Compiling PCL from source on Windows

This tutorial explains how to build the Point Cloud Library **from source** on Microsoft Windows platforms. In this tutorial, we assume that you have built and installed all the required dependencies, or that you have installed them using the dependencies installers provided on the downloads page.

Note

If you installed PCL using one of the **all-in-one** provided installers, then this tutorial is not for you. The **all-in-one** installer already contains prebuilt PCL binaries which are ready to be used without any compilation step.

Note

If there is no installers for your compiler, it is recommended that you build the dependencies out of source. The Building PCL's dependencies from source on Windows tutorial should guide you through the download and the compilation of all the required dependencies.

Requirements

we assume that you have built and installed all the required dependencies, or that you have installed them using the dependencies installers provided on the downloads page. Installing them to the default locations will make configuring PCL easier.

- **Boost**

used for shared pointers, and threading. **mandatory**

- **Eigen**

used as the matrix backend for SSE optimized math. **mandatory**

- **FLANN**

used in *kdtree* for fast approximate nearest neighbors search. **mandatory**

- **Visualization ToolKit (VTK)**

used in *visualization* for 3D point cloud rendering and visualization. **mandatory**

- **Qt**

used for applications with a graphical user interface (GUI) **optional**

- **QHULL**

used for convex/concave hull decompositions in *surface*. **optional**

- **OpenNI** and patched **Sensor Module**

used to grab point clouds from OpenNI compliant devices. **optional**

- **GTest** version >= 1.6.0 (http://code.google.com/p/googletest/)

is needed only to build PCL tests. We do not provide GTest installers. **optional**

> Note
>
> Though not a dependency per se, don't forget that you also need the CMake build system (http://www.cmake.org/), at least version **3.5.0**. A Git client for Windows is also required to download the PCL source code.

Downloading PCL source code

To build the current official release, download the source archive from http://pointclouds.org/downloads/ and extract it somewhere on your disk, say C:\PCL\PCL-1.5.1-Source. In this case, you can go directly to Configuring PCL section, and pay attention to adjust the paths accordingly.

Or, you might want to build an experimental version of PCL to test some new features not yet available in the official releases. For this, you will need git (http://git-scm.com/download).

The invocation to download the source code is thus, using a command line:

```
cd wherever/you/want/to/put/the/repo/ git clone
https://github.com/PointCloudLibrary/pcl.git
```

You could also use Github for Windows (https://windows.github.com/), but that is potentially more troublesome than setting up git on windows.

Configuring PCL

On Windows, we recommend to build **shared** PCL libraries with **static** dependencies. In this tutorial, we will use static dependencies when possible to build shared PCL. You can easily switch to using shared dependencies. Then, you need to make sure you put the dependencies' dlls either in your *PATH* or in the same folder as PCL dlls and executables. You can also build static PCL libraries if you want.

Run the CMake-gui application and fill in the fields:

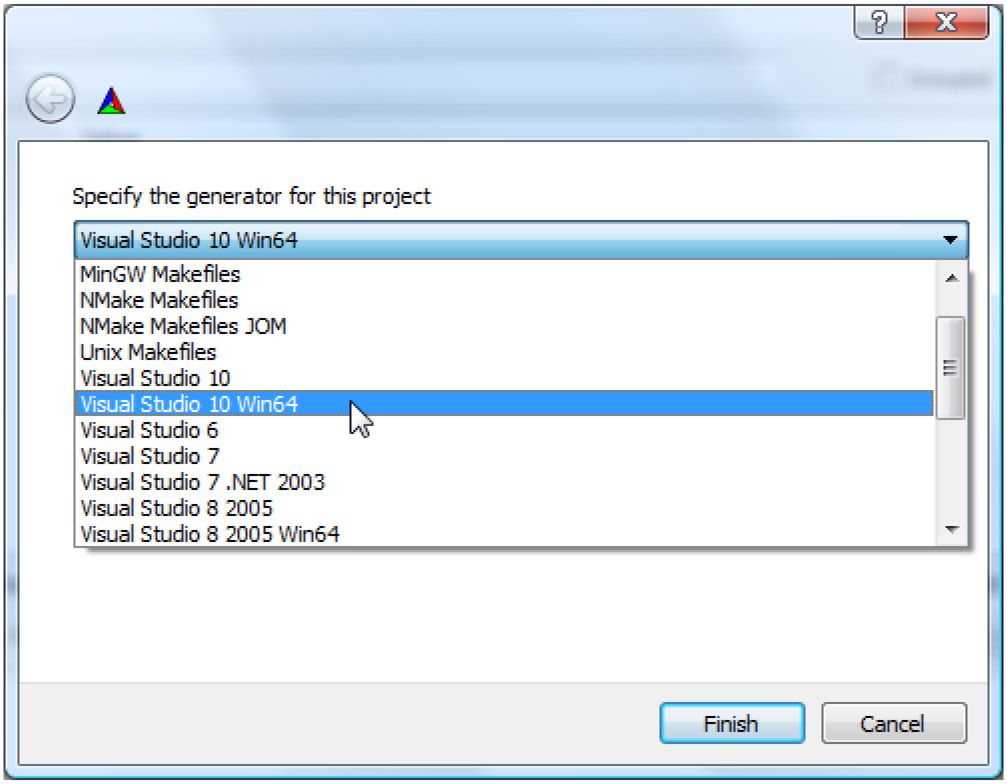
```
Where is the source code   : C:/PCL/pcl
Where to build the binaries: C:/PCL
```

Now hit the "Configure" button. You will be asked for a *generator*. A generator is simply a compiler.

Note

In this tutorial, we will be using Microsoft Visual C++ 2010 compiler. If you want to build 32bit PCL, then pick the "**Visual Studio 10**" generator. If you want to build 64bit PCL, then pick the "**Visual Studio 10 Win64**".

Make sure you have installed the right third party dependencies. You cannot mix 32bit and 64bit code, and it is highly recommended to not mix codes compiled with different compilers.

