Doing 3D With Tcl

Tcl3D = +

Paul Obermeier

obermeier@poSoft.de   info@tcl3d.org

http://www.poSoft.de   http://www.tcl3d.org

Sixth European Tcl/Tk User Meeting

1 Introduction

1.1 Overview: The mission

Tcl3D enables the 3D functionality of OpenGL and various other 3D libraries at the Tcl scripting level.

It's main design requirement is to wrap existing 3D libraries without modification of header files and with minimal manual wrapping effect.

This is accomplished by the use of SWIG, the Simplified Wrapper and Interface Generator.

It is based on ideas of Roger E. Critchlow, who created an earlier OpenGL binding called Frustum.
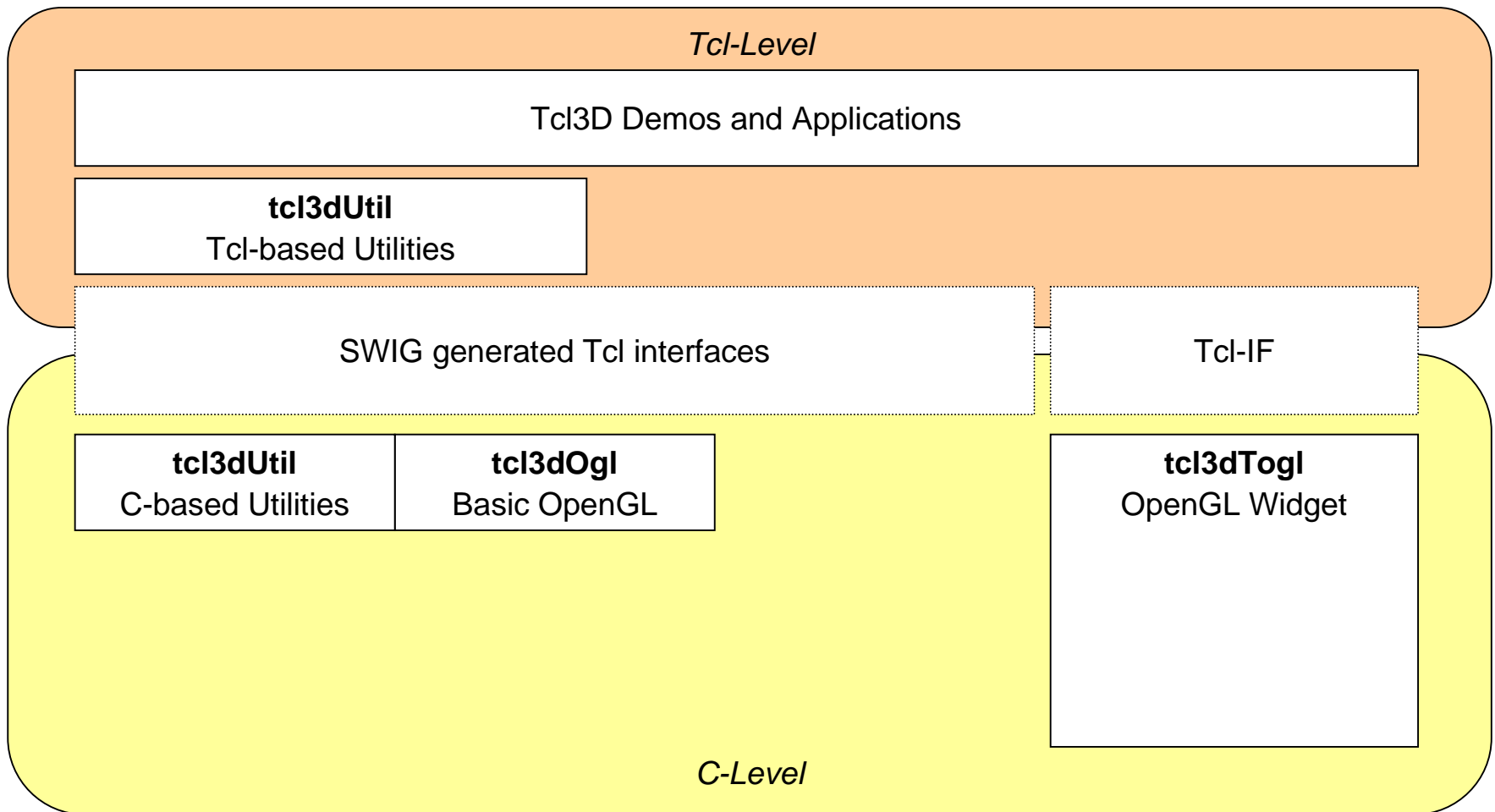
1.1 Overview: Design requirements

#	Requirement	Comment
1	Light-weight	Small code size, Tcl package.
2	License	Source code availability under BSD license.
3	High automation	No need to write lots of wrapper/glue code. Easy upgrade to newer versions of the 3D library.
4	Portable	Availability on many platforms.
5	C and Tcl IF	Ability to program the library in both C and Tcl. Easy interchange between Tcl and C code.
6	Up to date	Buildable with actual tools and operating systems.

