

OpenREC MANUAL

Installation

The additional material provides the software necessary to run openREC in GNU Linux Ubuntu 16.04.2 LTS¹. This software should work on more recent versions of Ubuntu and other Debian based distros too.

In this manual, we assume you have downloaded *install.sh* and *software.tgz* files in */tmp* directory.

In order to prepare your system for openREC, you must execute the Bash *install.sh* script as super-user. That will install all the needed packages in the system:

```
# first you must enter in the directory
# where install.sh is by means of cd
sudo /tmp/install.sh
```

If you are using Debian or a more recent version of Ubuntu, some of the names of the packages may vary lightly. Take into account that openREC has been compiled for python 3.5, and the associated tools have been compiled in GNU C++ 3.4.21.

Once you have installed all the packages, you can uncompress the rest of the software. By default the software is installed in */opt* directory:

```
# we move to the root directory
cd /
# then we uncompress the software
sudo tar xvfz /tmp/software.tgz
```

If you install the software in other folder you should change the settings of openREC later.

¹http://releases.ubuntu.com/16.04.2/ubuntu-16.04.2-desktop-amd64.iso?_ga=2.50189024.713698383.1500014964-1599430780.1500014964

Executing OpenREC

In order to execute openREC you must execute the script with the same name, assuming you have installed the software in the default folder:

```
# we move to the openREC folder  
cd /opt/openREC  
# then we launch openREC  
./openREC
```

A new window such as shown in Figure 1 should appear in the screen. This window has all its options disabled except the main menu where we can manage our projects, as explained in the next section.

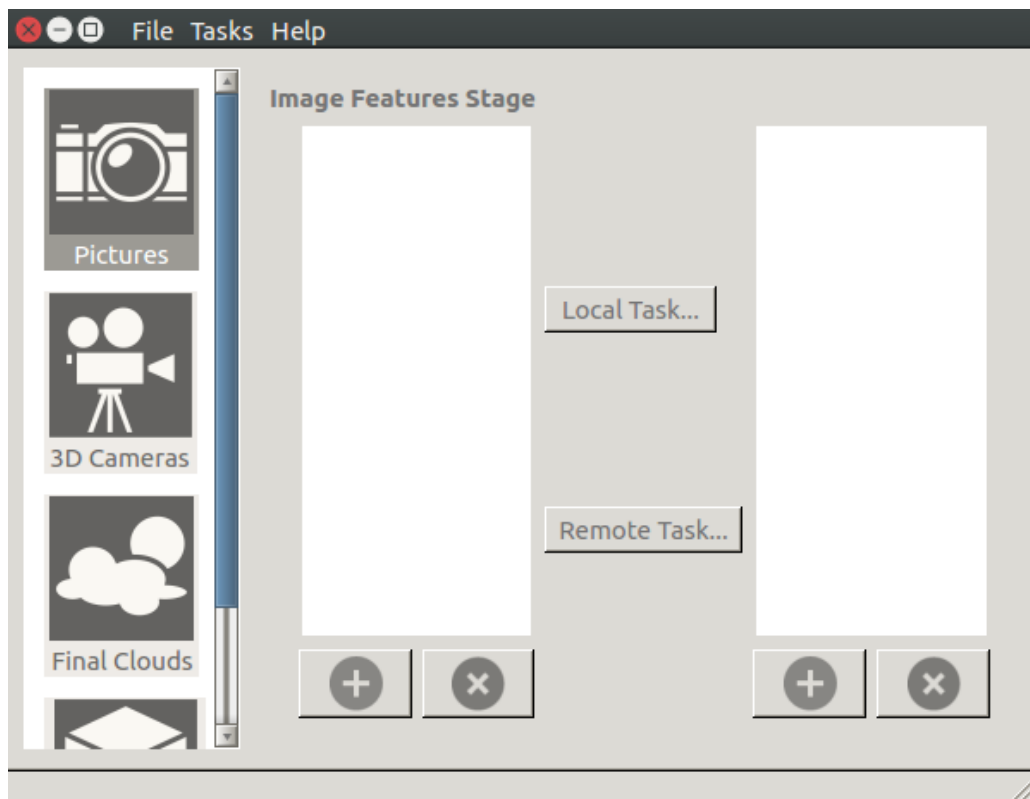


Figure 1: A screen-shot of the application when there is no active projects.