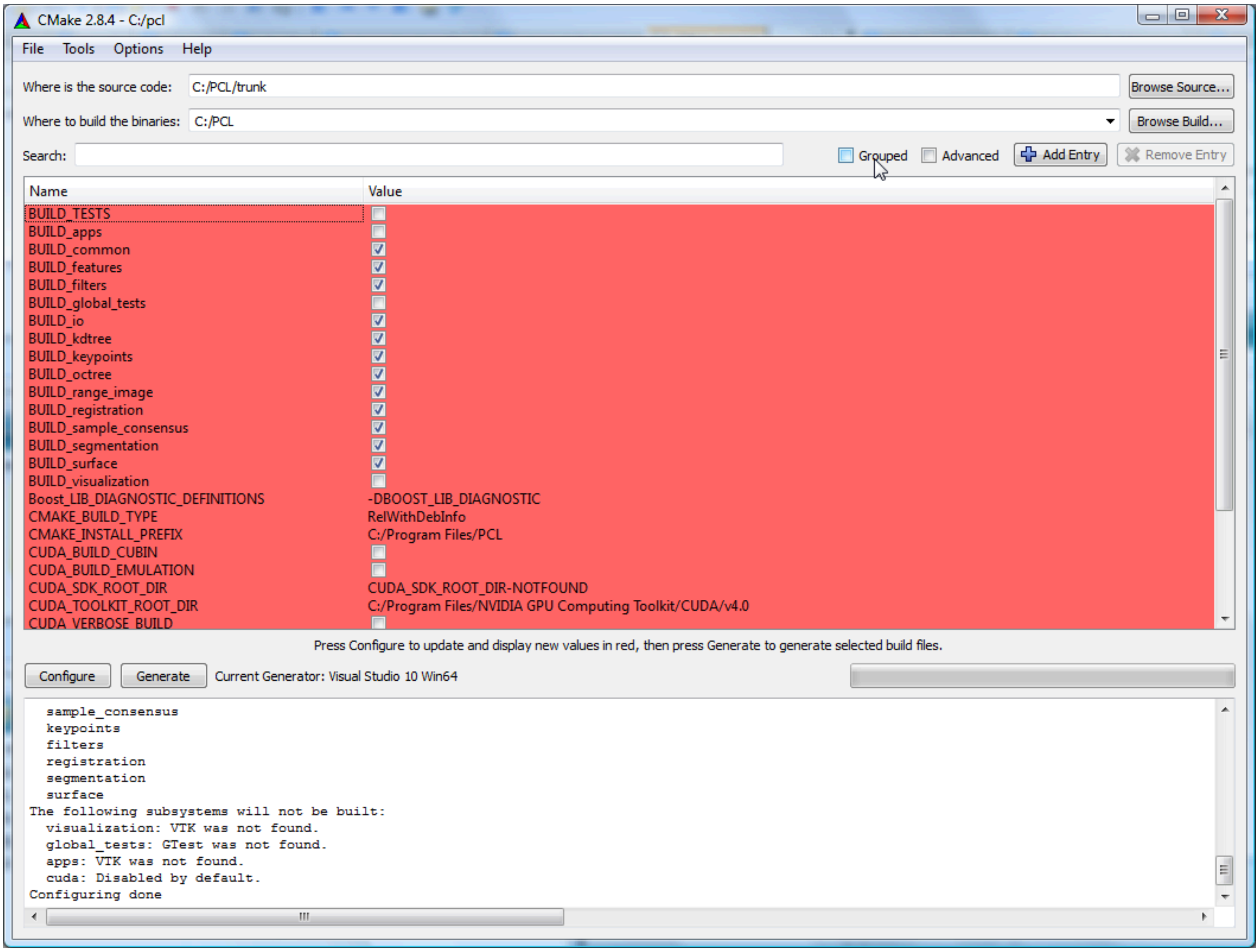


Specify the generator for this project

Visual Studio 10 Win64

MinGW Makefiles
NMake Makefiles
NMake Makefiles JOM
Unix Makefiles
Visual Studio 10
Visual Studio 10 Win64
Visual Studio 6
Visual Studio 7
Visual Studio 7 .NET 2003
Visual Studio 8 2005
Visual Studio 8 2005 Win64

In the remaining of this tutorial, we will be using “**Visual Studio 10 Win64**” generator. Once you picked your generator, hit finish to close the dialog window. CMake will start configuring PCL and looking for its dependencies. For example, we can get this output :



CMake 2.8.4 - C:/pcl

Where is the source code: C:/PCL/trunk

Where to build the binaries: C:/PCL

Search:

Name	Value
BUILD_TESTS	□
BUILD_apps	□
BUILD_common	☑
BUILD_features	☑
BUILD_filters	☑
BUILD_global_tests	□
BUILD_io	☑
BUILD_kdtree	☑
BUILD_keypoints	☑
BUILD_octree	☑
BUILD_range_image	☑
BUILD_registration	☑
BUILD_sample_consensus	☑
BUILD_segmentation	☑
BUILD_surface	☑
BUILD_visualization	□
Boost_LIB_DIAGNOSTIC_DEFINITIONS	-DBOOST_LIB_DIAGNOSTIC
CMAKE_BUILD_TYPE	RelWithDebInfo
CMAKE_INSTALL_PREFIX	C:/Program Files/PCL
CUDA_BUILD_CUBIN	□
CUDA_BUILD_EMULATION	□
CUDA_SDK_ROOT_DIR	CUDA_SDK_ROOT_DIR-NOTFOUND
CUDA_TOOLKIT_ROOT_DIR	C:/Program Files/NVIDIA GPU Computing Toolkit/CUDA/v4.0
CUDA_VERBOSE_BUILD	□