1.1 Overview: Available modules

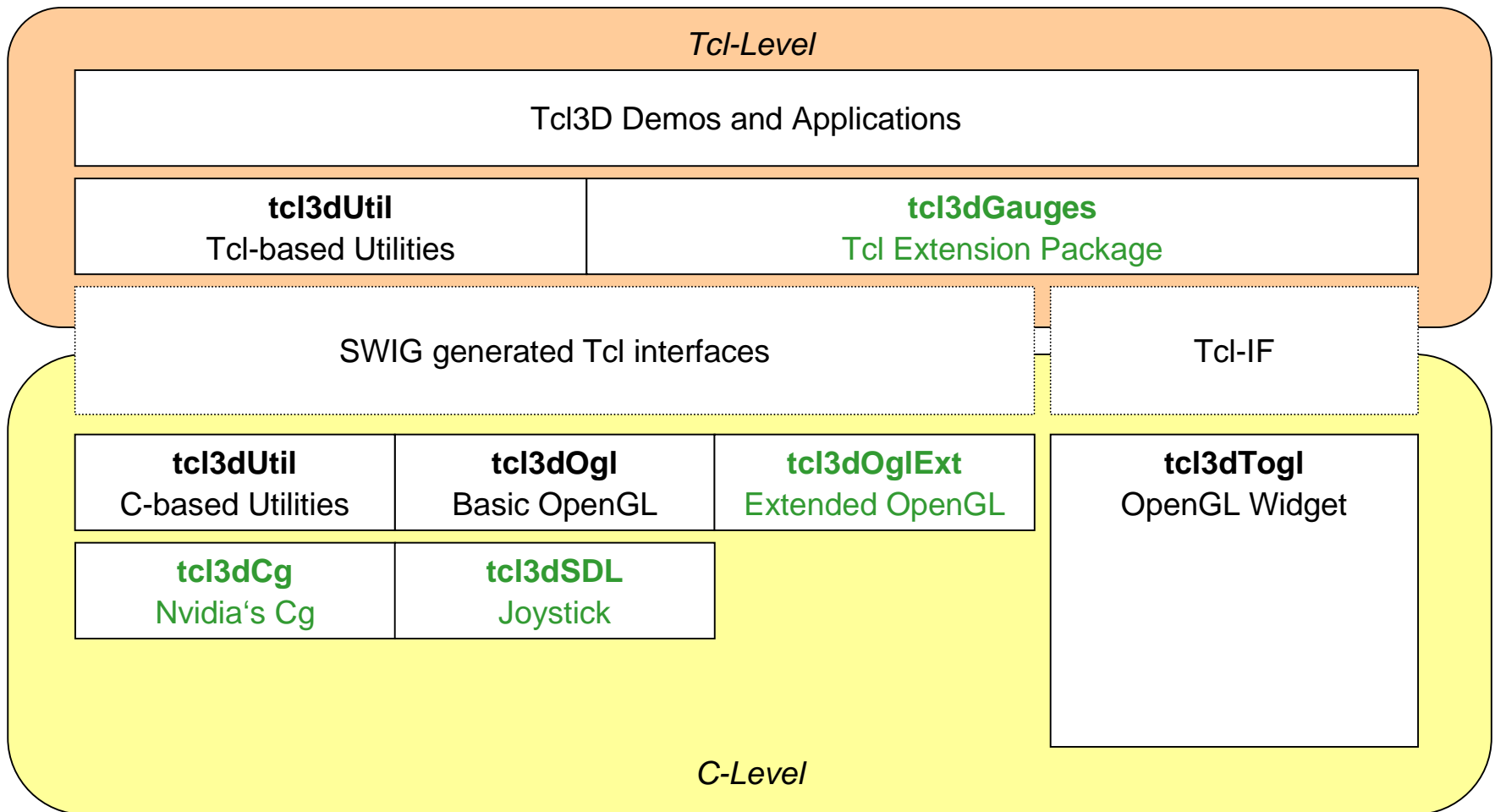|	
tcl3dTogl	Enhanced Togl widget, a Tk widget for displaying OpenGL content.
tcl3dUtil	Tcl3D utility library (math functions, shapes, stop watch, et al).
tcl3dOgl	Wrapper for basic OpenGL functionality (GL Version 1.1, GLU Version 1.2).
tcl3dOglExt	Wrapper for enhanced OpenGL functionality (GL Version 1.2 through 2.0) and OpenGL extensions.
tcl3dCg	Wrapper for NVidia's Cg shading language.
tcl3dSDL	Wrapper for the Simple DirectMedia Library.
tcl3dFTGL	Wrapper for the OpenGL Font Rendering library.
tcl3dGl2ps	Wrapper for the OpenGL To Postscript library.
tcl3dOde	*Wrapper for the Open Dynamics Engine (in work).*
tcl3dGauges	Tcl3D package for displaying gauges.

1.2 History: Version 0.1

Released 2005/05/29 as TclOgl: Basic OpenGL wrapping, Togl widget with Tcl callbacks.

Tcl-Level

Tcl3D Demos and Applications

tcl3dUtil
Tcl-based Utilities

SWIG generated Tcl interfaces

Tcl-IF

tcl3dUtil
C-based Utilities

tcl3dOgl
Basic OpenGL
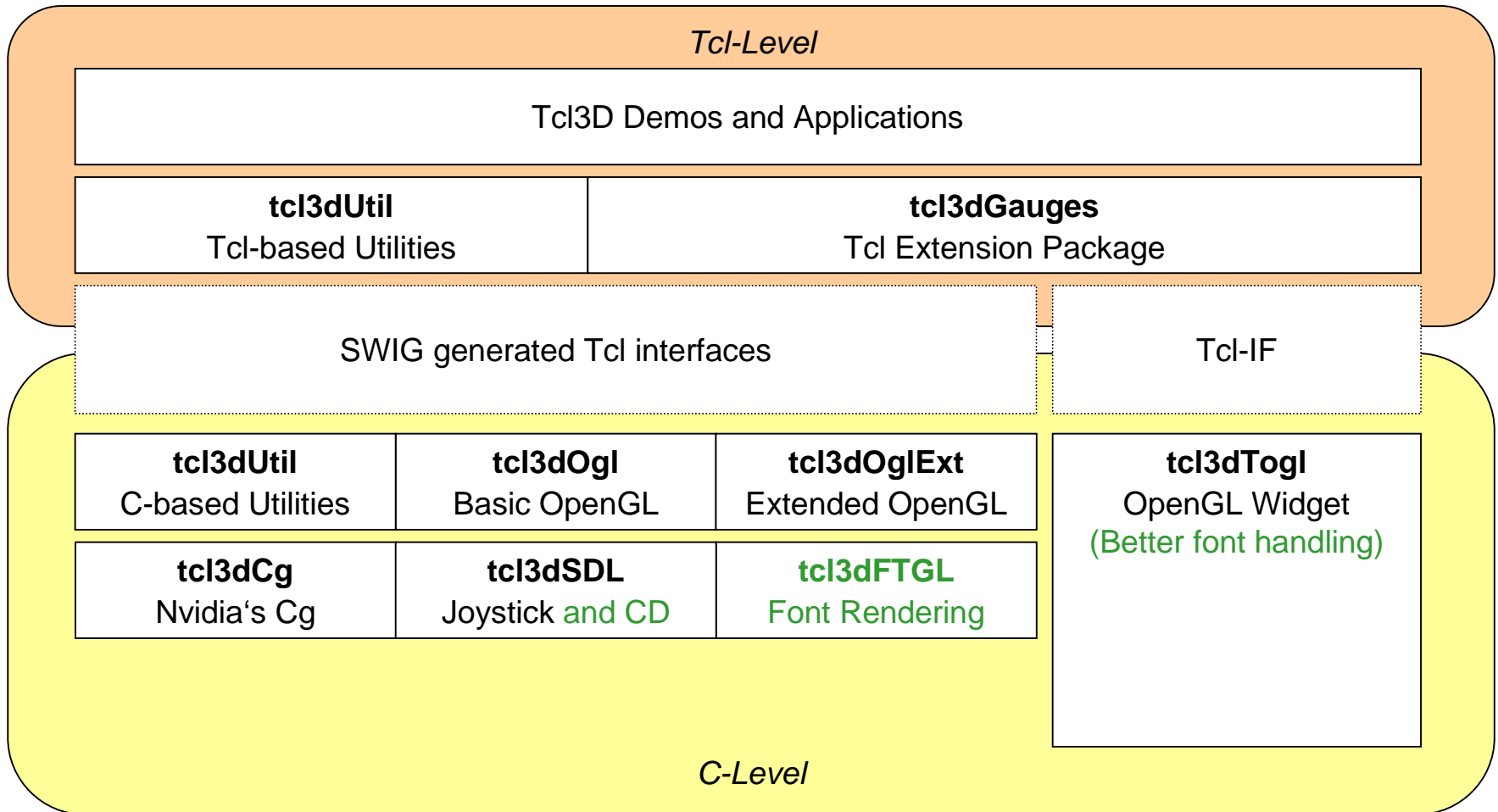
tcl3dTogl
OpenGL Widget

