Cave5D README
Version 2.0 March 2001

CONTENTS


NOTE. This information was obtained from the original Cave5D website. It is found at the address http://www.ccpo.odu.edu/~cave5d/cave5dGuide.html.

## 1. Introduction

Cave5D was originally developed by Glen Wheles, Cathy Lascara, Bill Hibbard, and Brian Paul. It combines the use of Vis5D version 5.2 and CAVE libraries to create a virtual environment were Vis5D files can be viewed in. Within Cave5D you can view the data set with higher resolution thus revealing much greater detail in the model simulation. While viewing data with Cave5D, you can enlarge the data image and rotate the view to better interpret the simulation. Cave5D also allows for more flexibility by offering many options that can be added to a configuration file. These options are listed below in Section 3.

## 2. Configuration Files

The configuration file contains information to Cave5D on which data, topography, and map file to use, which objects
to display, and specifications for the run time environment. Below are commands that Cave5D recognizes with in the
configuration file. All that is required, though, is a data file.

## 2.1 Filename Specifications

| ***Keyword*** | ***Arguments*** | ***Specifications*** |
|---|---|---|
| DATA_FILE | Filename | Provide full path name to the Vis5D data file to be visualized |
| TOPO_FILE | Filename | Provide full path name to a Vis5D topography file. |
| MAP_FILE | Filename | Provide full path name to a Vis5D map. |
| SAVE_FILE | Filename | Provide full path name to a Vis5D save "TCL" file. |
| **MASTER_PANEL_CONFIG** | Filename | Provide full path name to a configuration file for the master panel. |
| GOBJ_PANEL_CONFIG | Filename | Provide full path name to a configuration file for the master panel. |

## 2.2 View Parameters

| ***Keyword*** | ***Arguments*** | ***Specifications*** | ***Default Values*** |
|---|---|---|---|
| INIT_POSITION | Xpos, Ypos, Zpos | Specify the initial X, Y, Z positions (floats) for the origin of the bounding box. The defaults are 0.0, 0.0, –5.0. | 0.0<br>0.0<br>–5.0 |
| INIT_ROTATION | Xrot, Yrot, Zrot | Specify the initial rotation (float)in degrees about the X, Y, and Z axis for the orientation of the bounding box. The defaults are 0.0, 0.0, 0.0. | 0.0<br>0.0<br>0.0 |
| INIT_SCALE | Xscale, Yscale, Zscale | Specify the initial scaling factor (floats) for the X, Y, Z dimensions of the bounding box. The defaults are 1.0, 1.0, 1.0. | 1.0<br>1.0<br>1.0 |
| **CHANGE_SCALE_FACTOR** | Scale Factor | Specify the factor (float) which is multiplied by the magnitude of input received from the joystick pressure pad to create a new scale for the X, Y, or Z axis. The default is 0.75. | 0.75 |
| CAVENEAR | Near | Specify the Z–position (float) of the near clipping plane in CAVE coordinates relative to the user's head. Default is 0.2 feet. | 0.2 |
| CAVEFAR | Far | Specify the Z–position (float) of the far clipping plane in CAVE coordinates relative to the user's head. Default is 300 feet. | 300 |
| CLOCK_MODE | Mode | Specify that a clock should be displayed, acceptable modes are VIS5D or DECIMAL. | OFF |
| CLOCK_POSITION | x1, y1, z1, x2, y2, z2 | These are all floats. The first set of values define the top left of rectangle and the second set defines the lower right hand portion of the rectangular clock. Default is –3.0, 3.0, –5.0, –2.25, 2.25, –5.0. | –3.0<br>3.0<br>–5.0<br>–2.25<br>2.25<br>–5.0 |

| ***Keyword*** | ***Arguments*** | ***Specifications*** | ***Default Values*** |
|---|---|---|---|
| BOX_DISPLAY | OFF or ON | Specify OFF to disable the display of the bounding box, the default is ON. | 1 (on) |
| BOX_ASPECT_RATIO | x, y, z | Specify three floats which define the aspect ratio of the Vis5D bounding box. | 0.0<br>0.0<br>0.0 |