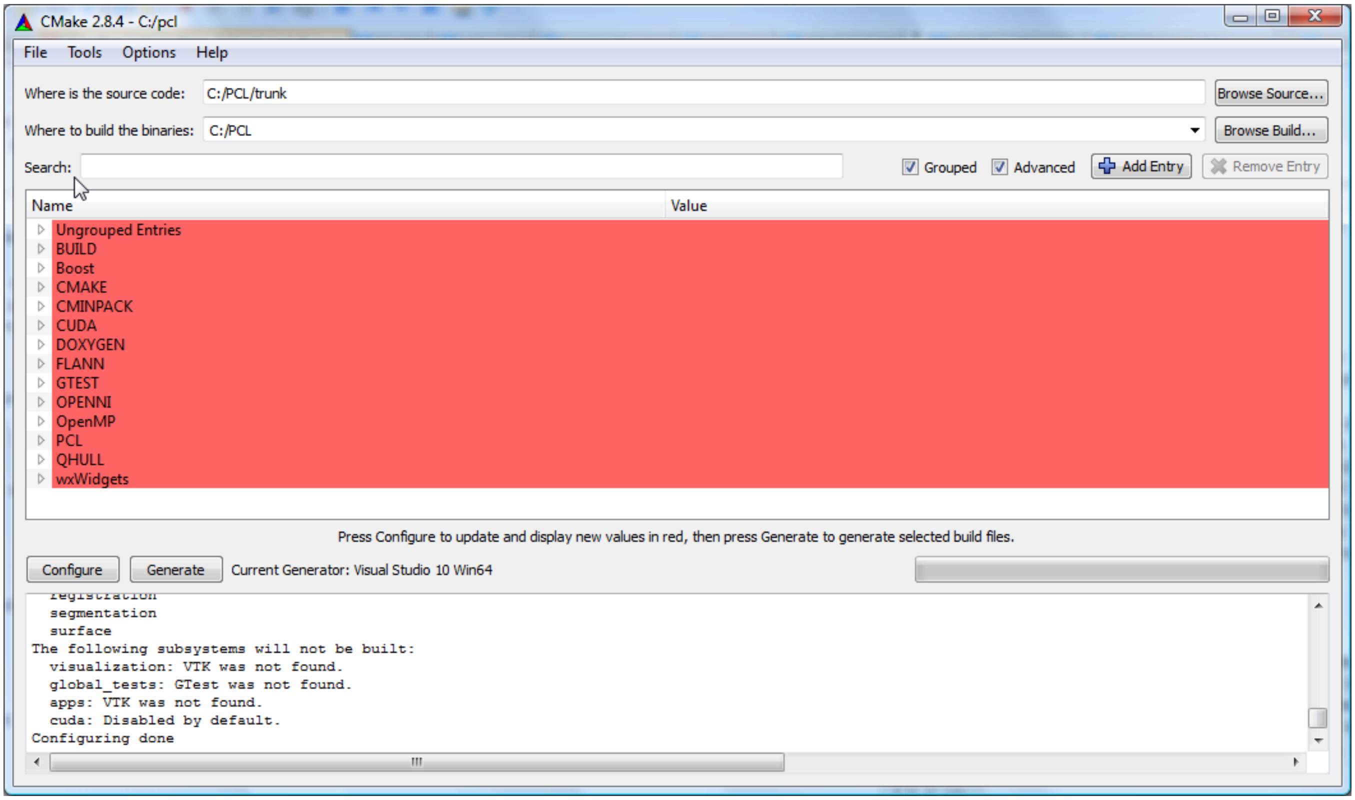
Press Configure to update and display new values in red, then press Generate to generate selected build files.

Current Generator: Visual Studio 10 Win64

```
  sample_consensus
  keypoints
  filters
  registration
  segmentation
  surface
The following subsystems will not be built:
  visualization: VTK was not found.
  global_tests: GTest was not found.
  apps: VTK was not found.
  cuda: Disabled by default.
Configuring done
```

The upper part of CMake window contains a list of CMake variables and its respective values. The lower part contains some logging output that can help figure out what is happening. We can see, for example, that VTK was not found, thus, the visualization module will not get built.

Before solving the VTK issue, let's organize the CMake variables in groups by checking the *Grouped* checkbox in the top right of CMake window. Let's check also the *Advanced* checkbox to show some advanced CMake variables. Now, if we want to look for a specific variable value, we can either browse the CMake variables to look for it, or we can use the *Search:* field to type the variable name.



Where is the source code: C:/PCL/trunk

Where to build the binaries: C:/PCL

Search:

☑ Grouped ☑ Advanced

Name | Value

- Ungrouped Entries
- BUILD
- Boost
- CMAKE
- CMINPACK
- CUDA
- DOXYGEN
- FLANN
- GTEST
- OPENNI
- OpenMP
- PCL
- QHULL
- wxWidgets

Press Configure to update and display new values in red, then press Generate to generate selected build files.

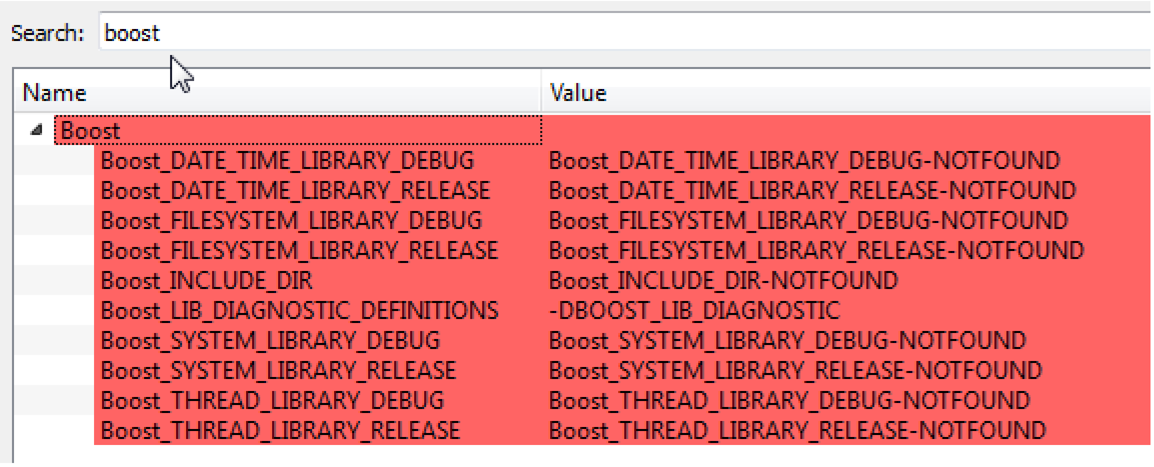
Current Generator: Visual Studio 10 Win64

```
  registration
  segmentation
  surface
The following subsystems will not be built:
  visualization: VTK was not found.
  global_tests: GTest was not found.
  apps: VTK was not found.
  cuda: Disabled by default.
Configuring done
```

Let's check whether CMake did actually find the needed third party dependencies or not :

- **Boost :**

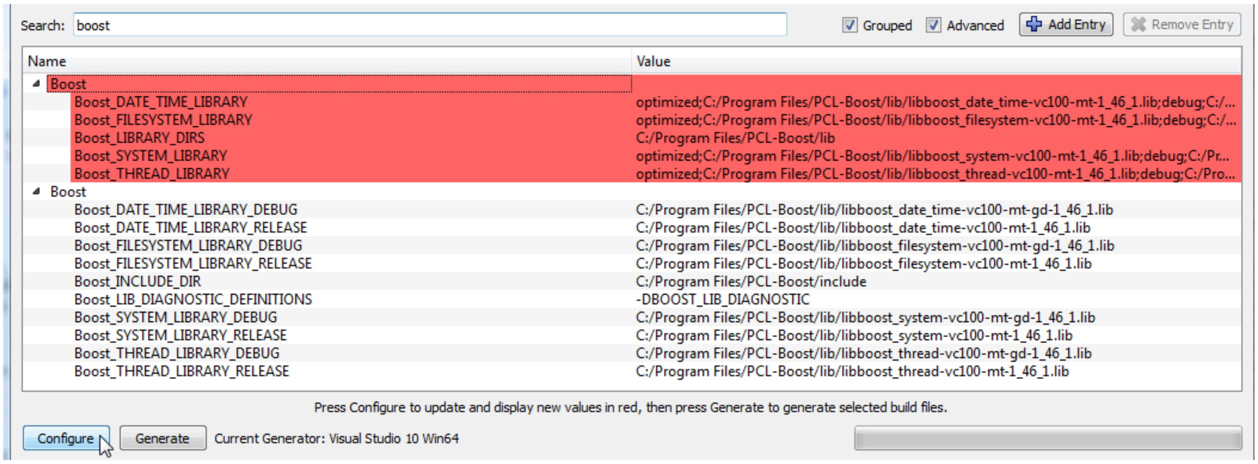
CMake was not able to find boost automatically. No problem, we will help it find it :) . If CMake has found your boost installation, then skip to the next bullet item.