C-Level

1.2 History: Version 0.2

Released 2006/01/07: Major rewrite and support of new libraries: OpenGL 2.0, OpenGL extensions, Cg, SDL, gauges. Domain www.tcl3d.org created.
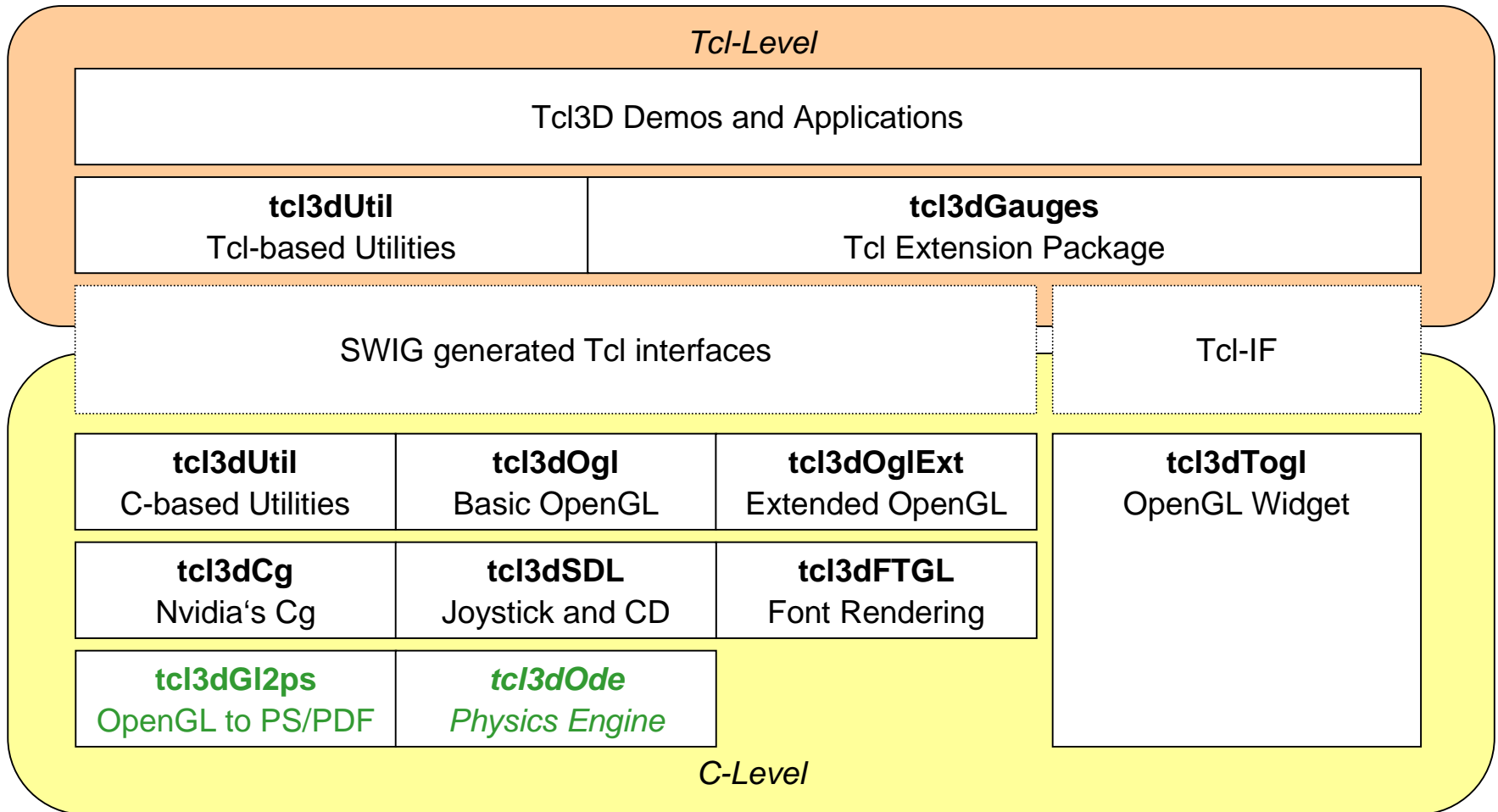
Tcl-Level

Tcl3D Demos and Applications

tcl3dUtil Tcl-based Utilities	**tcl3dGauges** Tcl Extension Package

SWIG generated Tcl interfaces

Tcl-IF

tcl3dUtil C-based Utilities	**tcl3dOgl** Basic OpenGL	**tcl3dOglExt** Extended OpenGL	**tcl3dTogl** OpenGL Widget

tcl3dCg Nvidia's Cg	**tcl3dSDL** Joystick

C-Level

1.2 History: Version 0.3

Released 2006/02/12: Enhanced font handling in Togl. Library FTGL added. Mac OS X support supplied by Daniel Steffen.

Tcl-Level

Tcl3D Demos and Applications

| **tcl3dUtil** | **tcl3dGauges** |
| Tcl-based Utilities | Tcl Extension Package |

SWIG generated Tcl interfaces | Tcl-IF

tcl3dUtil	**tcl3dOgl**	**tcl3dOglExt**	**tcl3dTogl**
C-based Utilities	Basic OpenGL	Extended OpenGL	OpenGL Widget
tcl3dCg	**tcl3dSDL**	**tcl3dFTGL**	(Better font handling)
Nvidia's Cg	Joystick and CD	Font Rendering	

C-Level

1.2 History: Version 0.3.1

Released 2006/05/25: Support for GL2PS and ODE (alpha) added. Starpack versions.