## 2.3 Lighting Parameters

| ***Keyword*** | ***Arguments*** | ***Specifications*** | ***Default Values*** |
|---|---|---|---|
| LIGHT0_POSITION | x, y, z | Specify the placement of the light in CAVE coordinates. Default values are 0, 500, 500. | 0.0<br>500.0<br>500.0 |
| LIGHT0_AMBIENT | r, g, b | Specify r, g, b values for the ambient lighting component of light0. Default values are 0.3, 0.3, 0.3. | 0.3<br>0.3<br>0.3 |
| LIGHT0_DIFFUSE | r, g, b | Specify r, g, b values for the diffuse lighting component of light 0. Default values are 0.4, 0.4, 0.4. | 0.4<br>0.4<br>0.4 |
| LIGHT0_SPECULAR | r, g, b | Specify r, g, b values for the specular lighting component of light0. Default values 1.0, 1.0, 1.0. | 1.0<br>1.0<br>1.0 |
| LIGHT_AMBIENT | r, g, b | Specify r, g, b values for ambient scene lighting. Default values are 0.2, 0.2, 0.2. | 0.2<br>0.2<br>0.2 |

## 2.4 Variable Assignments

| ***Keyword*** | ***Arguments*** | ***Specifications*** |
|---|---|---|
| **VELOCITY_ONE_FIELDS** | uFld, vFld, wFld | Specify the name for the data fields representing the U, V, W components of velocity vector one. The defaults are U, V, W. |
| **VELOCITY_TWO_FIELDS** | uFld, vFld, wFld | Specify the name for the data fields representing the U, V, W components of velocity vector two. The defaults are U, V, W. |

| Keyword | Arguments | Specifications |
|---|---|---|
| **TRAJECTORY_FILEDS** | uFld, vFld, wFld | Specify the name for the data fields representing the U, V, W components of velocity vector used to compute trajectories. The defaults are U, V, W. |
| **VAR_CLONE** | existingVarName, clonedVarName | Specify the name of an existing variable to make a clone of using the clonedVarName. The application supports a maximum of 4 cloned variables. |

## 2.5 Miscellaneous

| Keyword | Arguments | Specifications | Default Values |
|---|---|---|---|
| TARGET_RATE | rate | Specify a target rate(float) for the animation speed in terms of frames per second. | 0.5 |
| VIS5D_MEMSIZE | size | Specify (integer) in megabytes for total shared memory to be used by Vis5D data sets. | 2000 |
| C5D_MEMSIZE | size | Specify size (integer) in megabytes for total shared memory to be used by c5d data sets. Default size is 30 megabytes. | 30 |
| NAV_SPEED | speed | Specify scaling factor (integer) used to set navigation speed. The default is 10. | 10 |
| ROTATION_STYLE | type | Specify AIRPLANE or OBJECT as the types. The default is OBJECT. | OBJECT |
| JSTICK_THRESH | speed | Specify threshold factor (float) for the joystick pressure pad. The default is 0.3. This parameter is provided since individual joysticks have different sensitivities. | 0.30 |
| WORKERS | #ofWorkers | Specify the amount (integer) of processors to run Cave5D on | 1 |

| Keyword | Arguments | Specifications | Default Values |
|---|---|---|---|
| HI_RES_TOPO | 1 or 0 | Switch to display a high resolution topography map. Specify "0" for no or "1" for yes. | 0 |

## 2.6 Graphical Object Definitions

| Keyword | Arguments | Specifications |
|---|---|---|
| VIS5D_HSLICE | varName, label, cInt, cMin, cMax, vLv1, red, green, blue, alpha | Create horizontal slice with contour lines for the selected variable. Specify the contour interval, minimum, maximum values, the vertical placement for the slice (vLv1) and color fields. |
| VIS5D_CHSLICE | varName, label, vLv1, ctCurve, ctBias, ctPower, ctAlpha | Create a colored horizontal slice for the selected variable. Specify the vertical placement for the slice (vLv1) and the color table parameters. |
| VIS5D_HWIND | varName, label, density, scale, vLv1, red, green, blue, alpha | Create 3–D velocity vectors on horizontal slice. Specify the density (0–1) of what percentage of the grid points will have a vector, the scale factor for the vector, the vertical placement for the slice (vLv1), and the color fields. |
| VIS5D_VSLICE | varName, label, cInt, cMin, cMax, r0, c0, r1, c1, red, green, blue, alpha | Create vertical slice with contour lines for the selected variable. Specify the contour interval, minimum, maximum values, the horizontal placement for the slice (starting and ending row and column values) and the color fields. |
| VIS5D_CVSLICE | varName, label, r0, c0, r1, c1, ctCurve, ctBias, ctPower, ctAlpha | Create a colored vertical slice for the selected variable. Specify the horizontal placement for the slice (starting and ending row and column values), and the color fields. |

