrain Elevation** and **Terrain Slope** parameters. If the elevation difference or slope angle exceeds the specified thresholds for neighboring cells, those cells are excluded from the ground surface classification. Consequently, higher values for **Terrain Elevation** and **Terrain Slope** result in more points being included in the ground surface classification.

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3 Example

In the example below, there are two figures illustrating the effects of different classification settings.

3.1 Default Classification Settings

Figure 3a shows points marked and filtered using the default classification settings:

- **Terrain Elevation** = $0.05\,\mathrm{m}$
- **Terrain Slope** = $18°$
- **Regular Grid Mesh Cell Size** = $0.5\,\mathrm{m}$
- **Smoothing Factor** = 1
- **Smoothing Max Distance** = $0.05\,\mathrm{m}$

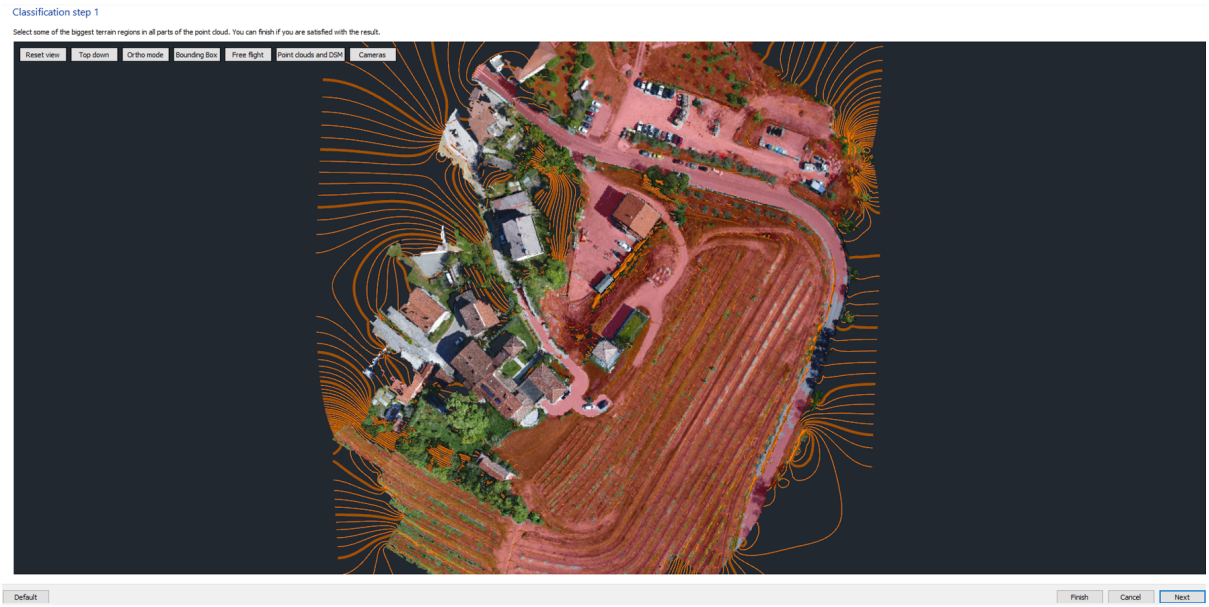

Figure 1: Points marked and filtered by default classification settings

3.2 Increased Terrain Elevation and Slope

Figure 3b displays the results obtained by increasing the values of **Terrain Elevation** and **Terrain Slope**. Evidently, there is an increase in the size of the area marked in RED. The parameters used for this classification are:

- **Terrain Elevation** = $0.1\,\mathrm{m}$
- **Terrain Slope** = $26°$
- **Regular Grid Mesh Cell Size** = $0.5\,\mathrm{m}$
- **Smoothing Factor** = 1
- **Smoothing Max Distance** = $0.05\,\mathrm{m}$