Tcl-Level

Tcl3D Demos and Applications	
tcl3dUtil Tcl-based Utilities	**tcl3dGauges** Tcl Extension Package

SWIG generated Tcl interfaces | Tcl-IF

tcl3dUtil C-based Utilities	**tcl3dOgl** Basic OpenGL	**tcl3dOglExt** Extended OpenGL	**tcl3dTogl** OpenGL Widget
tcl3dCg Nvidia's Cg	**tcl3dSDL** Joystick and CD	**tcl3dFTGL** Font Rendering	
tcl3dGl2ps OpenGL to PS/PDF	*tcl3dOde* *Physics Engine*		

C-Level

2 Tcl3D modules

2.1 Core module: tcl3dTogl

tcl3dTogl: Enhanced Togl widget

This module is an enhanced version of the Togl widget, a Tk canvas for displaying OpenGL graphics.

The following enhancements are currently implemented:
- Callback functions in Tcl.
- Better bitmap font support.

The enhanced Togl widget is contained in the Tcl3D distribution.

The original Togl widget is available from http://sourceforge.net/projects/togl

2.2 Core module: tcl3dUtil

tcl3dUtil: Tcl3D utility library

This module wraps several utilities offering functionality needed for 3D programs.

It currently contains the following modules:
- ✓ Various Tcl helper procedures.
- ✓ A stop watch for timing purposes.
- ✓ Vector and matrix functions.
- ✓ Wavefront model file parser.
- ✓ Tk photo image support.
- ✓ Implementation of a virtual trackball.
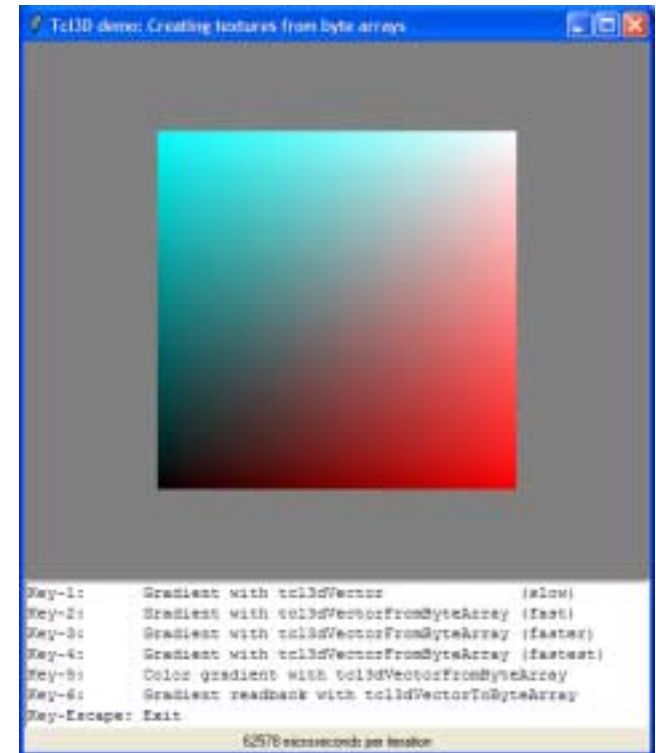
The utility module is contained in the Tcl3D distribution.

2.3 Core module: tcl3dOgl

tcl3dOgl: Wrapper for basic OpenGL functionality

This module wraps OpenGL functionality based on OpenGL Version 1.1, as well as the GLU library functions based on Version 1.2.

Standard shapes (ex. box, sphere, cylinder, teapot) with a GLUT compatible syntax are also supplied.

OpenGL features defined in versions greater than 1.1 have to be accessed via the OpenGL extension mechanism on Windows (as supplied with tcl3dOglExt).

Download an actual OpenGL driver from the manufacturer of your graphic card.

2.4 Optional module: tcl3dOglExt

tcl3dOglExt: Wrapper for enhanced OpenGL functionality

This module wraps OpenGL functionality based on versions 1.2 till 2.0, lots of OpenGL extensions not contained in the OpenGL core, as well as Windows specific extensions.

OpenGL2.0 (including the OpenGL shading language GLSL) and OpenGL extension wrapping is based on **OglExt**, an OpenGL extension library from the research center caesar.

The wrapping of Windows specific OpenGL functions is based on Intel's **GLsdk** library.

