



CMake / CTest / CPack

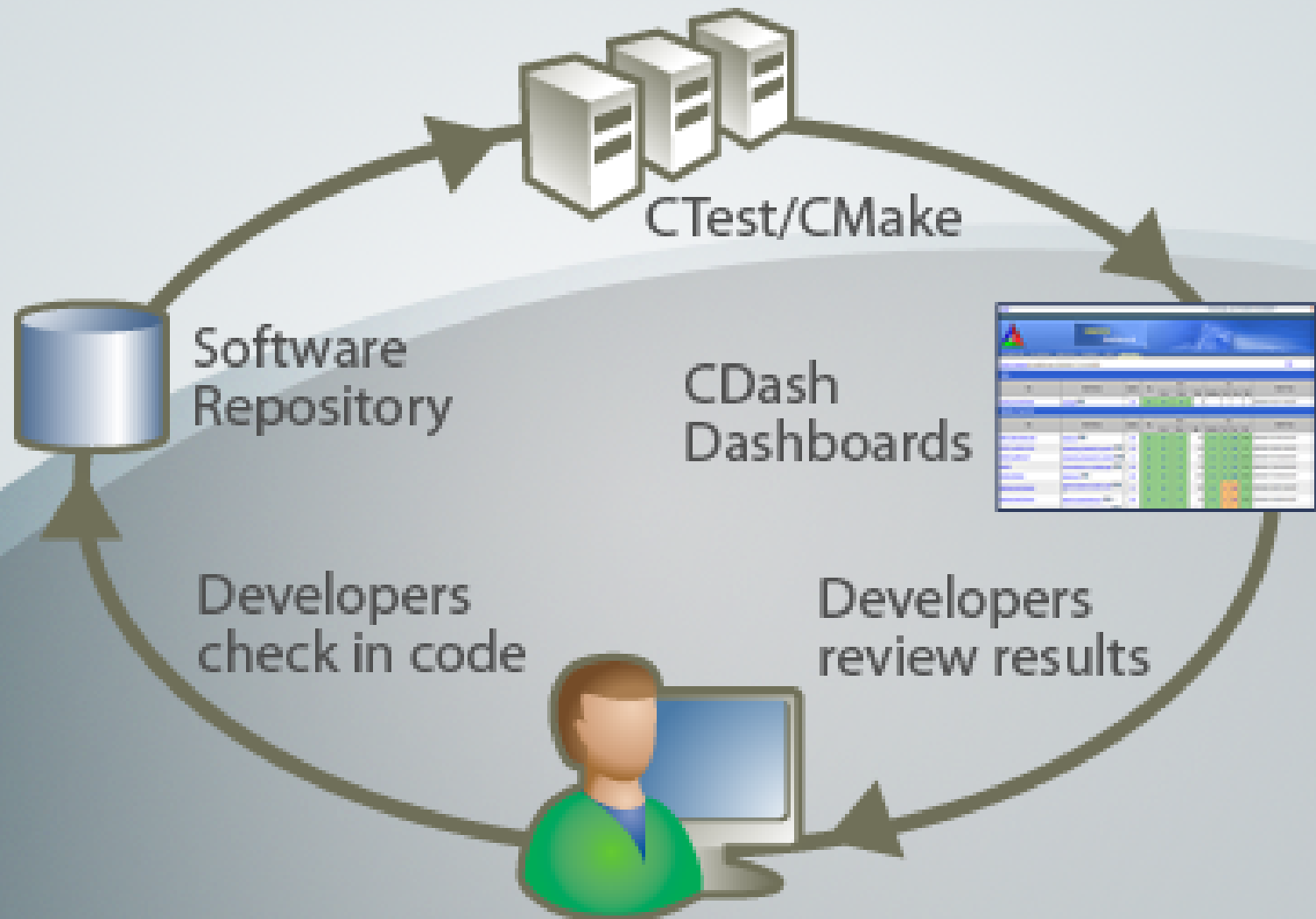
Open Source Tools to build, test, and install software

Bill Hoffman

bill.hoffman@kitware.com

BoostCon 2009

Kitware Quality Software Process



Overview

- Introduce myself and Kitware
- About CMake
 - Building with CMake
 - Testing with CTest/CDash
 - Packaging with CPack