Search: boost

Name	Value
Boost	
Boost_DATE_TIME_LIBRARY_DEBUG	Boost_DATE_TIME_LIBRARY_DEBUG-NOTFOUND
Boost_DATE_TIME_LIBRARY_RELEASE	Boost_DATE_TIME_LIBRARY_RELEASE-NOTFOUND
Boost_FILESYSTEM_LIBRARY_DEBUG	Boost_FILESYSTEM_LIBRARY_DEBUG-NOTFOUND
Boost_FILESYSTEM_LIBRARY_RELEASE	Boost_FILESYSTEM_LIBRARY_RELEASE-NOTFOUND
Boost_INCLUDE_DIR	Boost_INCLUDE_DIR-NOTFOUND
Boost_LIB_DIAGNOSTIC_DEFINITIONS	-DBOOST_LIB_DIAGNOSTIC
Boost_SYSTEM_LIBRARY_DEBUG	Boost_SYSTEM_LIBRARY_DEBUG-NOTFOUND
Boost_SYSTEM_LIBRARY_RELEASE	Boost_SYSTEM_LIBRARY_RELEASE-NOTFOUND
Boost_THREAD_LIBRARY_DEBUG	Boost_THREAD_LIBRARY_DEBUG-NOTFOUND
Boost_THREAD_LIBRARY_RELEASE	Boost_THREAD_LIBRARY_RELEASE-NOTFOUND

Let's tell CMake where boost headers are by specifying the headers path in **Boost_INCLUDE_DIR** variable. For example, my boost headers are in C:\Program Files\PCL-Boost\include (C:\Program Files\Boost\include for newer installers). Then, let's hit *configure* again ! Hopefully, CMake is now able to find all the other items (the libraries).



Search: boost ☑ Grouped ☑ Advanced

Name	Value
Boost	
Boost_DATE_TIME_LIBRARY	optimized;C:/Program Files/PCL-Boost/lib/libboost_date_time-vc100-mt-1_46_1.lib;debug;C:/...
Boost_FILESYSTEM_LIBRARY	optimized;C:/Program Files/PCL-Boost/lib/libboost_filesystem-vc100-mt-1_46_1.lib;debug;C:/...
Boost_LIBRARY_DIRS	C:/Program Files/PCL-Boost/lib
Boost_SYSTEM_LIBRARY	optimized;C:/Program Files/PCL-Boost/lib/libboost_system-vc100-mt-1_46_1.lib;debug;C:/Pr...
Boost_THREAD_LIBRARY	optimized;C:/Program Files/PCL-Boost/lib/libboost_thread-vc100-mt-1_46_1.lib;debug;C:/Pro...
Boost	
Boost_DATE_TIME_LIBRARY_DEBUG	C:/Program Files/PCL-Boost/lib/libboost_date_time-vc100-mt-gd-1_46_1.lib
Boost_DATE_TIME_LIBRARY_RELEASE	C:/Program Files/PCL-Boost/lib/libboost_date_time-vc100-mt-1_46_1.lib
Boost_FILESYSTEM_LIBRARY_DEBUG	C:/Program Files/PCL-Boost/lib/libboost_filesystem-vc100-mt-gd-1_46_1.lib
Boost_FILESYSTEM_LIBRARY_RELEASE	C:/Program Files/PCL-Boost/lib/libboost_filesystem-vc100-mt-1_46_1.lib
Boost_INCLUDE_DIR	C:/Program Files/PCL-Boost/include
Boost_LIB_DIAGNOSTIC_DEFINITIONS	-DBOOST_LIB_DIAGNOSTIC
Boost_SYSTEM_LIBRARY_DEBUG	C:/Program Files/PCL-Boost/lib/libboost_system-vc100-mt-gd-1_46_1.lib
Boost_SYSTEM_LIBRARY_RELEASE	C:/Program Files/PCL-Boost/lib/libboost_system-vc100-mt-1_46_1.lib
Boost_THREAD_LIBRARY_DEBUG	C:/Program Files/PCL-Boost/lib/libboost_thread-vc100-mt-gd-1_46_1.lib
Boost_THREAD_LIBRARY_RELEASE	C:/Program Files/PCL-Boost/lib/libboost_thread-vc100-mt-1_46_1.lib

Press Configure to update and display new values in red, then press Generate to generate selected build files.

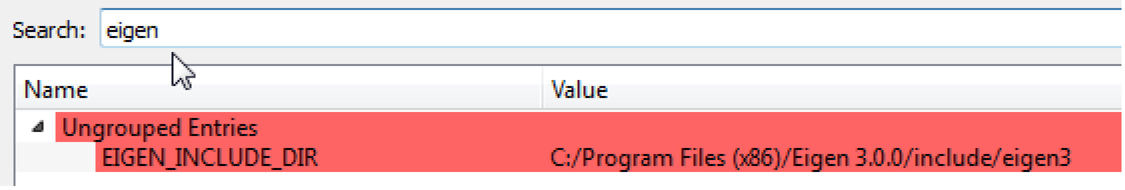
Current Generator: Visual Studio 10 Win64

Note

This behaviour is not common for all libraries. Generally, if CMake is not able to find a specific library or package, we have to manually set the values of all the CMake related variables. Hopefully, the CMake script responsible of finding boost is able to find libraries using the headers path.

- **Eigen** :

  Eigen is a header-only library, thus, we need only **EIGEN_INCLUDE_DIR** to be set. Hopefully, CMake did find Eigen.