OglExt is available from http://www.julius.caesar.de/oglext

GLsdk is available from http://oss.sgi.com/projects/ogl-sample/sdk.html

2.5 Optional module: tcl3dCg

tcl3dCg: Wrapper for NVidia's Cg shading language

This module wraps NVidia's Cg library based on version 1.4 and adds some Cg utility procedures.
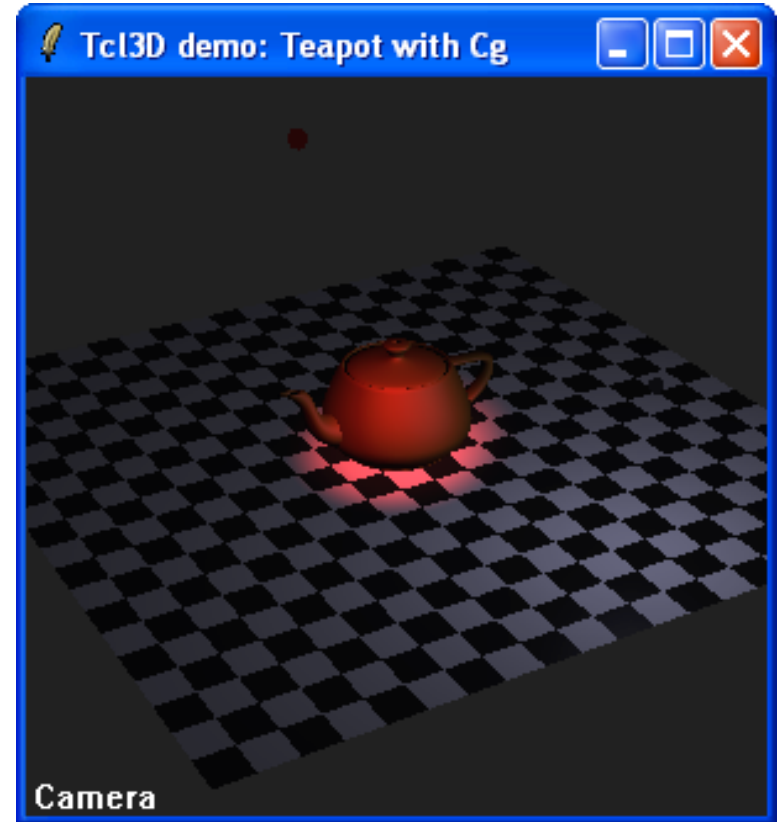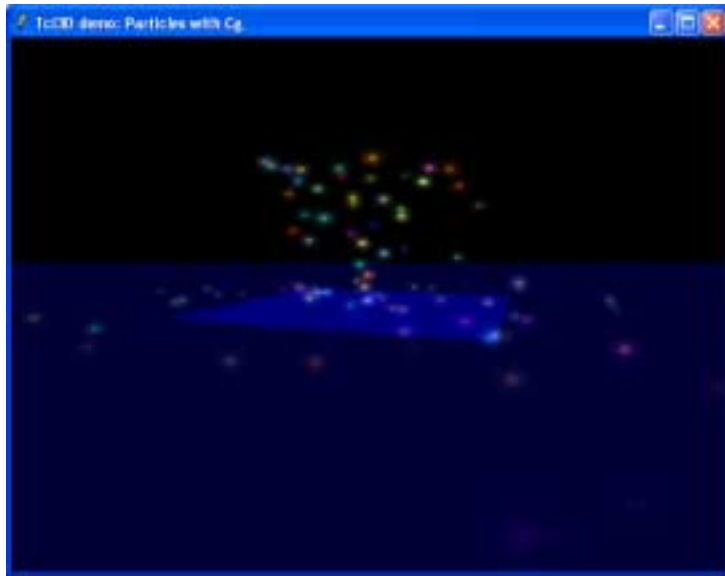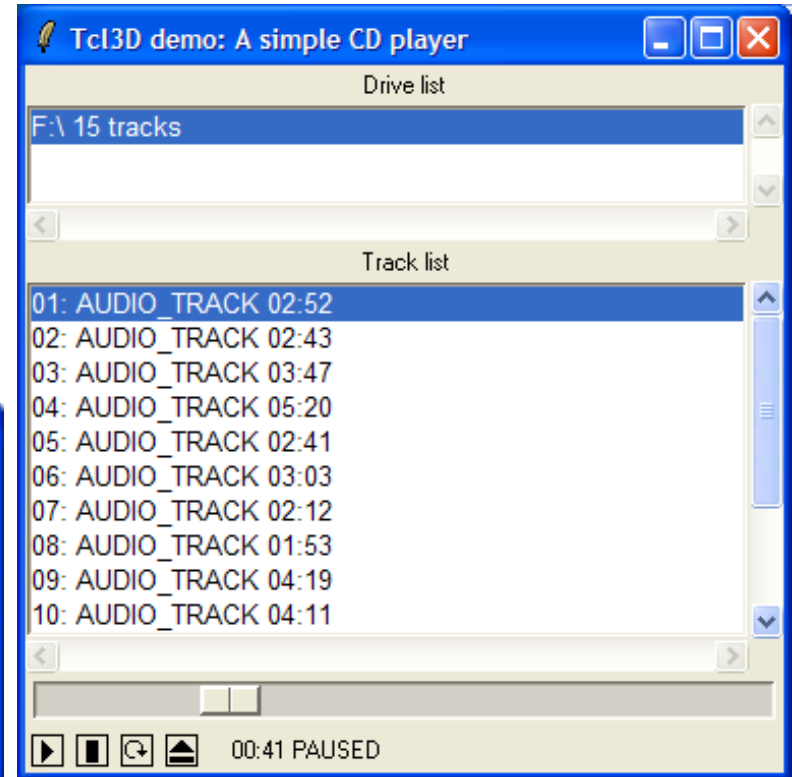

Cg is available from http://developer.nvidia.com/object/cg_toolkit.html

2.6 Optional module: tcl3dSDL

tcl3dSDL: Wrapper for the Simple DirectMedia Library

This module wraps the SDL library based on version 1.2.9.

Currently only the functions related to joystick and CD-ROM handling have been used and tested.

SDL is available from http://www.libsdl.org

2.7 Optional module: tcl3dFTGL

tcl3dFTGL: Wrapper for the OpenGL Font Rendering Library

This module wraps the FTGL library
based on version 2.1.2.

The following font types are available:

✓ Bitmap font (2D)
✓ Pixmap font (2D)
✓ Outline font
✓ Polygon font
✓ Texture font
✓ Extruded font

The FTGL library depends on the
Freetype2 library.

FTGL is available from http://homepages.paradise.net.nz/henryj

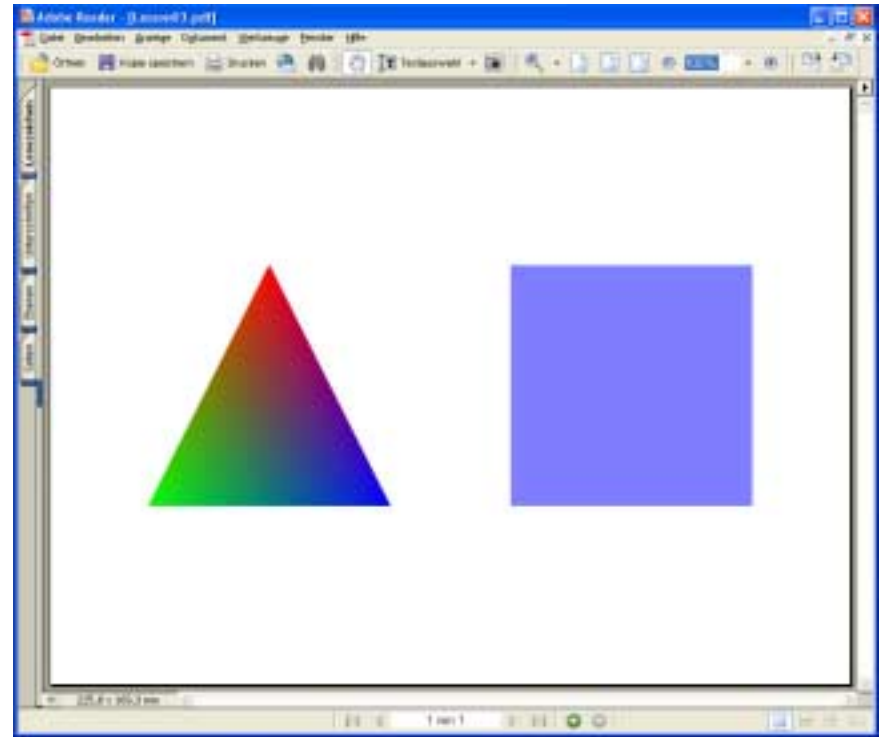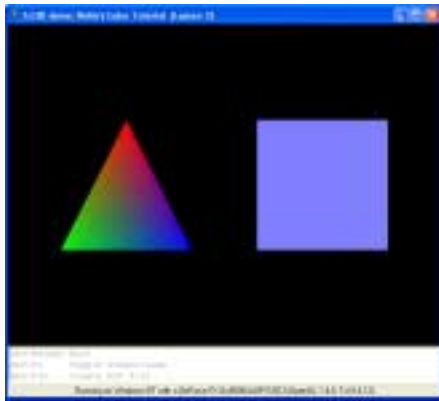Freetype2 is available from http://www.freetype.org

2.8 Optional module: tcl3dGl2ps

tcl3dGl2ps: Wrapper for the "OpenGL To Postscript" Library

This module wraps the GL2PS library based on version 1.2.7.