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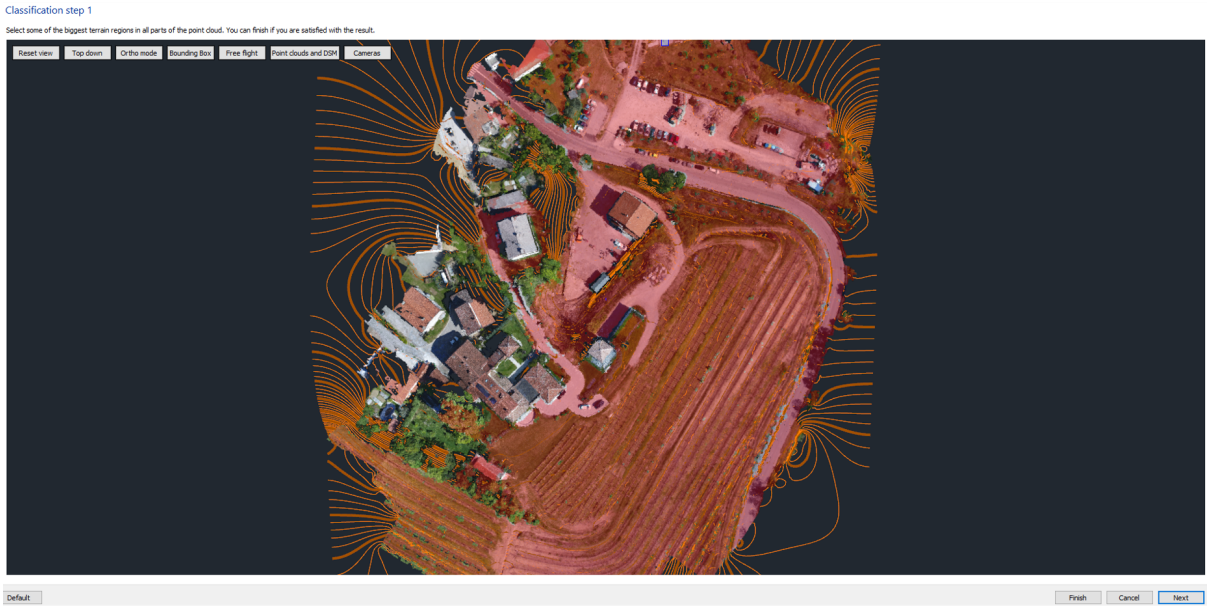

Figure 2: Points marked and filtered by increased values of **Terrain Elevation** and **Terrain Slope**

3.3 Effect of Smoothing Max Distance

A similar increase in the marked area can be achieved by adjusting the **Smoothing Max Distance** parameter, which affects the classification as follows:

- If the difference between the approximation of the **regular grid mesh** and a point is smaller than the **Smoothing Max Distance**, the point is marked RED (as part of the ground surface) in the second step of classification.
- If the difference is bigger than the **Smoothing Max Distance**, the point is not marked.

For example, increasing the **Smoothing Max Distance** to $0.7\,\mathrm{m}$ will result in less points being filtered out during the second classification step. However, this adjustment may lead to undesirable results, such as:

- **Kept points Around Vehicles**: Points representing details like tires around cars may remain in the point cloud after classification.
- **Lower Parts of Building Walls**: Points in the lower sections of building walls might also remain, resulting in less accurate classification.

Careful tuning of the **Smoothing Max Distance** is essential to balance between reducing noise and preserving important terrain features.