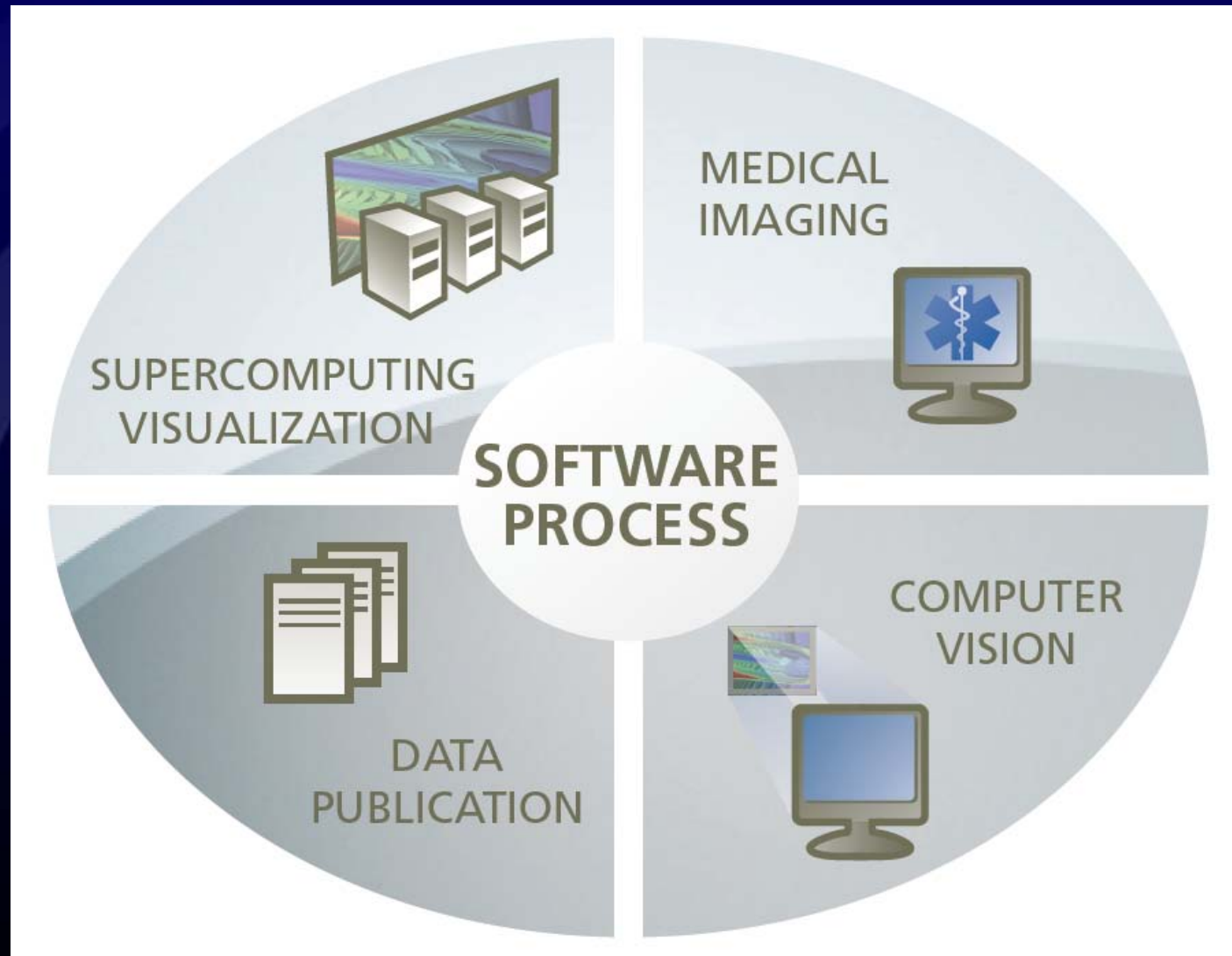


Introductions

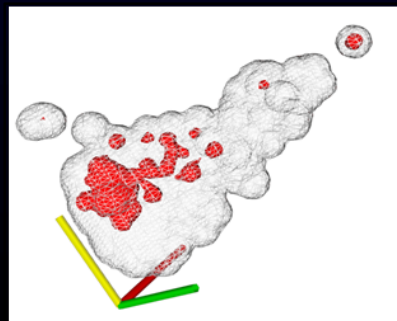
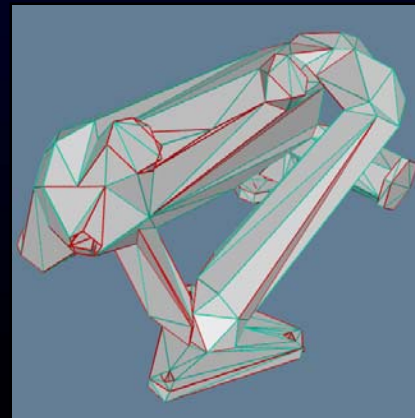
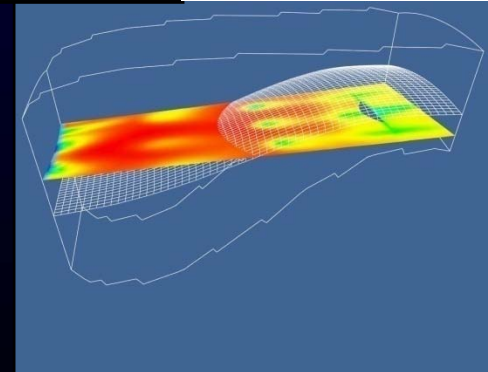
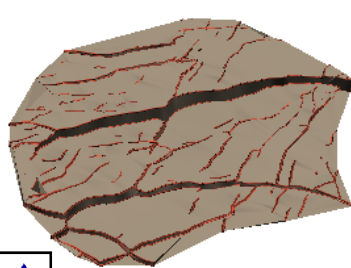
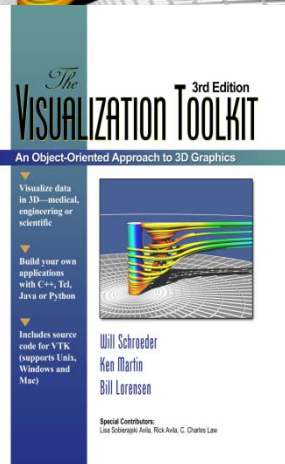
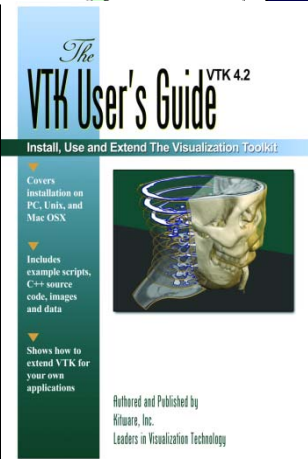
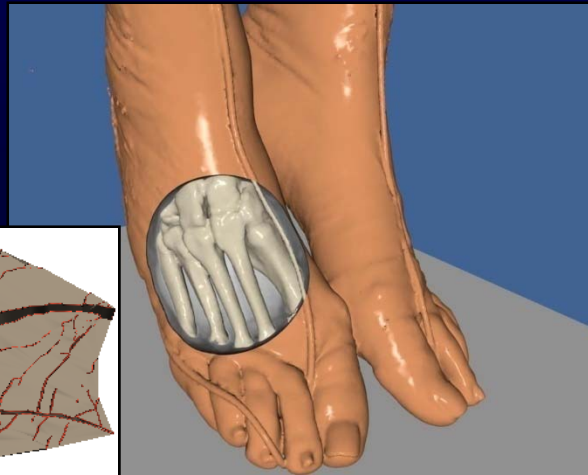
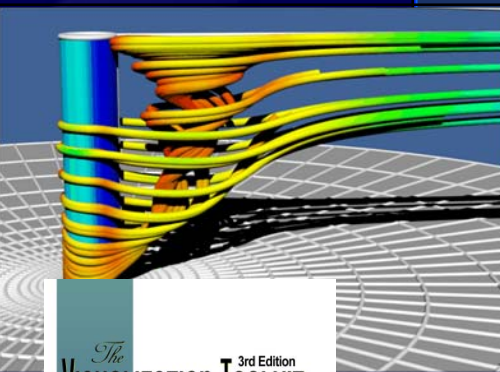
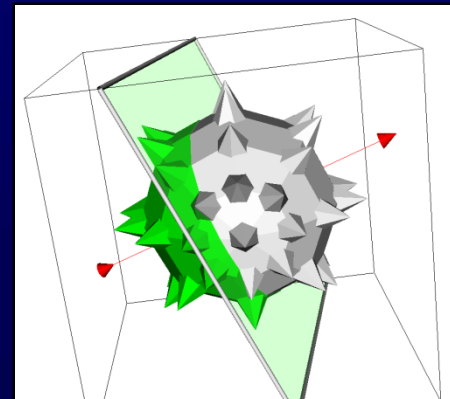
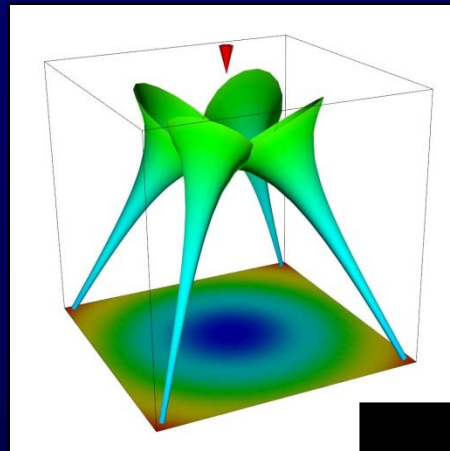
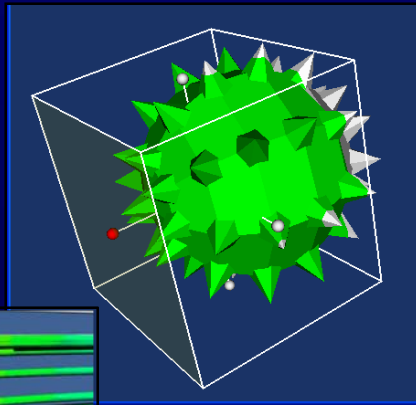
- Bill Hoffman
 - 1990 – 1999 GE Global Research Center Computer Vision Group
 - Large C++ research environments
 - 1999 – Present Vice President Kitware Inc
- Kitware Inc
 - Founded in 1998
 - Privately held
 - 55 employees and 2 locations (and hiring)
 - Clifton Park NY, USA
 - Chapel Hill, NC, USA
 - Supporting many open source projects
 - Medical Imaging, Super computing, Computer Vision



