WizardGUI

`WizardGUI` is a graphical interface to the various surface reconstruction programs. It has a wizard-like design and allows the user to perform the following tasks:

- Visualization of data sets
- Reconstruction of surfaces
- Comparison of two reconstructed surfaces

`WizardGUI` guides the user through a number of pages with different options to choose, stores the users selection of options and generates a batch script that runs all necessary programs in the correct order and with the options chosen by the user. In the following the individual pages of the wizard are explained.

Job type selection

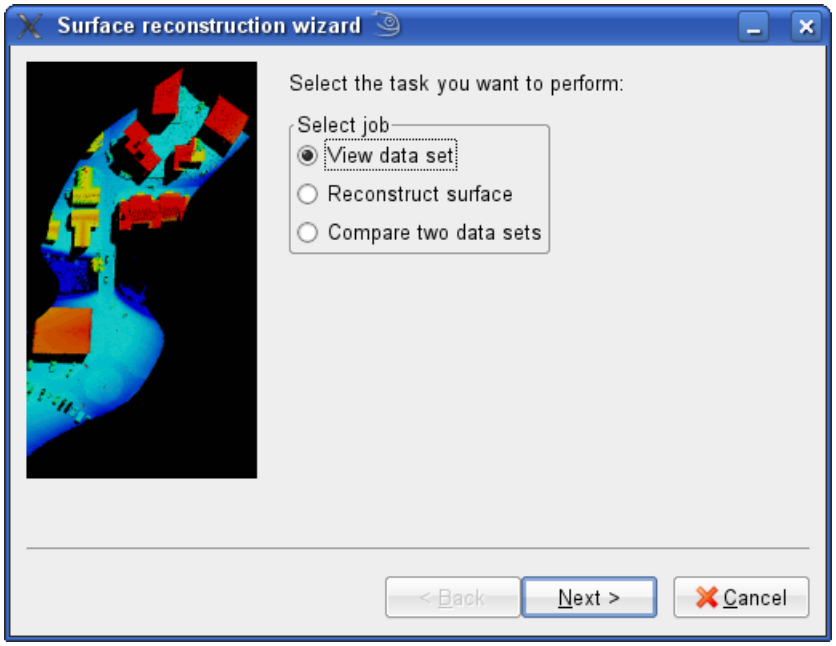

Figure 1: Job type selection page

Here the task to be performed is selected:

- **View data set**: Visualize a point cloud. If necessary, input data is converted to .pts format before viewing.
- **Reconstruct surface**: Reconstruct a surface from a point cloud and view the resulting surface
- **Compare two data sets**: Reconstruct surfaces independently for two point clouds, then generate a third surface representing the differences between the data sets.

Data file selection

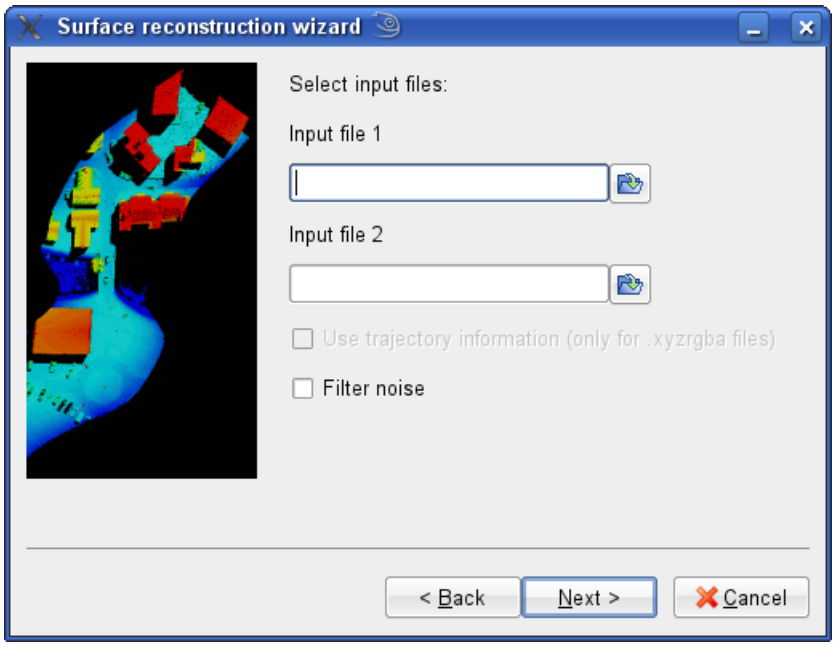

Figure 2: Data file selection page

On this page the data files to be processed are selected. Data files may have the formats *.pts*, *.stm*, *.xyz* or *.xyzrgba*.