Managing Projects

The first thing we can do in OpenREC is to create a new project or to open some existing project. Figure 2 shows the menu *File*, where projects are managed and we can set the configuration

of the software.

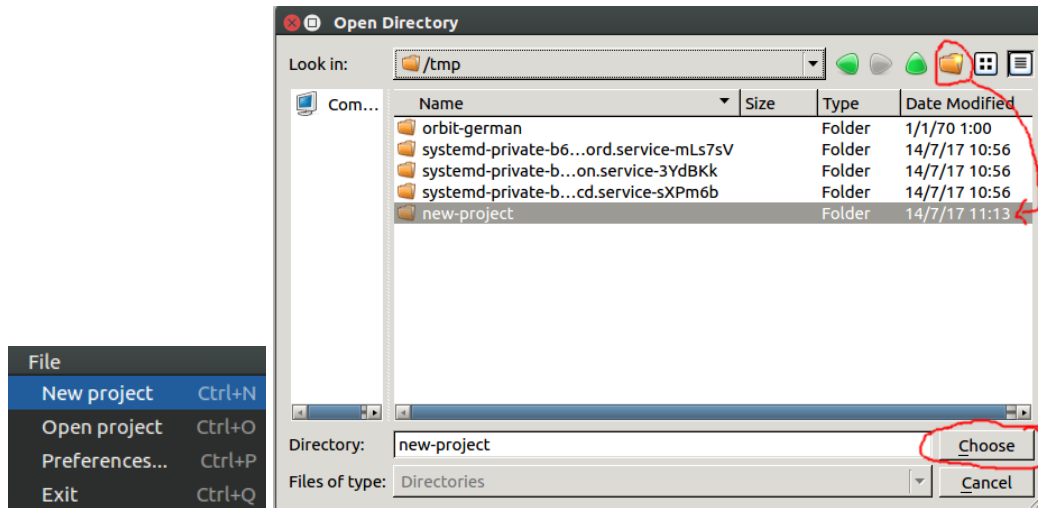


Figure 2: In order to create a new project, we can select *New Project* in menu *File*. Then we can create a folder via the upper icon, and select that folder for our project.

In order to create a new project we need to indicate some empty folder to start. OpenREC will create a file and the required sub-folders to work. When we open some existing project, we must select that file instead of the folder, as shown in Figure 3.

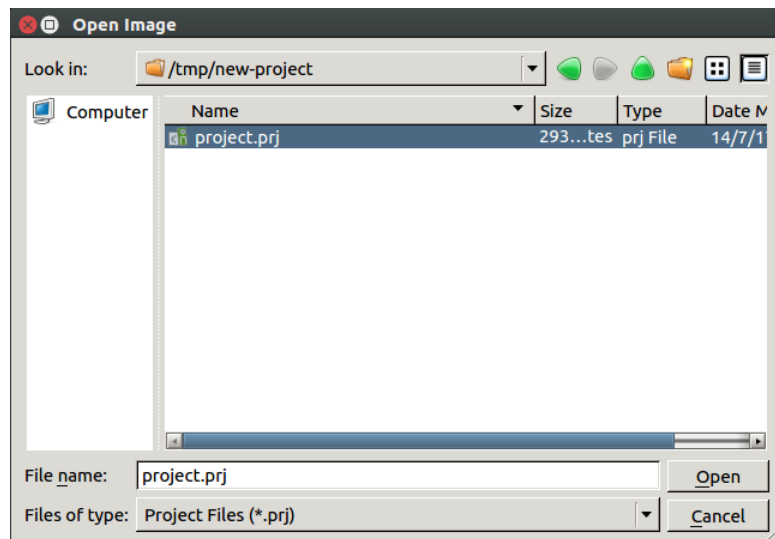


Figure 3: There is a file that contains all the information of the project. That file is required to open some existing project.

Configuration of OpenREC

OpenREC uses some underlying programs to compute the algorithms for the reconstruction and to view the result, the list of used tools is the following: openMVG, PVMS2, PoissonRec, and Meshlab.

So, we can set where this software is found by settings the options in the menu, as shown in Figure 4.