Kitware: Core Technologies

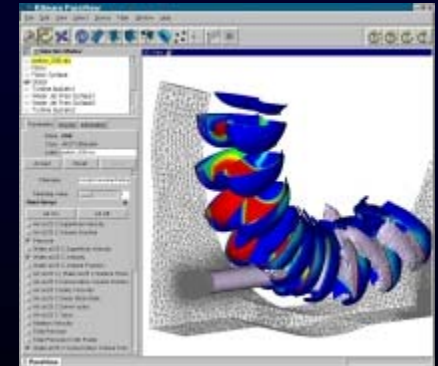
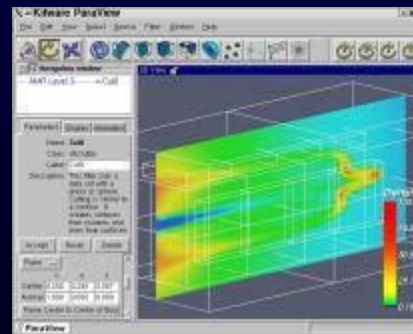
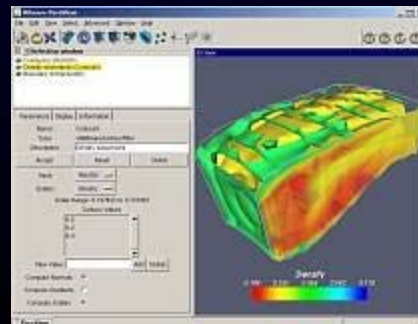
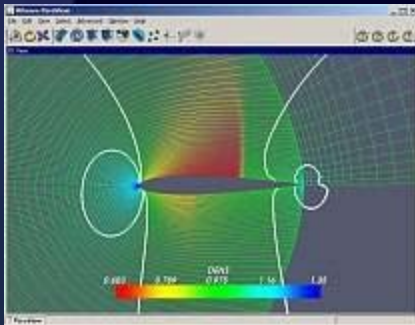
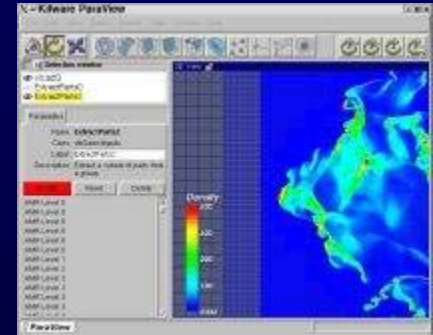