- **Input file 1/2**: Filenames of the data files, including path. Path may be given relative to the directory in which `WizardGUI` was started. By clicking the button next to the text input boxes, an interactive file selection dialog is presented. **Input file 2** is only available if comparison of surfaces was selected as job type.
- **Use trajectory information (only for .xyzrgba files)**: If this option is selected, calculation of the normals makes use of trajectory data. Trajectory data must have the

same base filename as the specified data file, but with extension *.traj*. This option is only available if data files are in *.xyzrgba* format.

- **Filter noise**: If activated, data files are run through a noise filtering algorithm prior to further processing.

Normal calculation parameters

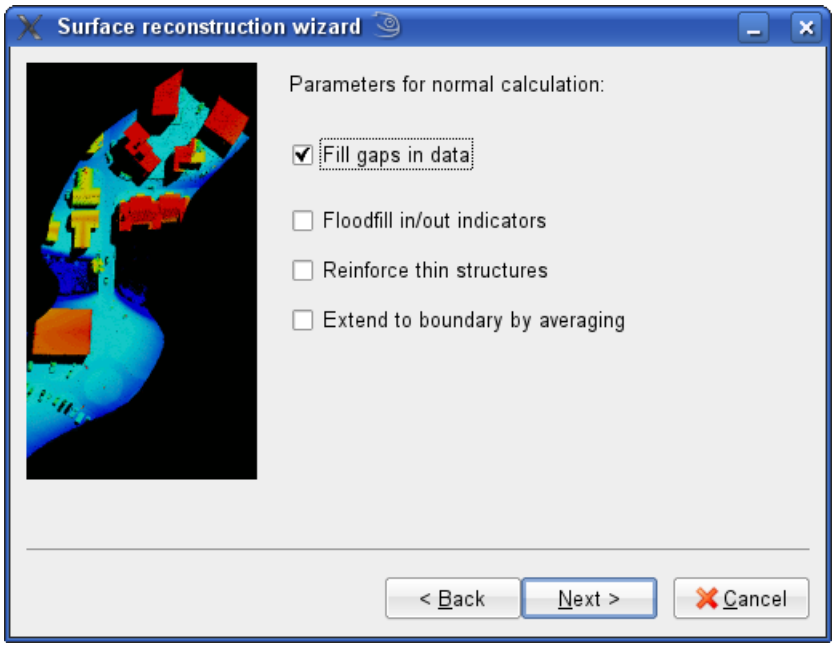

Figure 3: Normal calculation parameters page

For *.xyz* and *.xyzrgba* files, normals must be calculated prior to surface reconstruction. On this page, some options for the preprocessing of *.xyz* and *.xyzrgba* files can be set.

- **Fill gaps in data**: Attempt to fill gaps in the point cloud, like sides of buildings, and add ground points were no points are present in the data file. Sets the `fillgaps` option when calling `CalcNorms` or `CalcNormsView`.

The following options are only available if the use of trajectory information is enabled:

- **Floodfill in/out indicators**: Attempt to determine inside/outside of the scenery by a floodfilling algorithm before computing normals. Sets the `floodfill` option for `CalcNormsView`.

- **Reinforce thin structures**: Detect thin structures like fences, power lines and replace them by thicker, more dense objects. Sets the `thin_struct` option when calling `CalcNormsView`.
- **Extend to boundary by averaging**: Instead of adding ground where no points are present, add points at average height of neighbors. This option only has an effect if `fillgaps` is turned on, and it corresponds to the `extend_avg` option in `CalcNormsView`.