| *Keyword* | *Arguments* | *Specifications* |
|---|---|---|
| VIS5D_VWIND | varName, label, density, scale, r0, c0, r1, c1, red, green, blue, alpha | Create 3−D velocity vectors on a vertical slice. Specify the density (0−1) of what percentage of the grid points will have a vector, the scale factor for the vector, the horizontal placement for the slice, and the color fields. |
| VIS5D_ISOSURF | Mono Color:<br>varName, label, altName, varValue, red, green, blue, alpha<br><br>Color−graded according to second var:<br>varName, label, altName, varValue, c1, ctCurve, ctBias, ctPower, ctAlpha | For Mono:<br>To create a mono−color isosurface for this variable, specify the value of varName to be used for the isosurface and specify the color fields. Set altName to the varName. Specify the red, green, blue, and alpha values to use.<br><br>For Color−graded:<br>To create an isosurface for which the color is determined by another variable, specify the value of varName to be used for the isosurface. Set altName to the variable defining the color. Supply the four color−table parameters. |
| VIS5D_TRAJ | label, R_min, R_max, R_int, C_min, C_max, C_int, L_min, L_max, L_int, T_min, T_max, Length, Step, Set#, R_flag, red, green, blue, alpha | Particles will be released from each point within the rectangular region defined by the row, column, level specification. A total of six trajectory sets are supported.<br>The first argument is the label for the graphical objects window. The next nine arguments specify the min, max, and interval for rows, columns, and levels. The next two args are the min and max time steps during which tracers are to be released. |

| Keyword | Arguments | Specifications |
|---|---|---|
| C5D_VECTOR | label, filename, scle, red, green, blue, alpha | Display an arrow for each irregular grid node specified in the C5D_VECTOR file designated by filename. The magnitude and direction of the arrow is computed from the U, V, W data provided in the C5D_VECTOR file. Scale (float) specifies a user−defined scale to apply to the length of the arrows to make them meaningful in CAVE coordinate space. Specify the color of the arrows using rgba values. |
| C5D_BAR | label, filename, foot[0], foot[1], minSize, maxSize, axis, red, green, blue, alpha | Display a solid rectangle (or bar) for each irregular grid node specified in the C5D_BAR file designated by filename. The size of the bar varies in time according to the data in filename. Specify the footprint size of the bar in CAVE units. Specify the minimum and maximum data value in filename. Specify the axis along which the bar will change size. Specify the color of the bars using rgba values. |
| C5D_SURFACE | label, filename, scale, red, green, blue, alpha | Display a 2D surface according to data provided in filename. Specify scale to magnify the relative difference between the largest and smallest values which are specified in filename using data coordinates. Specify the color of the surface using rgba values. |

## 2.7 Panel Configuration Parameters

Several parameters may be defined at run−time to control the look of the graphical interface panels. These parameters are defined in a separate file which is identified by the MASTER_PANEL_CONFIG or GOBJ_PANEL_CONFIG keywords in the app's config file.

| Keyword | Arguments | Specification |
|---|---|---|
| BGCOLOR | red, green, blue | Background color of the panel |
| BUTTON_BG1 | red, green, blue | Background color for buttons in state 1 |

| Keyword | Arguments | Specification |
|---|---|---|
| BUTTON_BG2 | red, green, blue | Background color for buttons in state 2 |
| BUTTON_BG3 | red, green, blue | Background color for buttons in state 3 |
| BUTTON_TX1 | red, green, blue | Text color for buttons in state 1 |
| BUTTON_TX2 | red, green, blue | Text color for buttons in state 2 |
| BUTTON_TX3 | red, green, blue | Text color for buttons in state 3 |
| XRANGE | left, right | Left and right X position of where the panel is displayed |
| YRANGE | top, bottom | Top and bottom Y position of where panel is displayed |
| ZRANGE | front, back | Front and back Z position of where panel is displayed |

# 3.How to Run Cave5D

3.1 Start the application by typing "cave5d_2200 *config*"

where config is the path name of an ASCII file containing parameter definitions. The application reads the configuration, ingests the specified data sets, and then creates the graphical objects that have been identified by the config file.

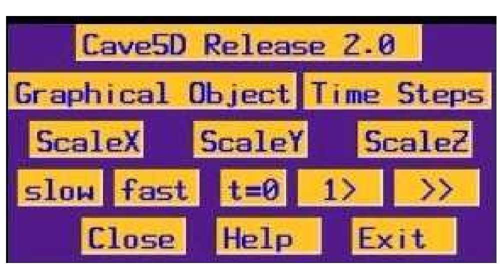
The application displays a single graphical object, the bounding box of the Vis5D 3−dimensional domain, and awaits user input to control the visualization process. The user interactively selects graphical objects, controls the animation, moves the location of graphical objects, navigates through space, and re−scales the 3−D domain based on inputs to the wand buttons and joystick.