VTK



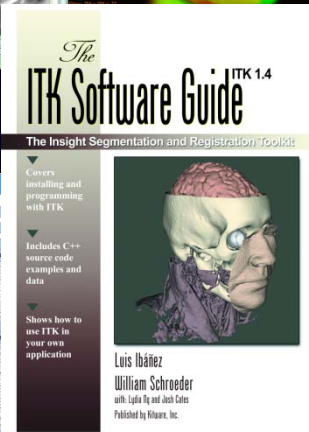
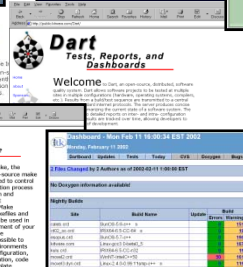
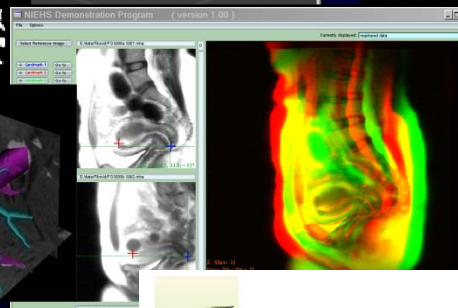
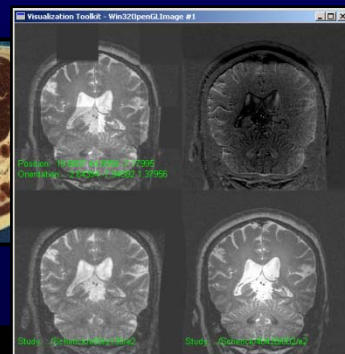
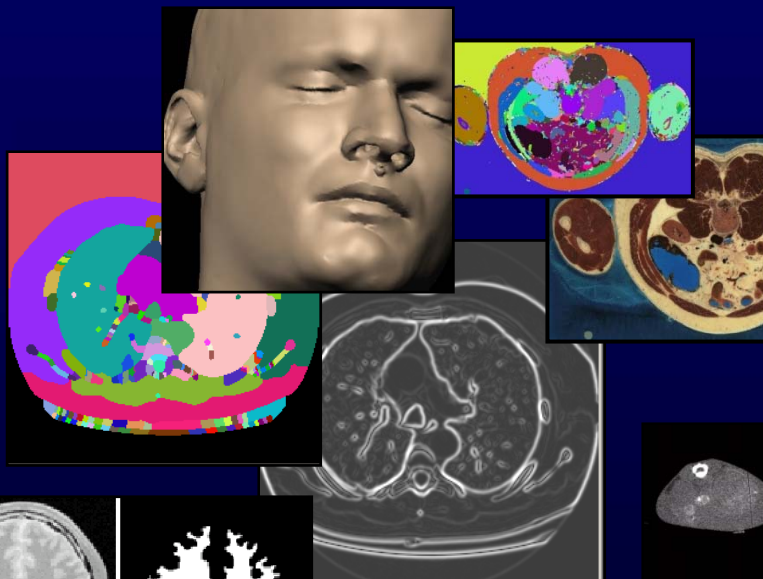
ParaView

- Parallel Visualization application
- Turn-key wrapper around VTK
- Supports parallel data processing and rendering
- Supports tiled displays, Caves, etc.
- 3D widgets, LOD (level-of-detail) display
- Extended by XML modules
- Extensive animation support





\$13 million over 6 years
Leading edge algorithms
Open Source Software



www.itk.org

CMake



Why CMake

- A build system that just works
- A build system that is easy to use cross platform
- Typical Project without CMake (curl)

```
$ ls
CHANGES          RELEASE-NOTES  curl-config.in  missing
CMake             acinclude.m4   curl-style.el   mkinstalldirs
CMakeLists.txt    aclocal.m4     depcomp         notes
build            docs          notes~
COPYING           buildconf      include         packages
CVS              buildconf.bat  install-sh      reconf
ChangeLog        compile       lib            sample.emacs
Makefile          config.guess   libcurl.pc.in   src
Makefile.am       config.sub     ltmain.sh       tests
Makefile.in       configure      m4             vc6curl.dsw
README           configure.ac   maketgz

$ ls src/
CMakeLists.txt  Makefile.riscos  curlsrc.dsp  hugehelp.h  version.h
CVS            Makefile.vc6     curlsrc.dsw  macos       writeenv.c
Makefile.Watcom Makefile.vc8     curlutil.c   main.c      writeenv.h
Makefile.am     config-amigaos.h curlutil.h   makefile.amiga writeout.c
Makefile.b32    config-mac.h     getpass.c    makefile.dj  writeout.h
Makefile.in     config-riscos.h  getpass.h    mkhelp.pl
Makefile.inc     config-win32.h   homedir.c    setup.h
Makefile.m32    config.h.in      homedir.h    urlglob.c
Makefile.netware curl.rc          hugehelp.c    urlglob.h
```



Why CMake – Very Fast

<http://blog.qgis.org/?q=node/16> :

“I was quite surprised with the speed of building Quantum GIS codebase in comparison to Autotools. “

Task	CMake	Autotools
Configure	0:08	Automake 00:41 Configure 00:20
Make	12:15	21:16
Install	0:20	0:36
Total	12:43	22:43



CMake (Everyone is using it)

KDE 2006 – Tipping Point!



- 800+ downloads per day from www.cmake.org
- Major Linux distributions and Cygwin provide CMake packages.
- KDE, Second Life, Boost (Experimentally), many others



What is CMake?