Noise filtering parameters

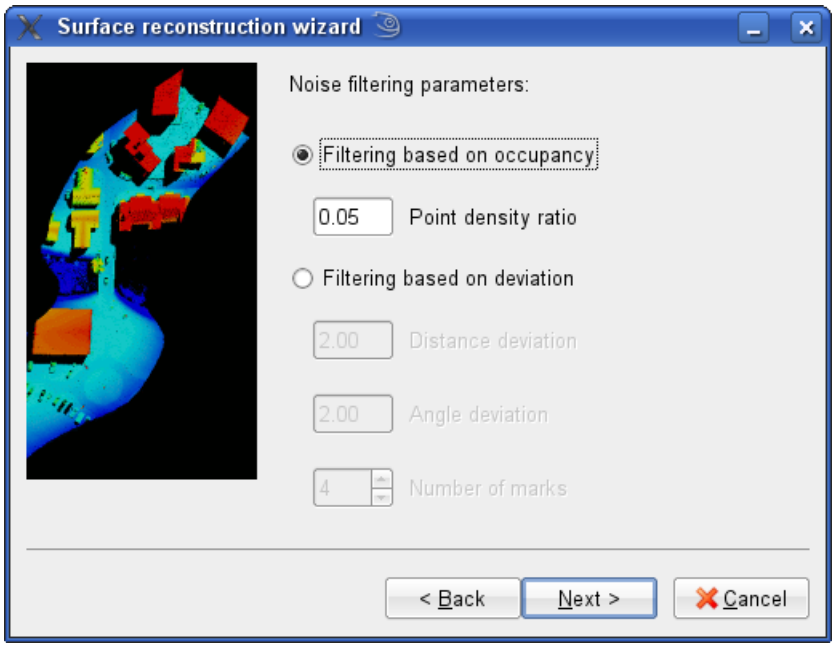

Figure 4: Noise filtering parameters page

If **Filter noise** was requested on the data file selection page, this page allows the user to specify various parameters of the noise filtering algorithms.

- **Filtering based on occupancy**: Points are removed if they have only a small number of neighbors. This option will cause `FilterOutliers` to be invoked during preprocessing of the data sets.
  - **Point density ratio**: Points are removed if their neighborhood contains less points than this number times the average number of points in a neighborhood.

Sets the `ratio` parameter for the call of `FilterOutliers`.

- **Filtering based on deviation**: A neighborhood of each point is approximated by a plane, and points are removed if they don't fit the plane well enough. Causes `SortPointsSimple` and `FilterPoints` to be invoked during preprocessing of the data sets.
  - **Distance deviation**: How far a point can lie off the fitting plane without getting a mark.
  - **Angle deviation**: Maximum angle the line from a point to the midpoint of its fitting plane can have with the plane without adding a mark for the point.
  - **Number of marks**: Maximum number of marks a point can incur without being removed as an outlier.

Reconstruction parameters

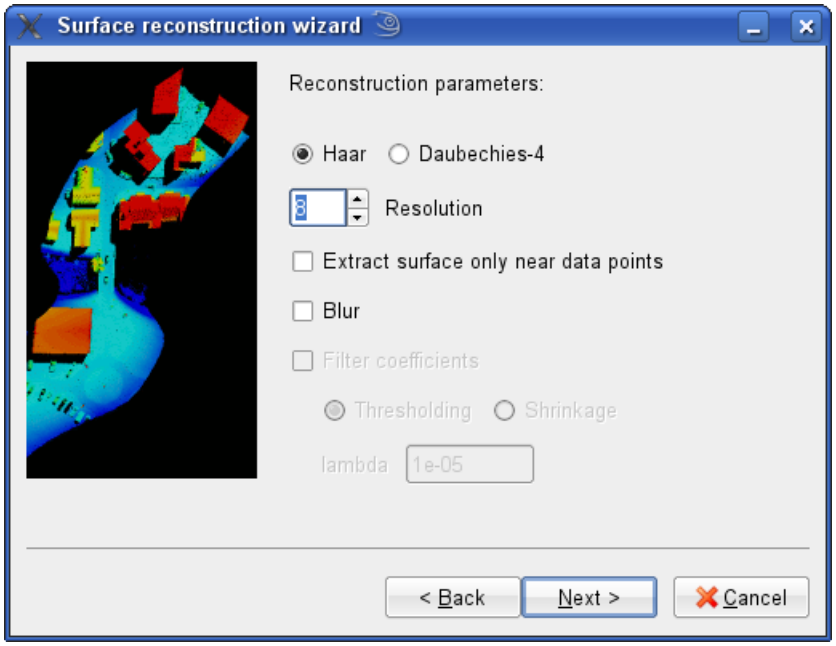

Figure 5: Reconstruction parameters page

On this page the parameters for the surface reconstruction algorithm are selected.