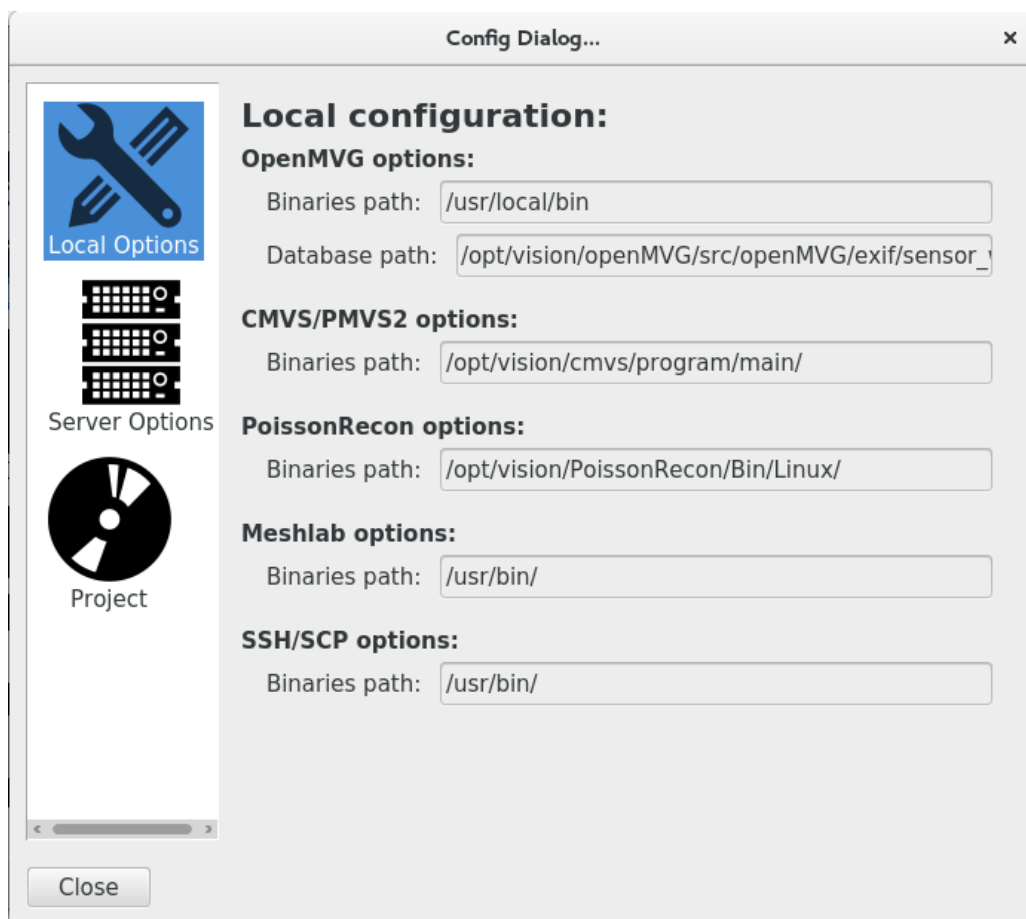


Figure 4: Local options for OpenREC.

This options are stored in a local file, so they are memorised until the next time we launch OpenREC.

3D Reconstruction from Photographs

Once we have created or selected a project we can start with the process of creating a points cloud. OpenREC is able to manage multiple independent points cloud for each project. The intention is that OpenREC can combine several points clouds in just one single cloud in the future.

The left menu is segmented in four options, that are the four stages of the reconstruction process. Figure 5 shows the process of adding pictures to construct a new cloud: a) we press the green *add* button on the left, then we create a new empty cloud, b) we select that cloud and we add all the pictures on the right side by pressing the right green *add* button.

Take into account that we can add several files at once by pressing *Ctrl+a* in the file selector. The red buttons delete points clouds or pictures respectively. We can also change the name of the points cloud by double-clicking in the name of the cloud on the left side of the screen.

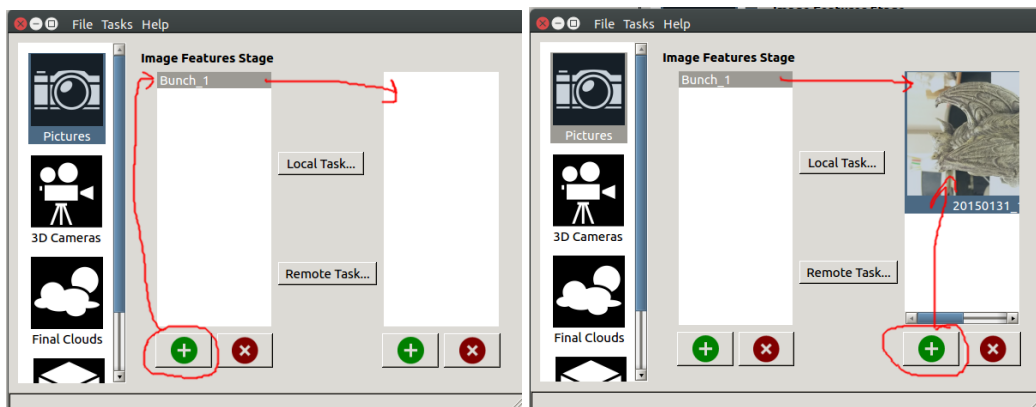


Figure 5: When adding a new cloud.