- Family of Software Development Tools
 - Build – CMake
 - Test – CTest/CDash
 - Package – CPack
- Open-Source License
- History
 - Insight Segmentation & Registration Toolkit (~2000)
 - Changed the way we build



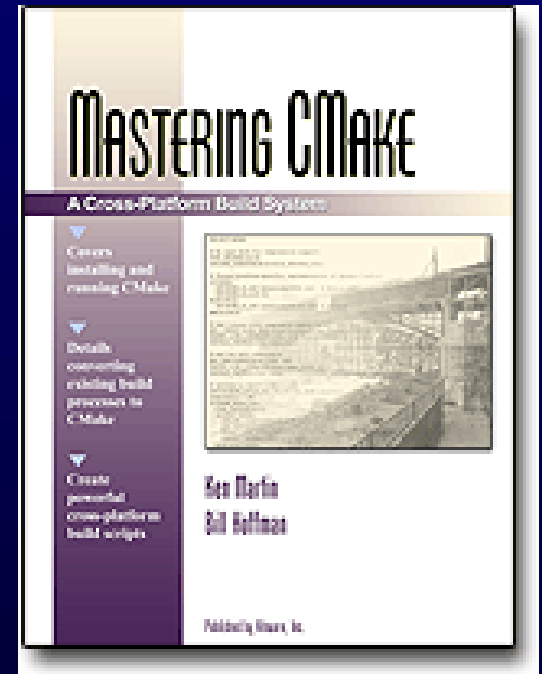
Who is involved?

- Users
 - KDE
 - Second Life
 - ITK
 - VTK
 - ParaView
 - Scribus
 - many more
- Supporters
 - Kitware
 - National Library of Medicine
 - Sandia National Labs
 - Los Alamos National Labs
 - NAMIC
 - ARL



CMake Documentation

- Mastering CMake Book
- Web Page: www.cmake.org
- <http://www.cmake.org/Wiki/CMake>
- mailing list: cmake@cmake.org
- Full reference documentation
 - <http://www.cmake.org/cmake/help/documentation.html>
 - Ships HTML, man, and command line help
- Tutorial included and tested in source tree



CMake Features

- One simple language for all platforms
 - Windows, Mac, Linux, UNIX variants
 - Embedded platforms via cross-compilation
- Generates native build systems
 - Makefiles (GNU, NMake, Borland, etc.)
 - KDevelop, Eclipse
 - Visual Studio 6,7,8,9 IDE
 - Xcode
- Out-of-source build trees leave source clean
- Interactive configuration via GUI
- Multiple configurations (Debug, Release, etc.)



CMake Features (cont.)

- Built-in rules for common targets
 - Executables
 - Shared Libraries / DLLs
 - Static Libraries (archives)
 - OS X Frameworks and App Bundles
- Custom rules for other targets
 - Documentation
 - Generated sources and headers
- Configuration rules
 - System introspection
 - Persistent variables (options, cached results)
 - Configured header files



CMake Features (cont.)

- Automatic analysis
 - Implicit dependencies (C, C++, Fortran)
 - Transitive link dependencies
 - Ordering of linker search path and RPATH
- Advanced Makefile generation
 - Modular, Fast, Parallel
 - Color and progress display
 - Help targets – `make help`
 - Preprocessor targets – `make foo.i`
 - Assembly targets – `make foo.s`



Input to CMake

- Simple scripting language in CMakeLists.txt file(s)
- Built-in commands for common rules
 - `add_library(MyLib MyLib.cxx)`
 - `add_executable(MyExe MyMain.cxx)`
- Example project using Boost:

```
cmake_minimum_required(VERSION 2.6)
project(MyProject)
find_package(Boost REQUIRED thread signals)
include_directories(${Boost_INCLUDE_DIRS})
add_executable(MyExe MyProjectMain.cxx)
target_link_libraries(MyExe ${Boost_LIBRARIES})
```

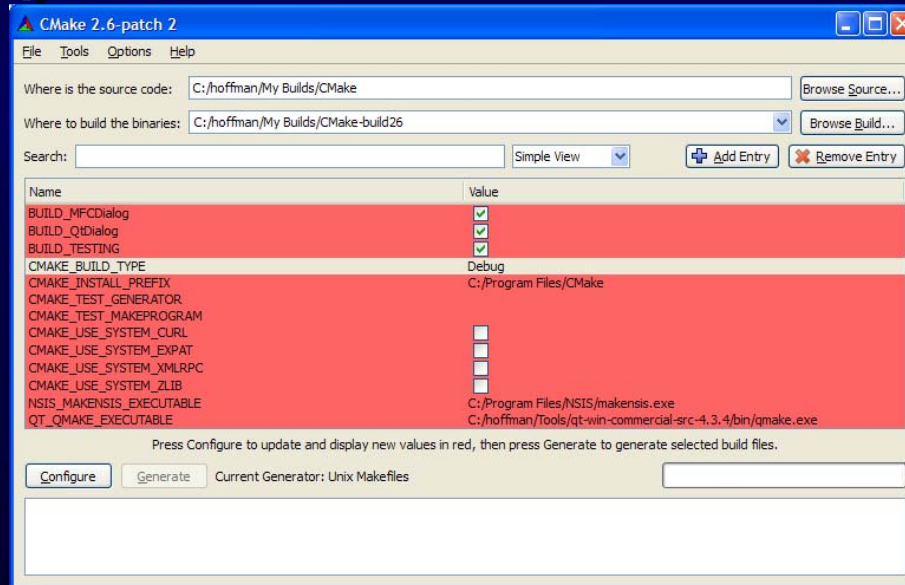


Installing CMake

- Easy to Get CMake
 - <http://www.cmake.org/cmake/resources/software.html>
 - Many Linux distributions and Cygwin include CMake packages
 - apt-get install cmake
- Installing CMake from www.cmake.org
 - Windows Binary installers
 - Linux Binaries – can be installed anywhere, (don't need root)
 - Mac
 - Other UNIX on download page
 - Source can bootstrap on any Unix platform