- **Haar/Daubechies-4**: Wavelet type that is used for the reconstruction. Sets the `wavelet` parameter for the call of `WaveletPipeRecon`.

- **Resolution**: Determines the depth of the wavelet tree. Corresponds to `depth` parameter of `WaveletPipeRecon`.
- **Extract surface only near data points**: Draw levelset only near points. Corresponds to `surf_at_pts` parameter of `WaveletPipeRecon`.
- **Blur**: Apply Gaussian blur to the computed characteristic function before extracting levelset. Corresponds to `blur` parameter of `WaveletPipeRecon`.
- (**Filter coefficients**: This setting is not currently implemented and therefore cannot be selected.)

Comparison parameters

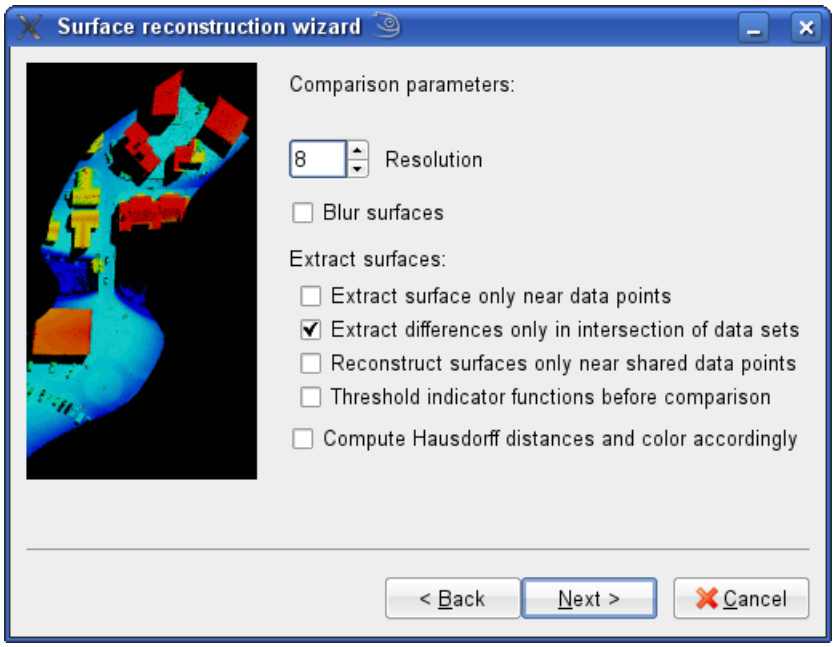

Figure 6: Comparison parameters page

Here the options for the comparison of two reconstructed surfaces are set. Notice that for the comparison of two data sets, Daubechies-4 wavelets are used for the reconstruction of the surfaces.

- **Resolution**: Depth of the wavelet tree. Specifies the `depth` parameter in the call of `Daub3DCompare`.

- **Blur surfaces**: Apply Gaussian blur to the computed characteristic functions before extracting levelsets. Corresponds to `blur` parameter of `Daub3DCompare`.
- **Extract surface only neat data points**: Extract levelsets only near points. Corresponds to `surf_at_pts` setting of `Daub3DCompare`.
- **Extract differences only in intersection of data sets**: A representation of the difference of the two data sets is only generated where the projection of both data to the xy-plane overlaps. Sets `surf_at_int` parameter of `Daub3DCompare`.
- **Reconstruct surfaces only near shared data points**: When set, only data points that share the same (x, y)-location are used to reconstruct the surfaces. Corresponds to `shared_pts` setting of `Daub3DCompare`.
- **Threshold indicator functions before comparison**: Threshold characteristic functions to $[0, 1]$ before extracting differences. Sets `cmp_thresh` parameter of `Daub3DCompare`.
- **Compute Hausdorff distances and color accordingly**: If set, instead of extracting the differences between the two surfaces, their distances are computed and both surfaces are drawn with colors according to their distance. This results in `SurfDistColor` and `ViewDists` being called after reconstructing the two surfaces.