Once all the pictures have been added, the next step is to compute the camera position, for that we press the button *Local task* if we want to compute the underlying tasks in the same computer or we can press *Remote tasks* if we want to compute the tasks in a another server.

We can see what are the active tasks in any moment by the menu *Tasks* and *Manage tasks*, as shown in Figure 6. The tasks are then shown in a list, a red button indicate their status in real time. If we want to cancel some task we can press at that red button that shows its current status to cancel it.

After pressing any button to execute a new set of tasks locally or remotely, we can see a new window with the options of the algorithms involved in the process. Figure 7 shows the options for the first stage.

If we press *Run Task*, one or more tasks of that stage are launched, adding the task to the tasks manager and creating the points cloud in the next stage. Tasks are automatically synchronised,

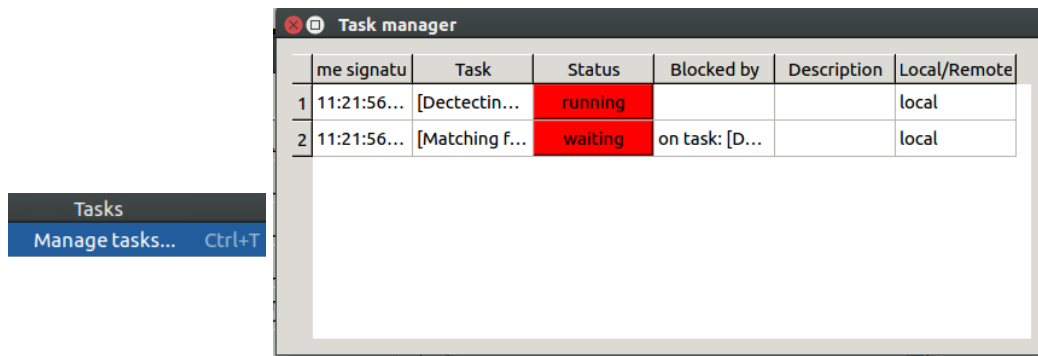


Figure 6: We can see and manage the tasks by the tasks manager in the menu.