Cache editors: cmake-gui (qt), ccmake (curses)



```
Page 1 of 1
BUILD_DOXYGEN OFF
BUILD_TESTING ON
CMAKE_CONFIGURE_INSTALL_PREFIX /usr/local
CMAKE_CXX_FLAGS
CMAKE_C_FLAGS
CMAKE_INSTALL_PREFIX /usr/local
CURSES_EXTRA_LIBRARY NOTFOUND
CURSES_INCLUDE_PATH /usr/include
CURSES_LIBRARY /usr/lib/libcurses.a
DART_ROOT /cygdrive/c/hoffman/Dart
EXECUTABLE_OUTPUT_PATH /cygdrive/c/hoffman/CMake-gcc/
FORM_LIBRARY /usr/lib/libform.a
LIBRARY_OUTPUT_PATH

BUILD_DOXYGEN: Build source documentation using doxygen
Press [enter] to edit option CMake Version 1.3 - development
Press [c] to configure Press [g] to generate and exit
Press [h] for help Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```



Running CMake from the command line

- Useful for scripted builds or for projects with no options or with options correctly set by default on the first configure

```
#CC=gcc; CXX=g++  
#CFLAGS, CXXFLAGS  
cd MyProjectSourceDir  
mkdir ../MyProjectSourceDir-build  
cd ../MyProjectSourceDir-build  
cmake ../MyProjectSourceDir
```

(cmake -Dvar=value)



cmake scripts

- `cmake -E` command
 - Cross platform command line utility
 - Ex. Copy file, Remove file, Compare and conditionally copy, time etc
- `cmake -P script.cmake`
 - Cross platform scripting utility
 - Does not generate `cmake_cache`
 - Ignores commands specific to generating build environment



CTest/CDash



Testing with CMake, CTest and CDash

- Testing command in CMake
 - `add_test (testname exename arg1 arg2 arg3 ...)`
 - Executable is expected to return 0 for passed
 - Can set other test passing conditions based on output matching.
- `ctest` – an executable that is distributed with cmake that can run tests in a project.
 - Used for continuous integration testing
 - Client for CDash
 - Can be use for both CMake based projects and other build systems



CDash Dashboard www.cdash.org

CDash - CMake - Mozilla Firefox


File Edit View History Bookmarks Tools Help

http://public.kitware.com/CDash/index.php?project=CMake

Kitware WIKI Dell CDash Dash1old CDash Public Road Runner Web Mail Kitware Calendar Kitware Inc. public.kitware.com: D... CNN.com - Breaking ... CMake Cross Platfor...

Google ugly duckling Search Bookmarks Check AutoLink AutoFill Send to ugly duckling Settings

Start Ora... DB! TravelSer... CDash... can anyon... Communic... PackageM... Re: postfil... LOCAPHO... http:...dges Qt 4.3: Q... Hotel Nov... Google Maps



CMAKE Dashboard

DASHBOARD CALENDAR PREVIOUS CURRENT NEXT PROJECT

[Nightly Changes](#) as of 2008-02-20 21:00:00 EST

Style [Nightly Expected] [Nightly 2.4 Release] [Nightly] [Continuous] [Experimental] [Coverage] [Dynamic Analysis]

Site	Build Name	Update	Cfg	Build			Test					Build Date
				Error	Warn	Min	NotRun	Fail	Pass	NA	Min	
insight.journal.kitware	KWStyle	7	0	0	0	0	0					2008-02-21 02:28:33 EST

Nightly Expected [Style] [Nightly 2.4 Release] [Nightly] [Continuous] [Experimental] [Coverage] [Dynamic Analysis]

Site	Build Name	Update	Cfg	Build			Test					Build Date
				Error	Warn	Min	NotRun	Fail	Pass	NA	Min	