Generate and run script

By clicking on **Run script**, a batch script named `run.bat` is generated in the current working directory and executed to run the surface reconstruction programs in the correct order and with the parameters specified on the wizard pages. Console output of the programs run by the batch script is printed on the standard output of the terminal from which `WizardGUI` was run. The wizard interface will wait for the batch script to finish before it accepts further input. If a problem is encountered while running the batch script, the program currently executed by the script can be manually terminated through a process manager in order to return focus to the wizard interface. If additional debugging is necessary, the script file `run.bat` can be edited and tested by hand.

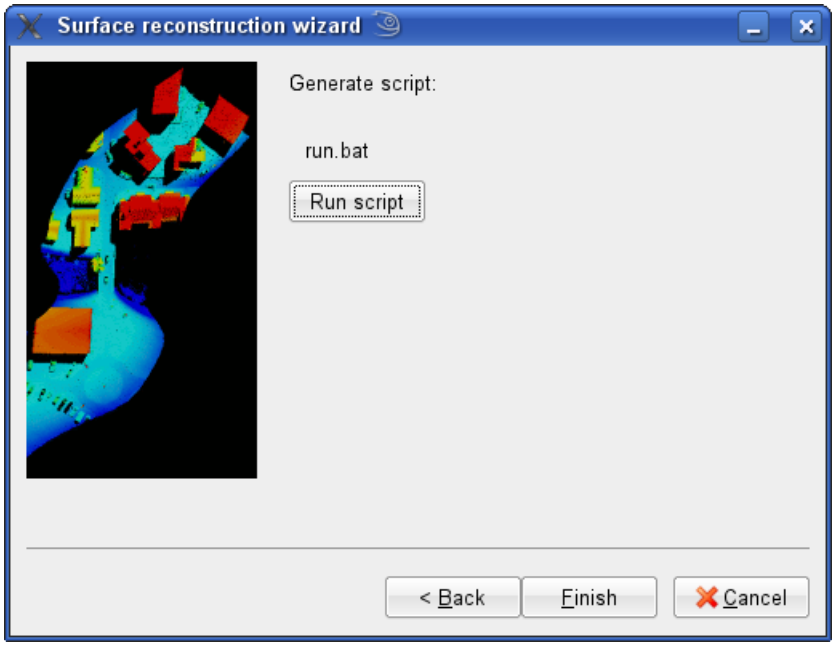

Figure 7: Script generation page

Test runs

In the following some sample program runs are discussed that help to get an idea of how the GUI works.

Viewing a point cloud

1. Obtain the data file `Clip1a.xyz`. This can be found on the MURI file server in the directory `/Eglin/data/Day_1`.
2. Run `WizardGUI`. On the Job type selection page, select *View data set*.
3. Use the file browse button to select `Clip1a.xyz` as the input file. Unselect the *Filter noise* option.
4. Unselect *Fill gaps in data* option.
5. Click the *Run script* button.

A window should open that looks like this:

Reconstruction of a surface

1. As in the previous example, the data file `Clip1a.xyz` is needed.
2. Run `WizardGUI`. On the Job type selection page, select *Reconstruct surface*.
3. Use the file browse button to select `Clip1a.xyz` as the input file. Unselect the *Filter noise* option.
4. Select *Fill gaps in data* option.
5. On the reconstruction page, select *Daubechies-4* as wavelet type, resolution *9*, and unselect all other options.
6. Click the *Run script* button.