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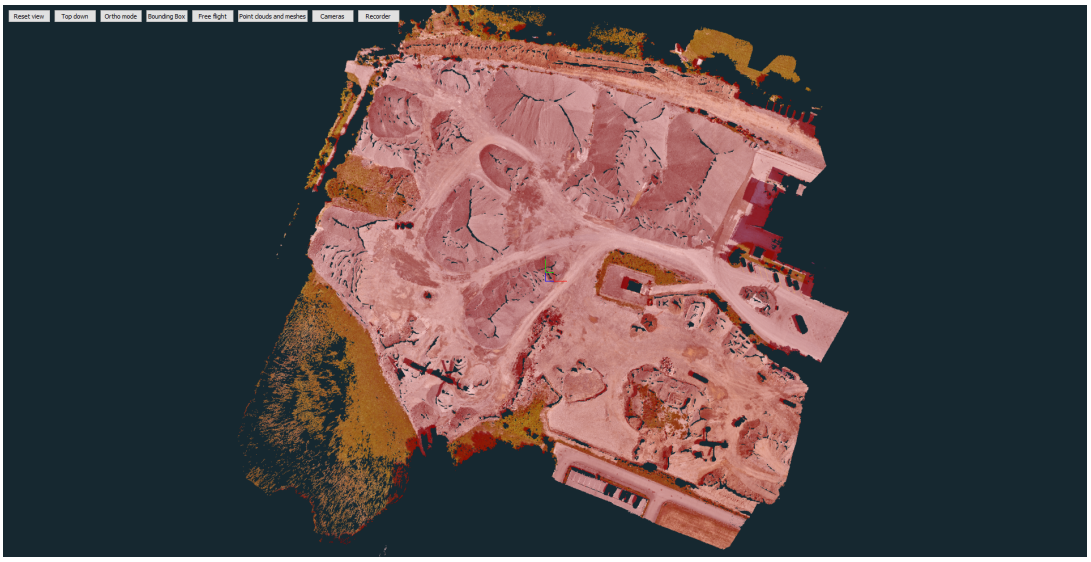
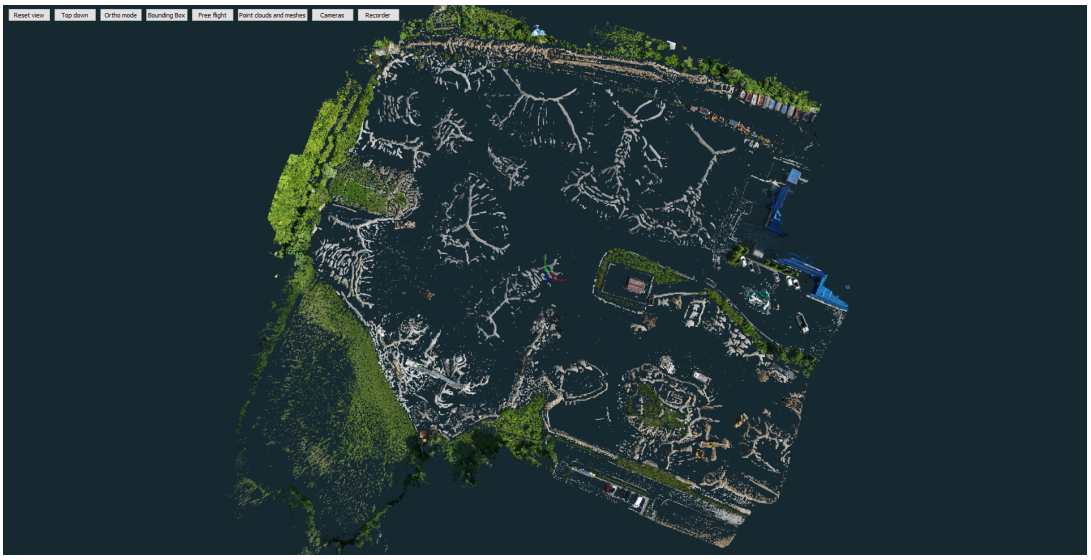
4 Special Case: Stockpiles

When performing classification on stockpiles, there is a high chance that the tops of the stockpiles won't be included in the terrain surface. In Figure 3, we used the default classification settings, and as a result, the tops of the stockpiles were not included in the ground level. This can lead to inaccurate results when calculating volumes.