Titanium.IMTS.us	Linux64-Rocks-ICC-Rel	107	0	0	0	10.7	0	0	93	0	8.1	2008-02-21 10:23:00 EST
krondor.kitware	Darwin-c++	0	0	0	0	59.1	0	1	95	0	55.2	2008-02-21 09:56:00 EST
dash8.kitware	Linux64-g++332	0	0	0	0	6.3	0	0	95	0	18.3	2008-02-21 08:02:00 EST
RogueResearch3	Mac10.5-CMake-Xcode-dbg-ppc64	1	0	0	0	13.1	0	0	90	0	23.4	2008-02-21 05:15:00 EST
RogueResearch3	Mac10.5-CMake-Xcode-dbg-ppc	1	0	0	0	13	0	0	90	0	23.9	2008-02-21 04:28:00 EST

Find: qfilein Next Previous Highlight all Match case

Done



Trilinos (Multi-Package Dashboard)

<http://trilinos-dev.sandia.gov/cdash/index.php>

CDash - Trilinos - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://trilinos-dev.sandia.gov/cdash/index.php?project=Trilinos&date=20090430

Most Visited Getting Started Latest Headlines Kitware Inc. CDash CDash - CMB Free Online Broken Lin... CMake Only Errors CMake Bugs Kitware Proposal Man... ARL CDash CNN.com - Breaking N... The New York Times - ...

Google Search

Bookmarks PageRank AutoLink AutoFill Send to

Settings

CDash - Trilinos

DASHBOARD CA

Main Project

Project	Configure			Build			Test			Last submission
	Error	Warning	Pass	Error	Warning	Pass	Not Run	Fail	Pass	
Trilinos	0	0	208	1	117	91	0	8	5227	2009-04-30 12:54:32

SubProjects

Project	Configure			Build			Test			Last submission
	Error	Warning	Pass	Error	Warning	Pass	Not Run	Fail	Pass	
Teuchos	0	0	6	0	0	6	0	0	386	2009-04-30 16:59:38
RTOP	0	0	5	0	0	5	0	0	95	2009-04-30 17:00:49
Kokkos	0	0	0	0	0	5	0	0	10	2009-04-30 17:01:00
Epetra	0	0	0	0	3	2	0	0	128	2009-04-30 17:01:14
Zoltan	0	0	0	0	6	0	0	0	9	2009-04-30 18:08:12
Shards	0	0	5	0	5	0	0	0	20	2009-04-30 17:02:09
Intrepid	0	0	5	0	2	3	0	0	8	2009-04-30 17:10:38

Sub Projects

Done



Query Filters : customize views

CDash - Trilinos - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://trilinos-dev.sandia.gov/cdash/index.php?project=Trilinos&display=project&filtercount=4&showfile

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Google Search PageRank AutoLink AutoFill Send to Settings

CMake - Cross Platform Make Capital District Youth Soccer League CDash - Trilinos

Trilinos Dashboard

DASHBOARD CALENDAR PREVIOUS CURRENT PROJECT

No file changed as of 2009-04-30T00:00:00 MDT [Help](#)

[\[Hide Filters\]](#)

Match of the following rules:

Build Name	is	Linux-GCC-4.1.2-MPI_DEBUG	-	+
Site	is	godel.sandia.gov	-	+
Build Time	is after	2009-04-30T10:58:53 MDT	-	+
Build Time	is before	2009-04-30T12:02:16 MDT	-	+

Nightly

Site	Build Name	Update		Configure		Build				Test				Build Time	Labels
		Files	Min	Error	Warn	Min	Error	Warn	Min	NotRun	Fail	Pass	Min		
godel.sandia.gov	Linux-GCC-4.1.2-MPI_DEBUG	0	0	0	0	0.1	0	0	1.2	0	0	40 +39	0.7	2009-04-30T11:40:16 MDT	Rythmos
godel.sandia.gov	Linux-GCC-4.1.2-	0	0	0	0	0	0	0	0.1	0	0	7	0.1	2009-04-30T11:09:49	AztecOO


Done



Kitware Hosted Cdash

<http://www.cdash.org/CDashPublic/>

[Login](#) | [Register](#) | [Buy](#)


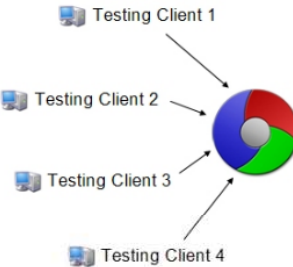


CDASH
Projects