The output window should show this:

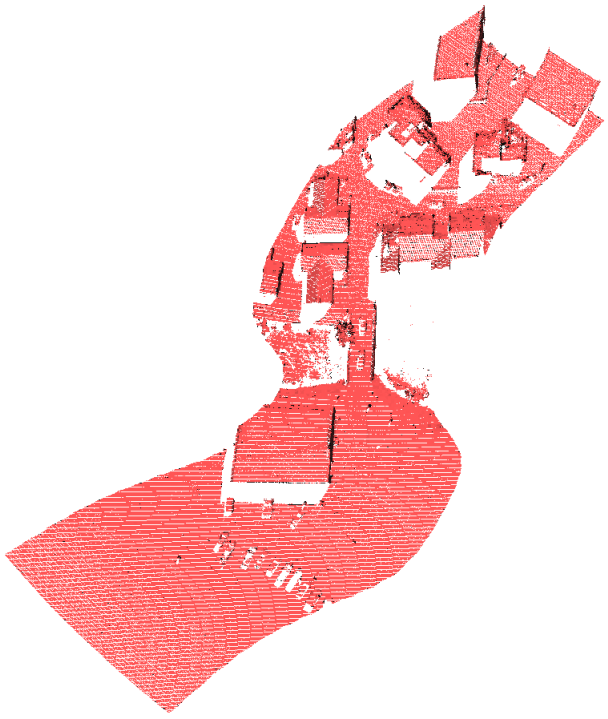

Figure 8: Eglin point cloud

Comparing two surfaces

1. Obtain the following files from the MURI file server (directory `/MOUT/MOUT/Object_Add_Remove/[data|trajectories]`):
   - `script2_traj_xyz.txt`
   - `script3_traj_xyz.txt`
   - `MOUT_script2.xyzrgba`
   - `MOUT_script3.xyzrgba`
2. Rename the trajectory files as follows:
   - `script2_traj_xyz.txt` → `MOUT_script2.traj`
   - `script3_traj_xyz.txt` → `MOUT_script3.traj`
3. Run `WizardGUI`. On the Job type selection page, select *Compare two data sets*.

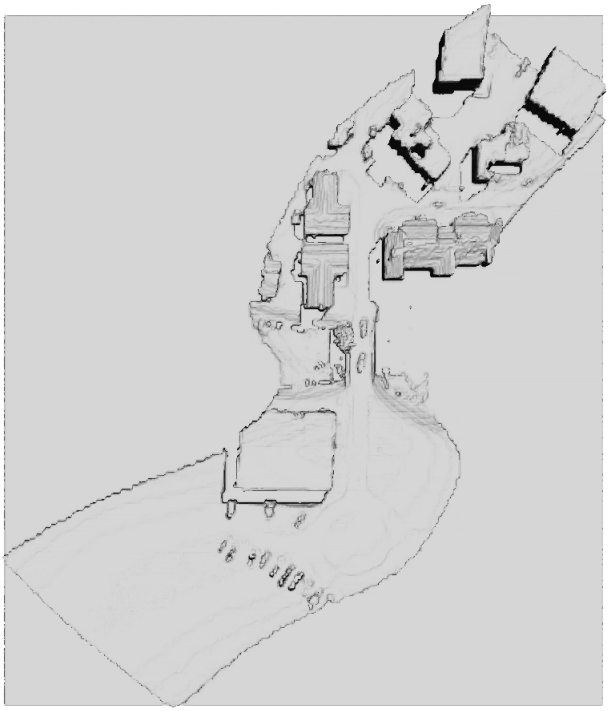

Figure 9: Reconstructed Eglin scene

4. Select `MOUT_script2.xyzrgba` as *input file 1*, and `MOUT_script3.xyzrgba` as *input file 2*. Select *Use trajectory information*, unselect *Filter noise*.
5. Unselect *Fill gaps in data* and all other options on this page.
6. Set resolution to 9, select *Extract surface only near data points*, *Extract differences only in intersection of data sets*, unselect all other options.
7. Click the *Run script* button.

After some calculations, the output should look like this:

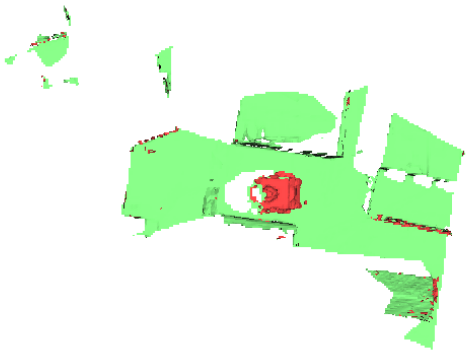

Figure 10: Comparison of two scenes