GL2PS is a C library providing high quality vector output for any OpenGL application.
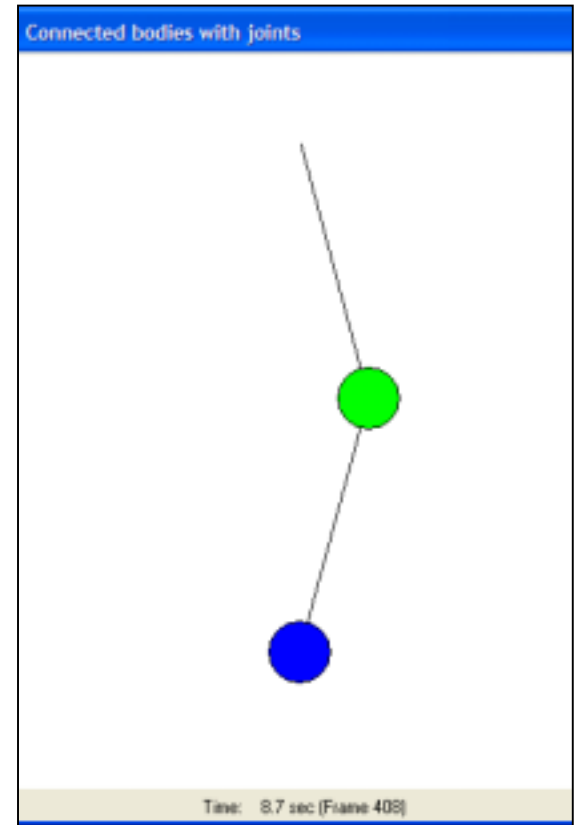
It does not support textures.

GL2PS is available from http://www.geuz.org/gl2ps

2.9 Optional module: tcl3dOde

tcl3dOde: Wrapper for the Open Dynamics Engine

This module wraps the Open Dynamics Engine based on version 0.5.

ODE wrapping is currently work in progress, the interface is not stabilized yet.

ODE is available from http://www.ode.org

2.10 Optional module: tcl3dGauges

tcl3dGauges: Tcl3D package for displaying gauges

This package implements the following gauges:
airspeed, altimeter, compass, tiltmeter.

The gauge package has been implemented and
contributed by Victor G. Bonilla.

The gauge module is contained in the Tcl3D distribution.

3 tcl3dsh: A Tcl3D Starpack

1. Introduction

Tcl3D overview

Tcl3D history

2. Tcl3D modules

Core modules:

Togl, Util, Ogl
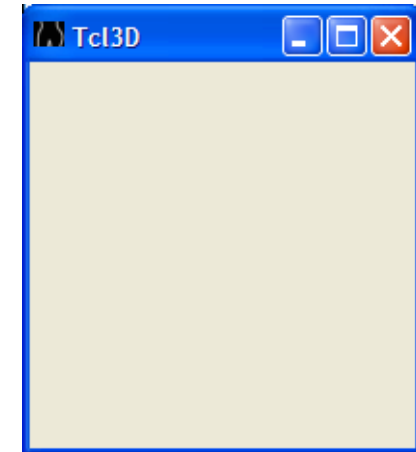
Optional modules:

OglExt, Cg, SDL, FTGL, Gl2ps, Gauges, Ode

3. tcl3dsh: A Tcl3D Starpack

4. The next year of Tcl3D

3.1 tcl3dsh: What is it good for?

The Starpack `tcl3dsh` can be used as

> ➢ a standalone executable like wish with builtin Tcl3D
> ➢ a test and presentation program for Tcl3D
> ➢ an installer for the Tcl3D specific libraries and demos
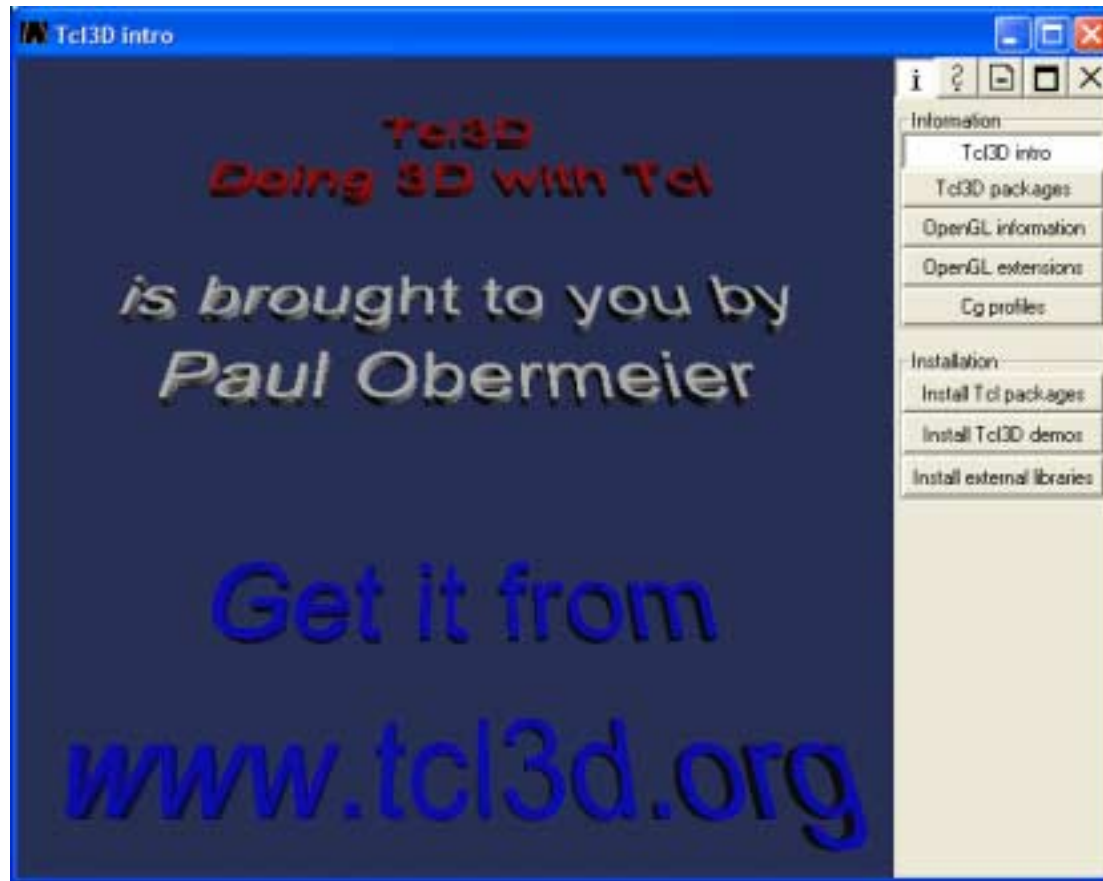
Tcl3D

```
Tcl3d Console
File    Edit
Type "pres" to start Tcl3D presentation
> info patchlevel
8.4.13
> lsort [package names]
Img Itcl Mk4tcl Tcl Tk dde gauge gaugeBase64 http img::base img::bmp img::dted img::gif img::ico img::j
peg img::pcx img::pixmap img::png img::ppm img::ps img::raw img::sgi img::sun img::tga img::tiff img::wi
ndow img::xbm img::xpm jpegtcl mk4vfs msgcat opt pngtcl pwb rechan registry scripdoc snack snackogg
snacksphere sound starkit tcl3d tcl3dcg tcl3dftgl tcl3dgauges tcl3dgl2ps tcl3dode tcl3dogl tcl3dsdl tcl3dt
ogl tcl3dutil tcltest tifftcl vfs vfs::mk4 vfs::mkcl vfs::zip vfslib zipvfs zlib zlibtcl
>
```