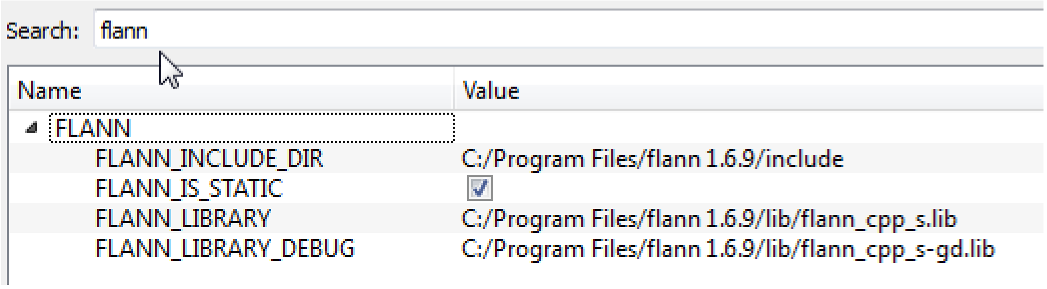


Search: eigen

Name	Value
Ungrouped Entries	
EIGEN_INCLUDE_DIR	C:/Program Files (x86)/Eigen 3.0.0/include/eigen3

- **FLANN** :

  CMake was able to find my FLANN installation. By default on windows, PCL will pick the static FLANN libraries with *_s* suffix. Thus, the **FLANN_IS_STATIC** checkbox is checked by default.

  Search: flann

Name	Value
FLANN	
FLANN_INCLUDE_DIR	C:/Program Files/flann 1.6.9/include
FLANN_IS_STATIC	☑
FLANN_LIBRARY	C:/Program Files/flann 1.6.9/lib/flann_cpp_s.lib
FLANN_LIBRARY_DEBUG	C:/Program Files/flann 1.6.9/lib/flann_cpp_s-gd.lib

  Note

  If you rather want to use the **shared** FLANN libraries (those without the *_s* suffix), you need to manually edit the **FLANN_LIBRARY** and **FLANN_LIBRARY_DEBUG** variables to remove the *_s* suffix and do not forget to uncheck **FLANN_IS_STATIC**. Make sure the FLANN dlls are either in your PATH or in the same folder as your executables.

  Note

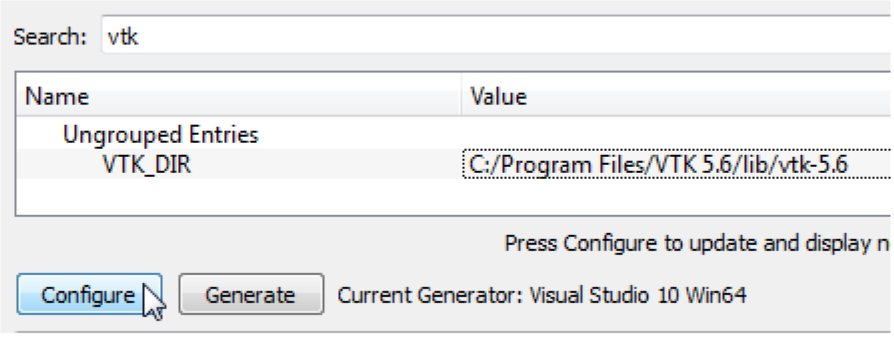
  In recent PCL, the **FLANN_IS_STATIC** checkbox no longer exists.

- **Qt** :

  It is highly recommended to install Qt to the default path suggested by the installer. You need then to define an environment variable named **QTDIR** to point to Qt installation path (e.g. *C:\Qt\4.8.0*). Also, you need to append the bin folder to the **PATH** environment variable. Once you modify the environment variables, you need to restart CMake and click “Configure” again. If Qt is not found, you need at least to fill **QT_QMAKE_EXECUTABLE** CMake entry with the path of *qmake.exe* (e.g. C:\Qt\4.8.0\bin\qmake.exe), then click “Configure”.

- **VTK** :

CMake did not find my VTK installation. There is only one VTK related CMake variable called **VTK_DIR**. We have to set it to the path of the folder containing **VTKConfig.cmake**, which is in my case : C:\Program Files\VTK 5.6\lib\vtk-5.6 (C:\Program Files\VTK 5.8.0\lib\vtk-5.8 for VTK 5.8). After you set **VTK_DIR**, hit *configure* again.