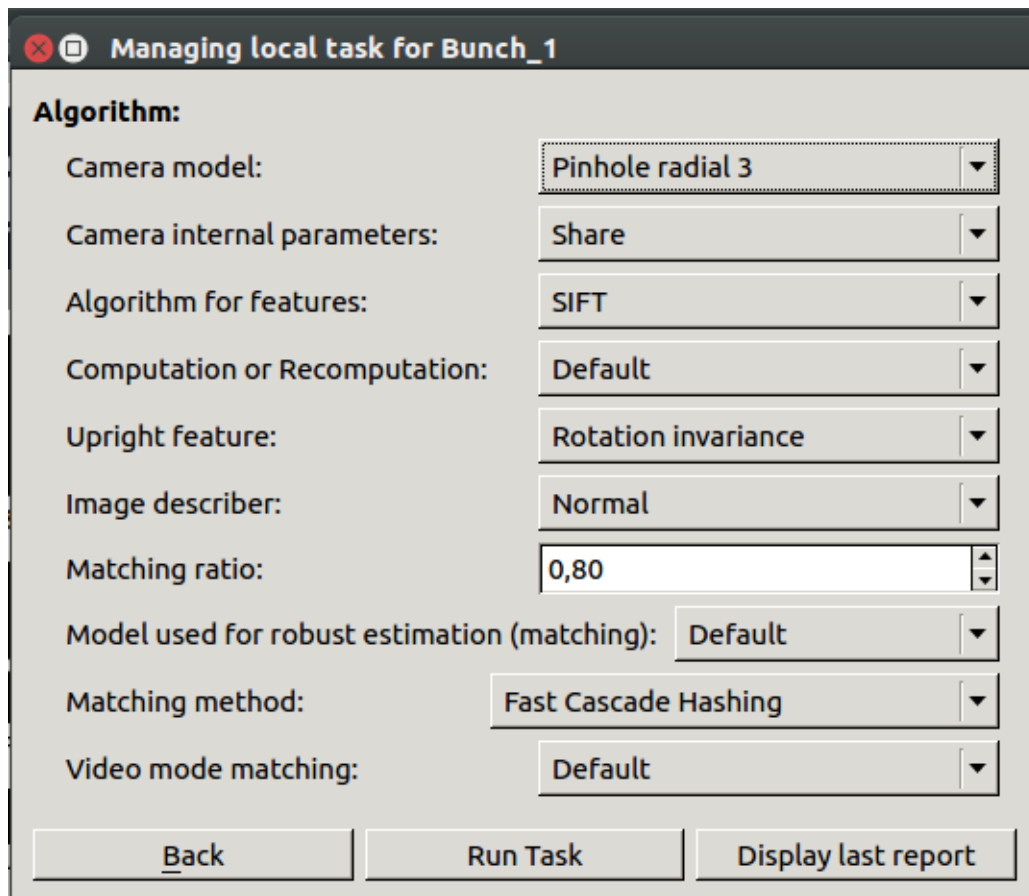


Figure 7: Options for the first stage.

so we should not be afraid of launching any task at any moment.

In next stages, including the stage named *3D Cameras*, there are blue eye icons on both left and right sides. These buttons are used to show information about the process of computing the points clouds or to show the points clouds themselves.

When we press on the left side eye icon after selecting a points cloud, OpenREC shows infor-

mation of the previous stage if that finished. So, in the case of the second stage, graphs and matrices with information of features matching are shown.

If we press the right eye icon after selecting one of the elements that appear when the stage has finished, Meshlab is launched to show us the cloud resulting for that stage. If we make some changes in that file the next stage will change accordingly.

Figure 8 shows an scheme of this process.

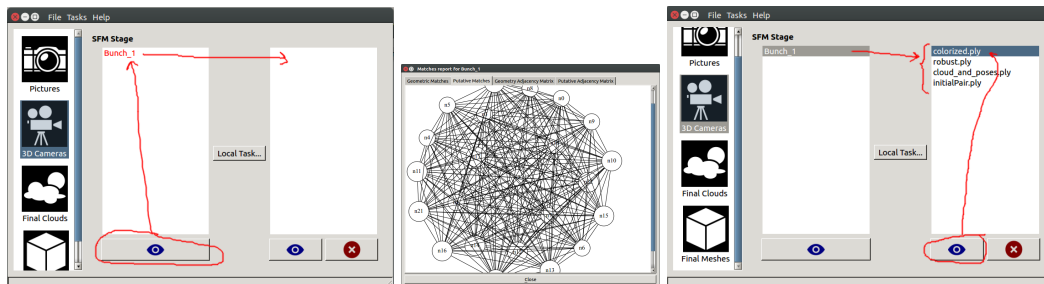


Figure 8: If we press the blue eye icon, we can launch a new window with information of that stage or the selected points cloud, once all tasks for that stage have finished.

Local task and *Remote task* buttons always shows a window that contains a button with label *Display last report*. If we press that button, a new window similar to shown in Figure 9 that shows us information about all the local underlying process that are computing the tasks. Obviously, in order to see some information we need to launch the tasks regarding to that stage.

Incremental versus Global ACSfm

The ACSfm is an evolution of the implementation used for the paper “Adaptive Structure from Motion with a contrario model estimation” published at ACCV 2012 by Pierre Moulon et al., whereas Global ACSfm is an algorithm based on the paper “Global Fusion of Relative Motions for Robust, Accurate and Scalable Structure from Motion.” published at ICCV 2013 by the same authors.

In the ACSfm algorithm, the incremental pipeline is a growing reconstruction process. It starts from an initial two-view reconstruction (the seed) that is iteratively extended by adding new views and 3D points, using pose estimation and triangulation. In Global ACSfm, the algorithm estimates the position and orientation of pictures in a common 3D coordinate frame. When views are treated incrementally, this external calibration can be subject to drift, contrary to global methods that distribute residual errors evenly.

Take into account that in order to perform a Global ACSfm successfully, we need to set the option *Image describer* as *HIGH*, and *Matching ratio* to 0.8 in the first stage.