3.2 tcl3dsh: Installation purpose

The Starpack contains the Tcl3D package, the Tcl3D demos as well as the external libraries needed for the optional modules.

These can be copied to the file system for use with standard tclsh or wish.
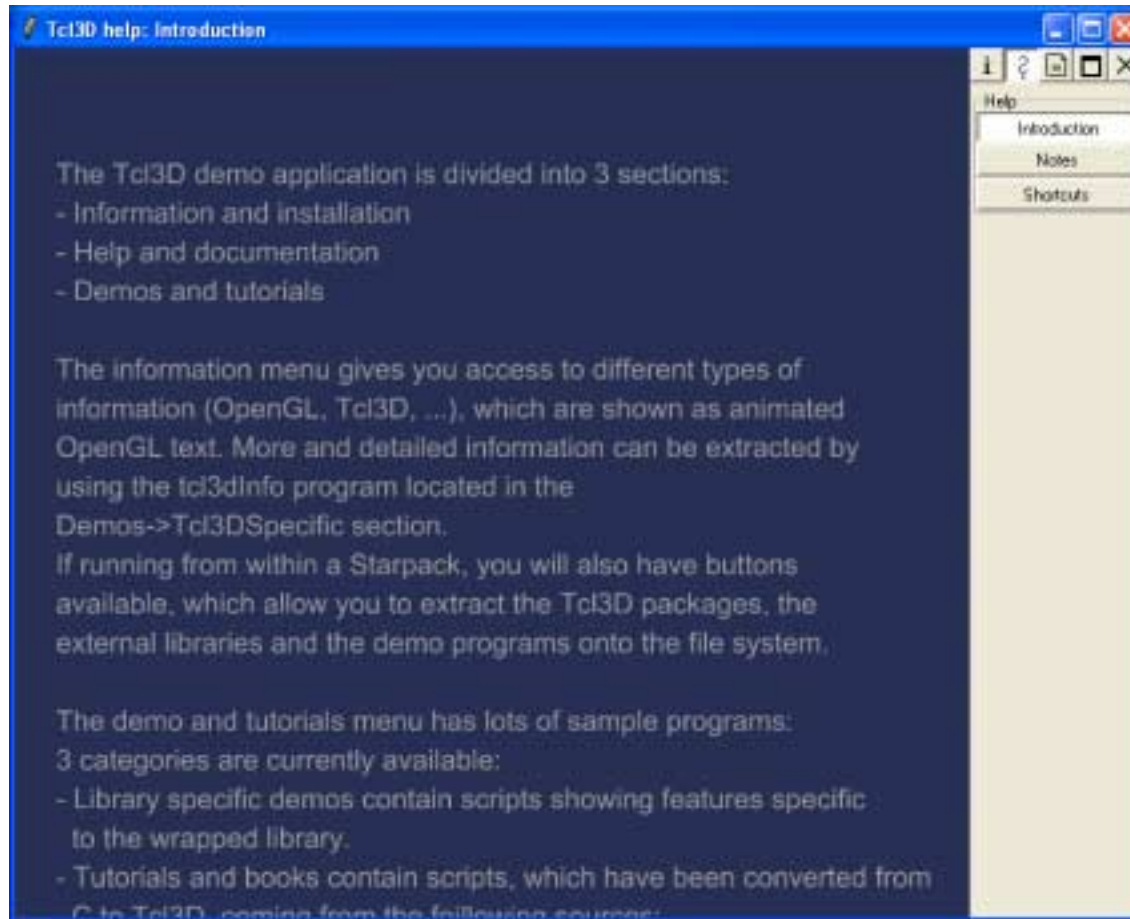
3.3 tcl3dsh: The demo container