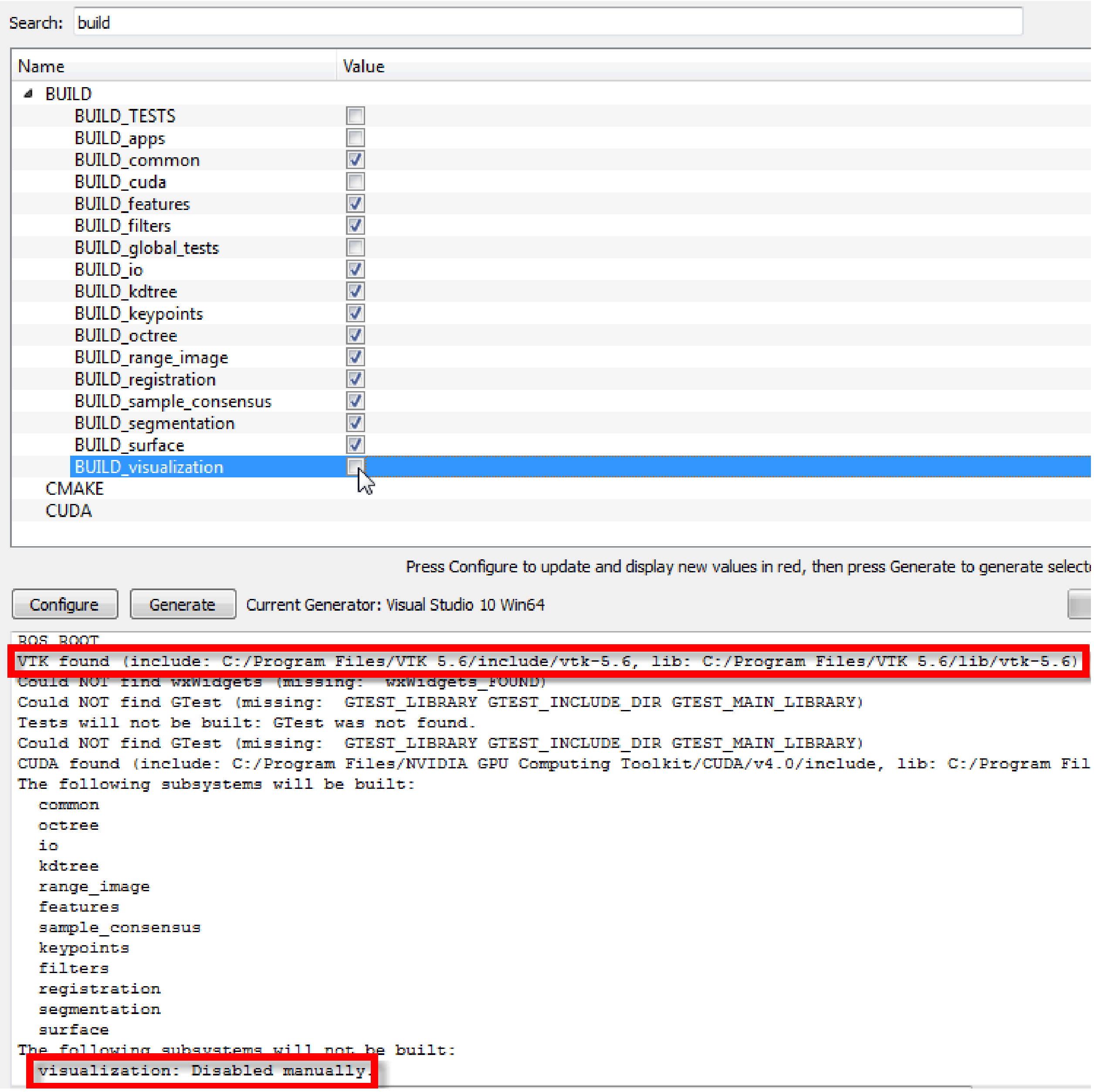
Search: vtk

Name	Value
Ungrouped Entries	
VTK_DIR	C:/Program Files/VTK 5.6/lib/vtk-5.6

Press Configure to update and display n

Current Generator: Visual Studio 10 Win64

After clicking *configure*, in the logging window, we can see that VTK is found, but the *visualization* module is still disabled *manually*. We have then to enable it by checking the **BUILD_visualization** checkbox. You can also do the same thing with the *apps* module. Then, hit *configure* again.



Search: build

Name	Value
◢ BUILD	
BUILD_TESTS	□
BUILD_apps	□
BUILD_common	☑
BUILD_cuda	□
BUILD_features	☑
BUILD_filters	☑
BUILD_global_tests	□
BUILD_io	☑
BUILD_kdtree	☑
BUILD_keypoints	☑
BUILD_octree	☑
BUILD_range_image	☑
BUILD_registration	☑
BUILD_sample_consensus	☑
BUILD_segmentation	☑
BUILD_surface	☑
BUILD_visualization	□
CMAKE	
CUDA	

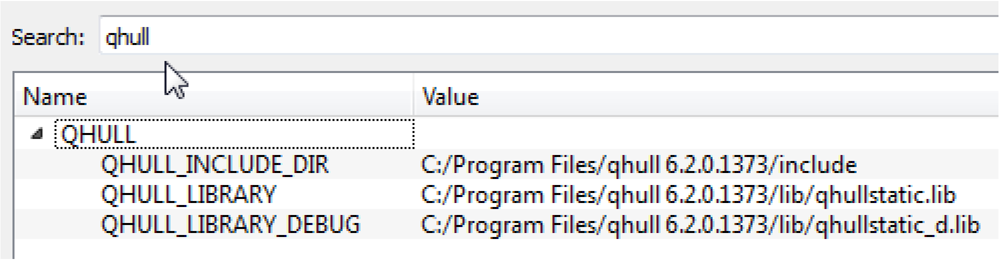
Press Configure to update and display new values in red, then press Generate to generate selecte

Current Generator: Visual Studio 10 Win64

```
ROS_ROOT
VTK found (include: C:/Program Files/VTK 5.6/include/vtk-5.6, lib: C:/Program Files/VTK 5.6/lib/vtk-5.6)
Could NOT find wxWidgets (missing:  wxWidgets_FOUND)
Could NOT find GTest (missing:  GTEST_LIBRARY GTEST_INCLUDE_DIR GTEST_MAIN_LIBRARY)
Tests will not be built: GTest was not found.
Could NOT find GTest (missing:  GTEST_LIBRARY GTEST_INCLUDE_DIR GTEST_MAIN_LIBRARY)
CUDA found (include: C:/Program Files/NVIDIA GPU Computing Toolkit/CUDA/v4.0/include, lib: C:/Program Fil
The following subsystems will be built:
  common
  octree
  io
  kdtree
  range_image
  features
  sample_consensus
  keypoints
  filters
  registration
  segmentation
  surface
The following subsystems will not be built:
  visualization: Disabled manually.
```

- **QHull** :

  CMake was able to find my QHull installation. By default on windows, PCL will pick the static QHull libraries with *static* suffix.

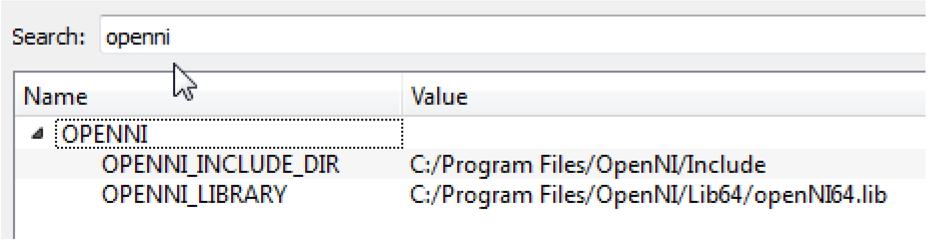


Search: qhull

Name	Value
◢ QHULL	
QHULL_INCLUDE_DIR	C:/Program Files/qhull 6.2.0.1373/include
QHULL_LIBRARY	C:/Program Files/qhull 6.2.0.1373/lib/qhullstatic.lib
QHULL_LIBRARY_DEBUG	C:/Program Files/qhull 6.2.0.1373/lib/qhullstatic_d.lib

- **OpenNI** :

CMake was able to find my OpenNI installation.



Search: openni

Name	Value
OPENNI	
OPENNI_INCLUDE_DIR	C:/Program Files/OpenNI/Include
OPENNI_LIBRARY	C:/Program Files/OpenNI/Lib64/openNI64.lib

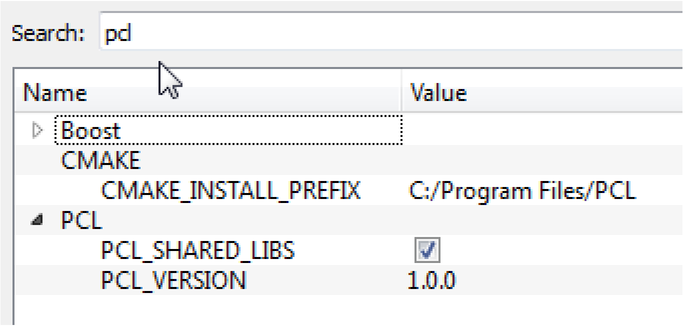
Note

CMake do not look for the installed OpenNI Sensor module. It is needed at runtime.

- **GTest** :

  If you want to build PCL tests, you need to download GTest and build it yourself. In this tutorial, we will not build tests.