Terminate the application by pressing 'ESC' or 'DELETE' key on the keyboard or select the exit button on the main control panel.

3.2 Control Panels

The graphical user interface is comprised of seven control panels each configured with a suite of buttons. User interaction with a panel is accomplished using the left button of the wand. Selected features of the panels and buttons can be specified at run−time via a configuration file.

3.2.1 Master Panel



This is the first panel that is displayed when the left button is pressed.   Below you will find descriptions for each of the buttons ...

| ***Button*** | ***Description*** |
|---|---|
| Cave5D Release 2.0 | Clicking on this button toggles between the rotation styles object and airplane |
| Graphical Object | Displays the panel that allows you to turn on and off the graphical objects you specified in the configuration file. It also leads you to the option of changing the configuration values. |
| Time Steps | Displays the panel that allows you to change the start and end time of the simulation. |
| ScaleX | Selecting this button allows you to scale along the X axis by moving the joystick. |
| ScaleY | Selecting this button allows you to scale along the Y axis by moving the joystick. |
| ScaleZ | Selecting this button allows you to scale along the Z axis by moving the joystick. |
| slow | Slow down the animation speed. |
| fast | Speed up the animation speed. |
| t=0 | Reset the animation to the first time step. If the time steps have been changed, this button will bring you back to the time step you specified as the start time. |
| 1> | Move forward 1 time step. |
| >> | Toggle animation on and off. |
| Close | Closes the Master panel. |
| Help | Displays the Help Menu panel. |
| Exit | Exits Cave5D. |

### 3.2.2 Graphical Objects Panel

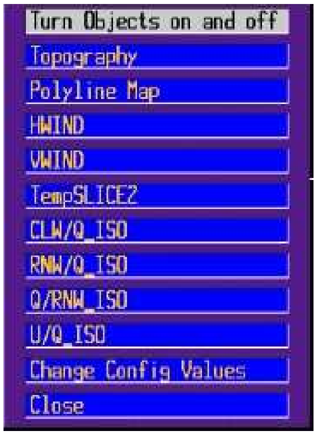
This panel is displayed when the 'Graphical Object' button is pressed on the Master panel.  Each of the buttons may be toggled between 1 to 3 different states depending on the button and object being selected.

**Button State 1**:  This is the default state when the application comes up.  The display of the graphical object associated with the button is set to off.

**Button State 2**:  The display of the graphical object associated with the button is set to ON.  The background and text colors of a button in state 2 are displayed in reverse video from state 1 colors.

**Button State 3**:  The graphical object associated with the button is displayed.  The background color is the same as state 2 and the text color changes.  If the object is a horizontal or vertical slice–type object, button state 3 specifies that the object can be moved with the wand as described below.

An example of a graphical object panel is shown below.  Obviously, it will not always look like this one, but it will always contain the 'Close' button as well as the 'Change Config Values' button.




| *Button* | *Description* |
|---|---|
| Topography | If a topography file is specified, pressing this button will display the specified topo file. |
| Polyline Map | If a map file is specified, pressing this button will display the map file. |
| Graphical Objects specified in config file | By following the different button states above, you toggle the display of the object. |
| Change Config Values | Displays a panel that will allow you to select which object to change. |
| Close | Closes the Graphical Object panel and returns back to the Master panel. |

### 3.2.3 Graphical Objects Change Panel

This panel allows you to select which object to change. When an object is selected, a new panel is displayed for that particular type of graphical object. Hitting the close button leads you back to the Graphical Objects panel. An example of a graphical Objects Change panel is shown below.


### 3.2.4 Select Variable Panel

This panel displays all of the variables that can be changed for that particular type of graphical object.  Selecting one, opens up the next panel that allows you to change the value.  The close button leads you to the Graphical Objects Change panel.  An example Select Variable panel for an isosurface is shown below.

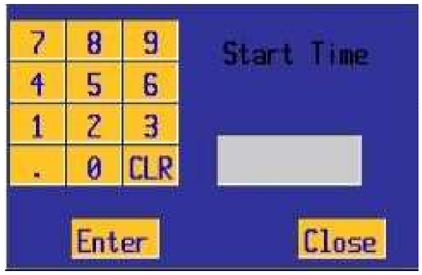

3.2.4 Create Change Panel

This panel allows you to change the configuration value.  The variable that you are changing should be located on the panel as well as the current value.  To change the value, enter in the new value by pressing the left button over the numbers.  Then press 'Enter'.  If 'Enter' is not pressed, the value will not be changed.  'Close' will bring you back to the Select Variable panel for the object that you were changing.