The Starpack contains over 100 demo and tutorial programs showing many aspects of Tcl3D programming techniques.
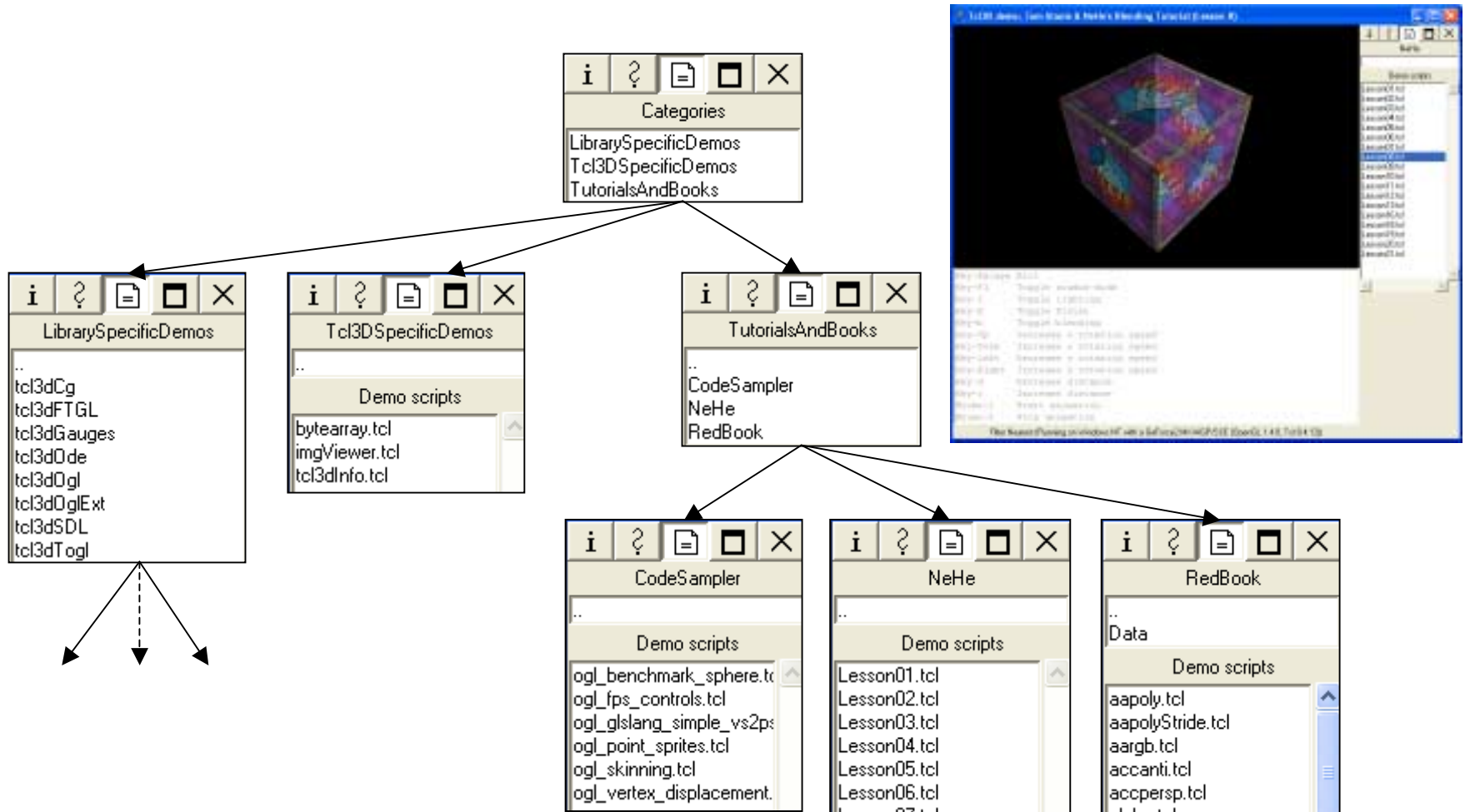
3.4 tcl3dsh: Built-in help

The Starpack contains built-in help and documentation.

Currently very low-level. It is planned to include the Tcl3D manual.

Paul Obermeier   Tcl3D: One year after   25

3.5 tcl3dsh: Starpacking issues (1)

Starpack/Starkit problem 1

If shipping external libraries with your Starpack, you have to copy them to the file system, before they can be used.

Best place is the directory containing the Starpack.

```
# Check if all necessary external libraries exists in the directory
# containing the Starpack. Copy them to the filesystem, if necessary.
set __tcl3dExecDir [file dirname $::starkit::topdir]
set __tcl3dDllList [glob -nocomplain -dir [file join $starkit::topdir dlls] \
                    *[info sharedlibextension]*]

foreach starkitName $__tcl3dDllList {
    set osName [file join $__tcl3dExecDir [file tail $starkitName]]
    if { ! [file exists $osName] } {
        set retVal [catch { file copy -force -- $starkitName $__tcl3dExecDir }]
        puts "Copying DLL $starkitName to directory $__tcl3dExecDir"
        if { $retVal != 0 } {
            error "Error copying DLL $starkitName to directory $__tcl3dExecDir"
        }
    }
}
```

3.5 tcl3dsh: Starpacking issues (2)

Starpack/Starkit problem 1

This aforementioned solution seems to be the best possible solution today, but has the following two disadvantages:

Windows user will typically place the Starpack onto the desktop. Starting the Starpack inflates the desktop with lots of DLL's.

On Linux/Unix the current directory typically is not included in the LD_LIBRARY_PATH variable. So we need a separate shell script:

```
#!/bin/sh
LD_LIBRARY_PATH=".:$LD_LIBRARY_PATH"
LD_LIBRARYN32_PATH=".:$LD_LIBRARYN32_PATH"
export LD_LIBRARY_PATH
export LD_LIBRARYN32_PATH
./tcl3dsh
```

3.5 tcl3dsh: Starpacking issues (3)

Starpack/Starkit problem 2

Some of the external libraries need files for initialization, ex. the FTGL library needs the name of a TrueType font file to construct it's OpenGL commands.

Tcl3D supports a utility procedure `tcl3dGetExtFile`, which you should use, if intending to use a Tcl3D script - depending on such a library - in a Starpack.

A typical usage is shown in the following code segment:

```
set fontfile [file join [file dirname [info script]] "yudit.ttf"]
# tcl3dGetExtFile is available only in versions 0.3.1 and up.
# You may check availability of command first, if running scripts with older
# Tcl3D versions.
if { [info proc tcl3dGetExtFile] eq "tcl3dGetExtFile" } {
    # Get the font file in a Starpack independent way.
    set fontfile [tcl3dGetExtFile $fontfile]
}
```

4 The next year of Tcl3D

4.1 Planned Tcl3D features

The following items are on my personal ToDo list

➢ Complete the ODE wrapper.
➢ Coordinate tcl3dTogl changes with official Togl maintainer.
➢ Extend Togl to support multisampling, Swap control and Pbuffers.
➢ Add more 3D file formats (at least 3ds).
➢ Implement TEA compliant build structure.
➢ Make it a SourceForge project. (??)

Contributions of any kind are welcome.

bug fixes

testing

ideas for libraries to be added

demo programs

platform specific support

Send them to info@tcl3d.org.

4.2 Goodbye - Hello

If you like Tcl3D, you can do the following:

➢ Watch out comp.lang.tcl for Tcl3D release announcements.
➢ Visit http://wiki.tcl.tk/15278 for actual Tcl3D discussions.
➢ Get distributions and demos from http://www.tcl3d.org

I don't know, why you say goodbye, I say hello

See you next year for

Tcl3D: Two years after