CDash is a web-based software testing server. CDash aggregates, analyzes and displays the results of **software testing processes** submitted from clients located around the world. Developers depend on CDash to convey the state of a software system, and to continually improve its quality. To learn more about CDash visit the main [CDash website](#).

Starting a project is **easy** and **free**, in just a few clicks you can start monitoring the quality of your software development.

Start My Project >



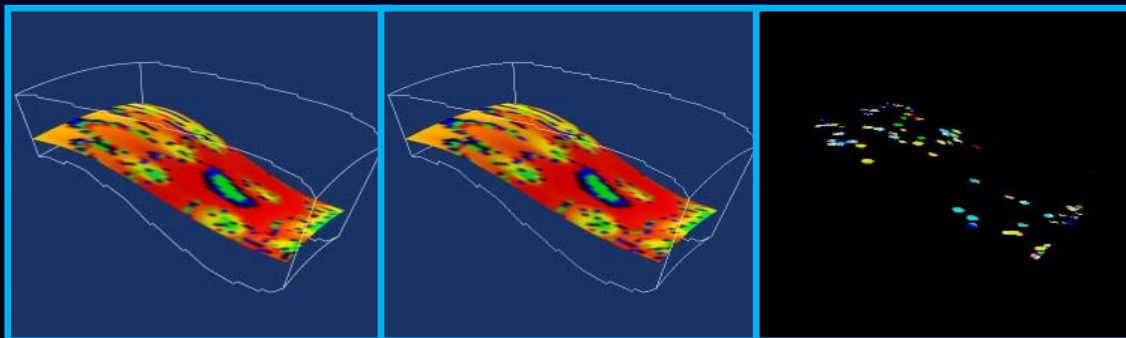
Available Dashboards

Project	Description	Submissions	First build	Last activity
automoc4	automoc4 is a tool which makes moc-processing with Qt4 easier.	26	2009-04-18T12:33:22 EDT	2009-04-29 14:36:51
Avogadro	Avogadro is an advanced molecular editor designed for cross-platform use in computational chemistry, molecular modeling, bioinformatics, materials science, and related areas. It offers flexible rendering and a powerful plugin architecture.	57	2009-01-28T14:01:47 EST	2009-05-01 08:08:03
CERTI	CERTI	262	2008-09-26T18:27:04 EDT	2009-04-29 03:23:39
CERTI HLA TestsSuite	CERTI HLA TestsSuite	234	2008-09-26T17:23:43 EDT	2009-04-29 03:26:28
CMakePorts	A collection of popular open-source libraries which can be built using CMake	266	2009-03-05T20:28:33 EST	2009-05-01 01:35:47



CDash testing

- Experimental
- Nightly
- Purify / valgrind
- Coverage (gcov, bullseye)
- Configuration coverage
 - Make sure different OS's, Libraries and options are covered
- Image difference testing



CMake Tutorial — Step7

Adding dashboard support

- Demo
 - add dashboard support to tutorial with CDash



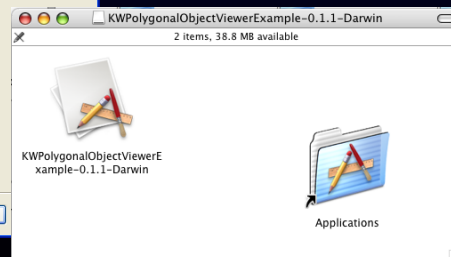
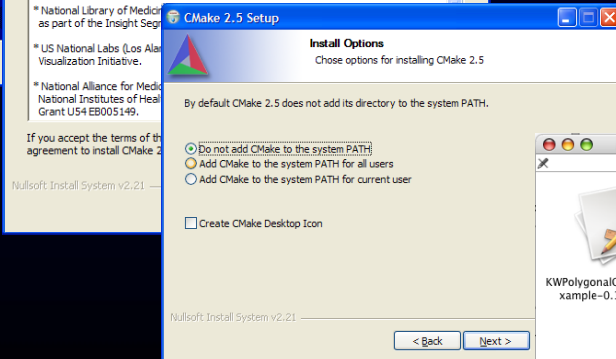
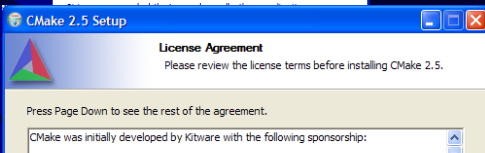
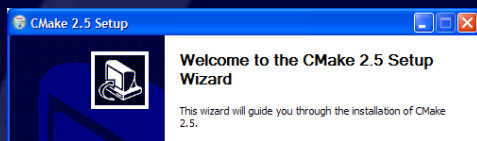
Configuration Coverage

- CMake
 - Spaces in paths
 - Network paths
 - Different drive letters and directories
- VTK
 - Mesa
 - OpenGL
 - CMake release
 - Current CMake



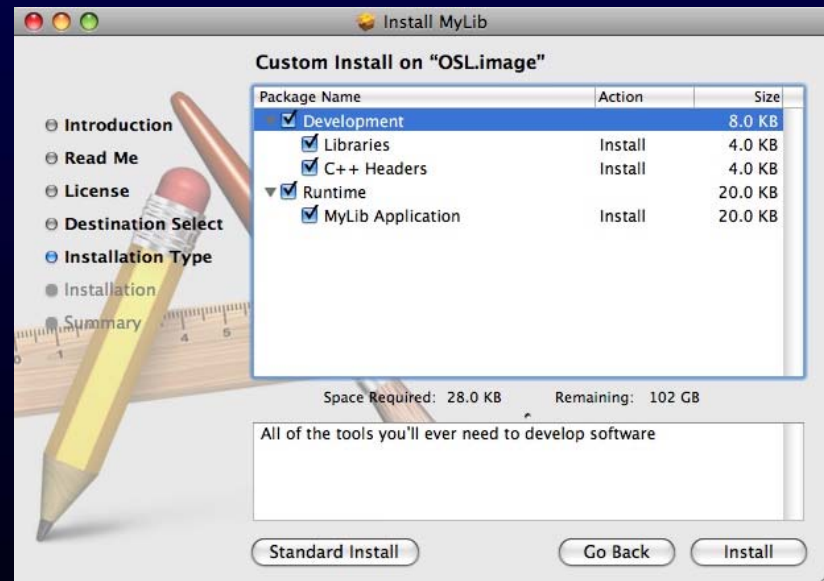
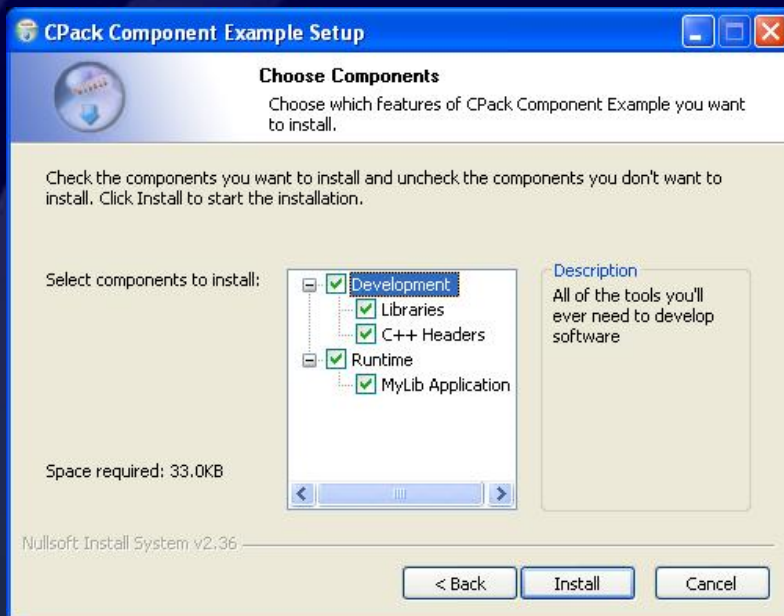
CPack

- CPack is bundled with CMake
- Creates professional platform specific installers
 - TGZ and Self extract TGZ (STGZ), NullSoft Scriptable Install System (NSIS), OSX PackageMaker, RPM, Deb



CPack Components

- http://www.cmake.org/Wiki/CMake:Component_Install_With_CPack



Using CPack

- On Windows install command line ZIP program, and NSIS
- setup your project to work with cpack
 - set cpack option variables if needed
 - include(CPack)
 - Reuses existing project install rules
- Running cpack
 - make package (create all packages)
 - make package_source (create source package)
 - cpack -C CPackConfig.cmake -G NSIS
 - cpack -C CPackConfig.cmake -G ZIP
 - cpack -C CPackSourceConfig.cmake -G ZIP



CPack more information

- Mastering CMake
- http://www.cmake.org/Wiki/CMake:Packaging_With_CPack



Summary

- Build - CMake
- Test - CTest /CDash/KWStyle
- Deploy – CPack
- Links
 - www.kitware.com
 - www.cmake.org
 - www.cdash.org
 - <https://svn.boost.org/trac/boost/wiki/CMake>
 - bill.hoffman@kitware.com



Thank you!

Kitware Quality Software Process