(a) Ground surface - Default Classification Settings



(b) Unassigned class - Default Classification Settings

Figure 3: Comparison of Classification Settings

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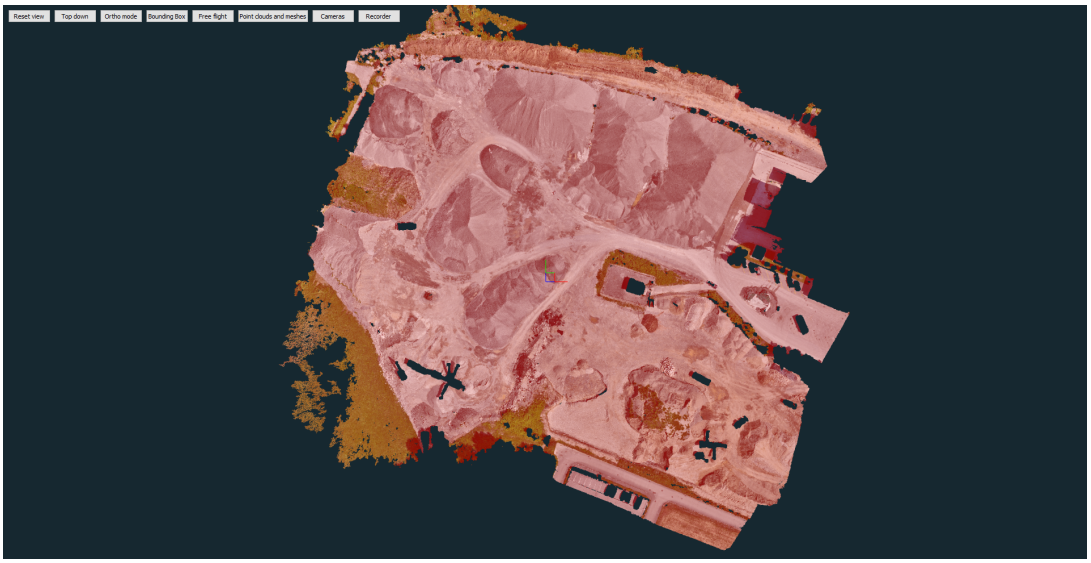
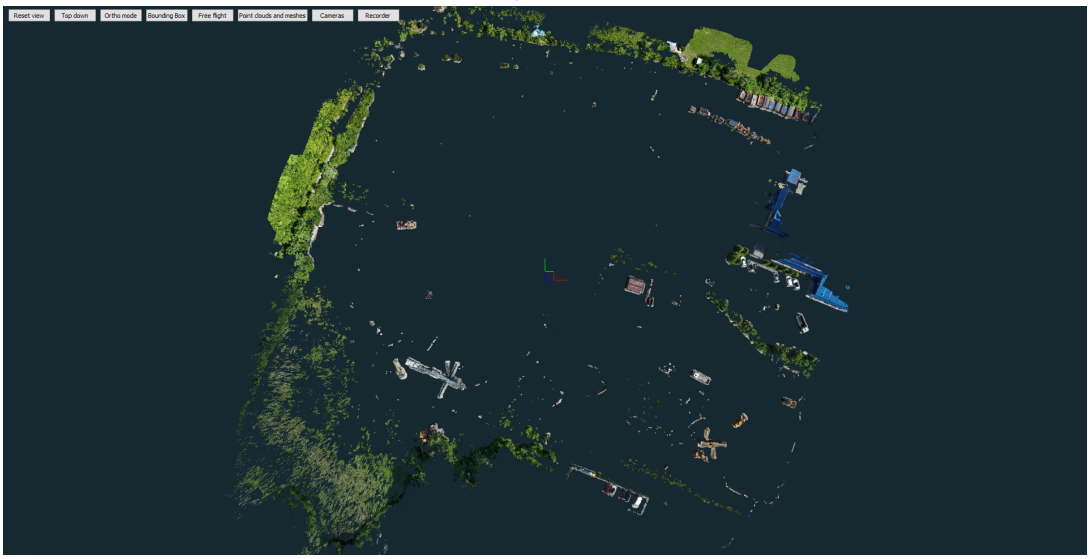
To resolve this issue, we adjust the classification parameters by **reducing** the value of the **Regular Grid Mesh Cell Size** and increasing the value of the **Smoothing Max Distance**. After selecting the largest terrain regions, you will see that the tops of the stockpiles are now classified as ground surface (see Figure 4).
While these adjustments improve the inclusion of stockpile tops, they may also result in unwanted features being classified as ground surface. Non-terrain elements like vehicle tires and the lower sections of building walls might be incorrectly included.
The parameters used to include the tops of stockpiles in this case are:

- **Terrain Elevation** = $0.05\,\mathrm{m}$
- **Terrain Slope** = $18°$
- **Regular Grid Mesh Cell Size** = $0.25\,\mathrm{m}$
- **Smoothing Factor** = 1
- **Smoothing Max Distance** = $0.08\,\mathrm{m}$



(a) Ground surface - Improved Classification Settings



(b) Unassigned class - Improved Classification Settings

Figure 4: Comparison of Classification Settings

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