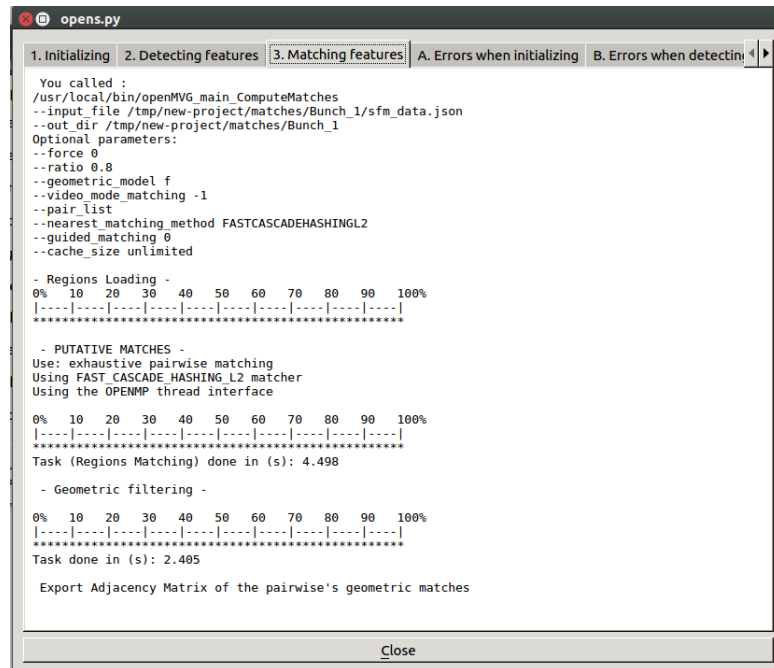


Figure 9: OpenREC shows the activity of the tasks by recording the reports of the underlying commands in real-time.

The parameters of the first stage are described in the website of OpenMVG:

- http://openmvg.readthedocs.io/en/latest/software/SfM/SfMInit_ImageListing/
- <http://openmvg.readthedocs.io/en/latest/software/SfM/ComputeFeatures/>
- <http://openmvg.readthedocs.io/en/latest/software/SfM/ComputeMatches/>

The parameters of the second stage are also described in the website of OpenMVG:

- <http://openmvg.readthedocs.io/en/latest/software/SfM/IncrementalSfM/>
- <http://openmvg.readthedocs.io/en/latest/software/SfM/GlobalSfM/>.

Configuration Options

As we have said in previous sections, OpenREC uses other tools to create all the necessary information in the local computer or in a remote server. Local options refer basically to the paths where the tools are installed, so the options are the following:

- OpenMVG options:
 - Binaries path: the path where the program has been installed.
 - Database path: the path pointing to the file with the cameras database.
- CMVS/PMVS2 options:
 - Binaries path: the path where the program has been installed.
- PoissonRecon options:
 - Binaries path: the path where the program has been installed.
- Meshlab options:
 - Binaries path: the path where the program has been installed.
- SSH/SCP options:
 - Binaries path: the path where *ssh* and *scp* programs are installed. These programs are used only when a remote task is launched.

Server Options

In order to make OpenREC works in a server, we need to have an account on the server and to configure the SSH certificates for the server and the local client².

The options for the server are the following:

- Address: the IP address or the name of the server to connect with.
- User: is the name of the user for the remote account. If it is blank, the user will be the same as the local computer.
- Remote path: this is a temporal directory where all the information will be saved.
- NOHUP server path: this is the path where we can find the command *nohup* in the remote server. This tool is used to manage the remote tasks when disconnecting our application.
- Last remote task: this number is used to identify every task launched in the server. With this option we can reset it manually when no remote tasks are being executed.
- Path to OpenMVG: this is the path to the tools of OpenMVG.
- Path to OpenMVG database: this is the path to the file of remote cameras. If this option is blank or None the database is copied from the local computer.

²http://www.linuxproblem.org/art_9.html

- Path to CMVS/PVMS2: path pointing to the CMVS tools.
- PoissonRecon: path to the PoissonRecon tools.
- SSH options: additional options for the SSH and SCP connection.

Finally, given that the reconstruction can take a considerable time to finish, it is convenient to launch as many tasks as possible into a remote server. OpenREC is able to deal with different servers, so if you launch some tasks against some server, you can later re-set the server options to launch additional tasks in other servers. OpenREC remembers the data relative to the servers and the log-in account for each task independently.