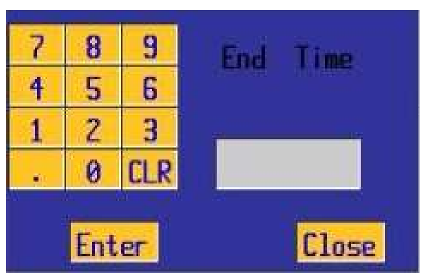

| ***Button*** | ***Description*** |
|---|---|
| 0–9 & . | When pressed the number or decimal point is shown in the gray box |
| CLR | Clears the number entered. |
| ENTER | Changes the current value for the variable.  When pressed, the entire object is placed in a queue and is displayed when it is computed.  Without pressing 'Enter', the value is never changed. |
| Close | Closes the Change panel and returns back to the Select Variable panel. |

3.2.5 Time Step Panels

There two panels that make up the time step panels.  One for the beginning time step and one for the ending time step.  They work similarly to the Create Change panel.




| ***Button*** | ***Description*** |
|---|---|
| 0–9 & . | When pressed the number or decimal point is shown in the gray box |
| CLR | Clears the number entered. |
| ENTER | Changes the start time.  The End time panel is then displayed.  Without pressing 'Enter', the value is never changed. |
| Close | Closes the Time Step panel and returns back to the Main panel. |




| ***Button*** | ***Description*** |
|---|---|
| 0–9 & . | When pressed the number or decimal point is shown in the gray box |
| CLR | Clears the number entered. |
| ENTER | Changes the end time.  TheMain panel is then displayed.  Without pressing 'Enter', the value is never changed. |
| Close | Closes the Time Step panel and returns back to the Main panel. |

## 3.3 Wand Interactions

*Rotation
The user can rotate the application domain by pressing the middle button on the wand and

changing the orientation and position of the wand.

Cave5D has two types of rotation:

***Airplane:*** The world rotates about the head of the user
***Object:*** The world rotates about it's center

*Wand Buttons
**Left Button:** Used to interact with panels (used to select objects/buttons).
**Middle Button:** Used to rotate the application domain. See above for more details.
**Right Button:** To move slices when they are toggled to do so. This is done by pointing to the tag on the top of the slice, holding down the right button, and moving the wand.
**Left and Right Buttons Simultaneously:** Returns to default orientation.

## 4.0 Version History

Version 2.0 – July 2001

New config parameter to specify the amount of threads (WORKERS)
New config parameter to use the high resolution topography (HI_RES_TOPO)
Now uses Vis5D version 5.2 as the Vis5D archive library file
Make modifications to the configuration file during run–time
Select which time steps to view
Now a 64–bit executable

Version 1.4 – April 1998

New rotation style: AIRPLANE
New config parameter ROTATION_STYLE
New config parameters to specify lighting values, LIGHT0_POSITION, LIGHT0_AMBIENT, LIGHT0_DIFFUSE, LIGHT0_SPECULAR, LIGHT_AMBIENT.
New graphical objects :
C5D_BAR – Irregularly–located, time–varying solid rectangles (bars) whose size change according to time–series scalar data set
C5D_VECTOR – Irregularly–located, time–varying arrows whose magnitude and direction change according to time–series vector (u,v,w) data set
C5D_SURFACE – Time–varying 2D surface whose height changes according to time series scalar data for a 2D grid
New config parameter BOX_ASPECT_RATIO
New config parameter BOX_DISPLAY
Elimination of config parameter MEMORY_SIZE
New config parameter VIS5D_MEM_SIZE
New config parameter C5D_MEM_SIZE
Cave5D release number displayed in main panel
Requires C++ compiler
Default INIT_ROTATION for X changed to 0 from –50
Default INIT_POSITION for Z changed to –5 from 20

Version 1.3 – October 1997

Publically available on web.
Smoother, faster navigation.
Run–time control of animation speed.

NEW Display object: CLOCK.
Optional display of topography as wire frame object instead of filled polygons.
Specification of CAVENear and CAVEFar in config file.
Support termination of program using ESCAPE or DELETE key from keyboard.

Version 1.2 – August 1997

Publically available on web.
Linked to vis5d release 4.3 archive library.
Improved navigation.
Trajectories added as graphical objects.

Version 1.1 – December 1996

Internal release only.
Run–time configurable application.
Selected Vis5d graphics objects.
Required modifications to underlying vis5d API calls.

Version 1.0 – December 1995

Internal release only.
Hard coded version to support demonstration of Chesapeake Bay Virtual Environment at Supercomputing 95.