Once CMake has found all the needed dependencies, let's see the PCL specific CMake variables :



Search: pcl

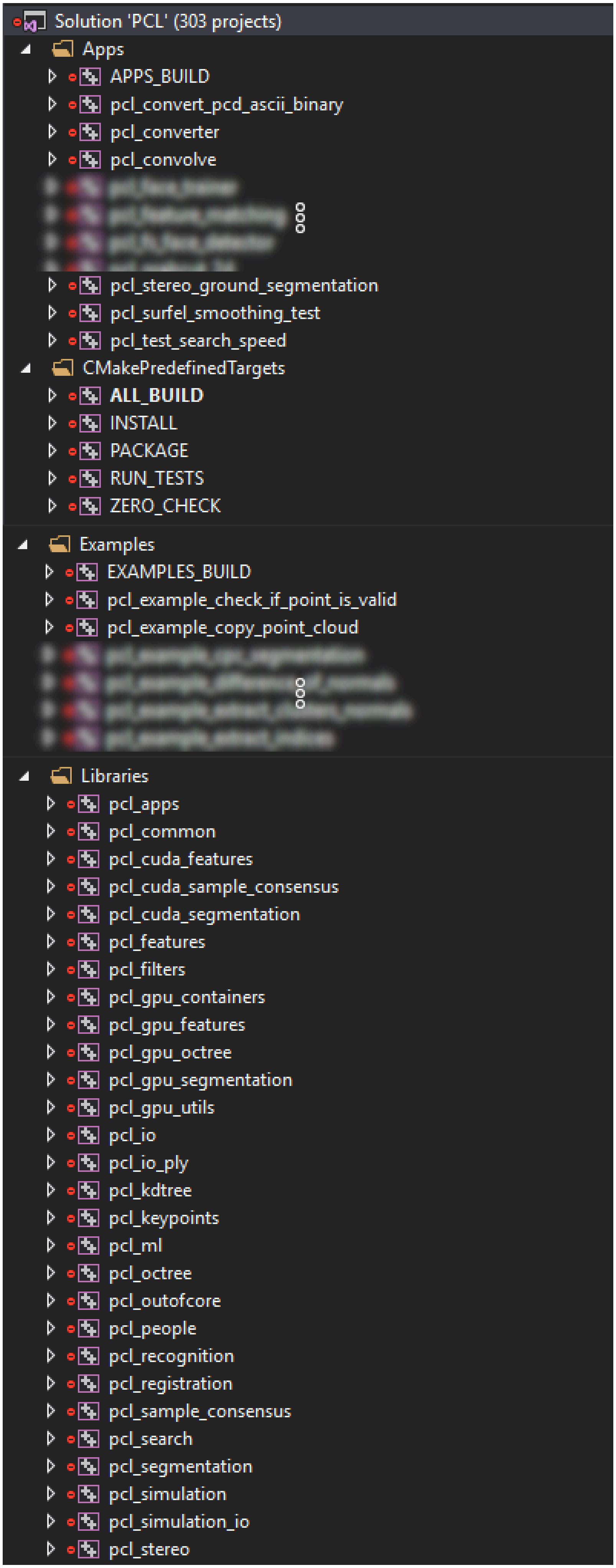
Name	Value
Boost	
CMAKE	
CMAKE_INSTALL_PREFIX	C:/Program Files/PCL
PCL	
PCL_SHARED_LIBS	☑
PCL_VERSION	1.0.0

- **PCL_SHARED_LIBS** is checked by default. Uncheck it if you want static PCL libs (not recommended).
- **CMAKE_INSTALL_PREFIX** is where PCL will be installed after building it (more information on this later).

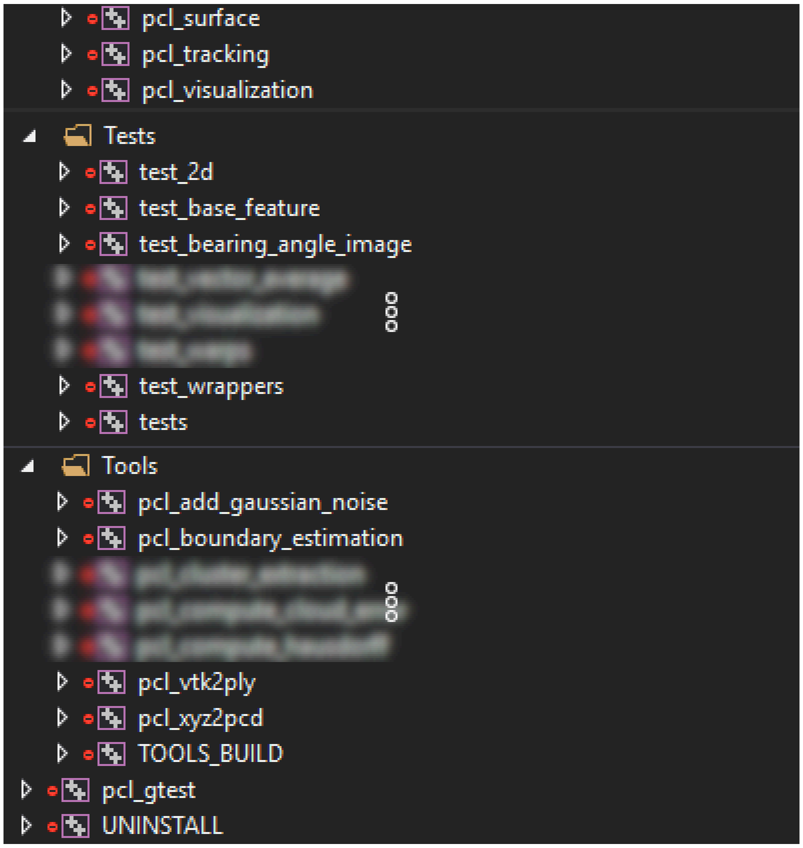
Once PCL configuration is ok, hit the *Generate* button. CMake will then generate Visual Studio project files (vcproj files) and the main solution file (PCL.sln) in C:\PCL directory.

Building PCL

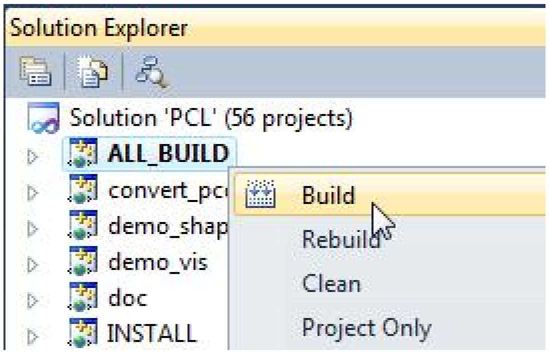
Open that generated solution file (PCL.sln) to finally build the PCL libraries. This is how your solution will look like.



```
Solution 'PCL' (303 projects)
  Apps
    APPS_BUILD
    pcl_convert_pcd_ascii_binary
    pcl_converter
    pcl_convolve
    pcl_stereo_ground_segmentation
    pcl_surfel_smoothing_test
    pcl_test_search_speed
  CMakePredefinedTargets
    ALL_BUILD
    INSTALL
    PACKAGE
    RUN_TESTS
    ZERO_CHECK
  Examples
    EXAMPLES_BUILD
    pcl_example_check_if_point_is_valid
    pcl_example_copy_point_cloud
  Libraries
    pcl_apps
    pcl_common
    pcl_cuda_features
    pcl_cuda_sample_consensus
    pcl_cuda_segmentation
    pcl_features
    pcl_filters
    pcl_gpu_containers
    pcl_gpu_features
    pcl_gpu_octree
    pcl_gpu_segmentation
    pcl_gpu_utils
    pcl_io
    pcl_io_ply
    pcl_kdtree
    pcl_keypoints
    pcl_ml
    pcl_octree
    pcl_outofcore
    pcl_people
    pcl_recognition
    pcl_registration
    pcl_sample_consensus
    pcl_search
    pcl_segmentation
    pcl_simulation
    pcl_simulation_io
    pcl_stereo
```



Building the “ALL_BUILD” project will build everything.

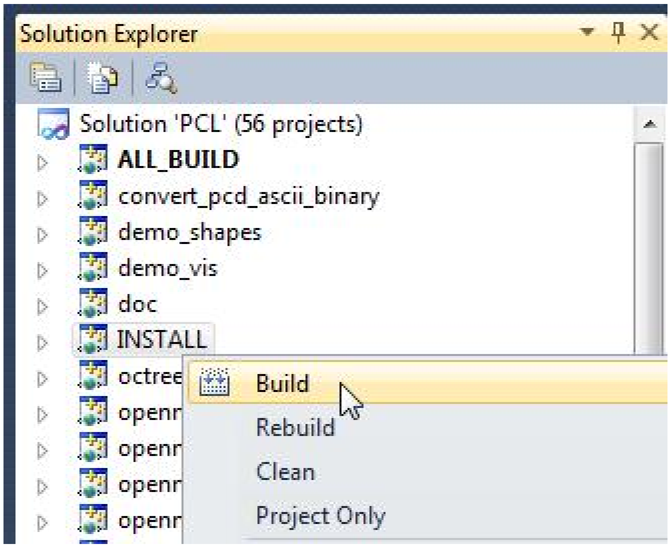


Note

Make sure to build the “ALL_BUILD” project in both **debug** and **release** mode.

Installing PCL

To install the built libraries and executables, you need to build the “INSTALL” project in the solution explorer. This utility project will copy PCL headers, libraries and executable to the directory defined by the **CMAKE_INSTALL_PREFIX** CMake variable.



Note

Make sure to build the “INSTALL” project in both **debug** and **release** mode.

Note

It is highly recommended to add the bin folder in PCL installation tree (e.g. C:\Program Files\PCL\bin) to your **PATH** environment variable.

Advanced topics

- **Building PCL Tests** :

  If you want to build PCL tests, you need to download *GTest* 1.6 (http://code.google.com/p/googletest/) and build it yourself. Make sure, when you configure GTest via CMake to check the **gtest_force_shared_crt** checkbox. You need, as usual, to build *GTest* in both **release** and **debug**.

  Back to PCL’s CMake settings, you have to fill the **GTEST_*** CMake entries (include directory, gtest libraries (debug and release) and gtestmain libraries (debug and release)). Then, you have to check **BUILD_TEST** and **BUILD_global_tests** CMake checkboxes, and hit *Configure* and *Generate*.

- **Building the documentation** :

You can build the doxygen documentation of PCL in order to have a local up-to-date api documentation. For this, you need Doxygen (http://www.doxygen.org). You will need also the Graph Visualization Software (GraphViz, http://www.graphviz.org/) to get the doxygen graphics, specifically the *dot* executable.

Once you installed these two packages, hit *Configure*. Three CMake variables should be set (if CMake cannot find them, you can fill them manually) :

- *DOXYGEN_EXECUTABLE* : path to *doxygen.exe* (e.g. C:/Program Files (x86)/doxygen/bin/doxygen.exe)
- *DOXYGEN_DOT_EXECUTABLE* : path to *dot.exe* from GraphViz (e.g. C:/Program Files (x86)/Graphviz2.26.3/bin/dot.exe)
- *DOXYGEN_DOT_PATH* : path of the folder containing *dot.exe* from GraphViz (e.g. C:/Program Files (x86)/Graphviz2.26.3/bin)

Then, you need to enable the *documentation* project in Visual Studio by checking the **BUILD_DOCUMENTATION** checkbox in CMake.

You can also build one single CHM file that will gather all the generated html files into one file. You need the Microsoft HTML HELP Workshop. After you install the *Microsoft HTML HELP Workshop*, hit *Configure*. If CMake is not able to find **HTML_HEL_COMPILER**, then fill it manually with the path to *hhc.exe* (e.g. C:/Program Files (x86)/HTML Help Workshop/hhc.exe), then click *Configure* and *Generate*.

Now, in PCL Visual Studio solution, you will have a new project called *doc*. To generate the documentation files, right click on it, and choose *Build*. Then, you can build the *INSTALL* project so that the generated documentation files get copied to **CMAKE_INSTALL_PREFIX**/PCL/share/doc/pcl/html folder (e.g. C:\Program Files\PCL\share\doc\pcl\html).

Using PCL

We finally managed to compile the Point Cloud Library (PCL) as binaries for Windows. You can start using them in your project by following the Using PCL in your own project tutorial.

Note

You may get errors when your program is linked if you use specific point types that are not used so often (so for example *pcl::PointXYZ* and *pcl::PointXYZI* are usually not affected). Of course, the first thing you should check is whether you correctly link to all PCL libraries (*target_link_libraries(<my_executable> ${PCL_LIBRARIES})* in CMake). The next thing you can try is adding *#define PCL_NO_PRECOMPILE* before including any PCL headers. The background is that on Windows, PCL is always compiled with *PCL_ONLY_CORE_POINT_TYPES* enabled, otherwise some PCL modules (e.g. pcl_features) would fail to build due to limitations of the Windows linker. The effect is that the templated classes are only instantiated for some commonly used point types, not for all. For further explanations, see the Adding your own custom PointT type tutorial.