Cave5D README
Version 2.0 March 2001

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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 2.

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.	0.0 0.0 -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.	0.0 0.0 0.0
INIT_SCALE	Xscale, Yscale, Zscale	Specify the initial scaling factor (floats) for the X, Y, Z dimensions of the bounding box.	1.0 1.0 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.	0.75
CAVENEAR	Near	Specify the Z-position (float) of the near clipping plane in CAVE coordinates relative to the user's head.	0.2
CAVEFAR	Far	Specify the Z-position (float) of the far clipping plane in CAVE coordinates relative to the user's head.	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.	-3.0 3.0 -5.0 -2.25 2.25 -5.0
BOX_DISPLAY	OFF or ON	Specify OFF to disable the display of the bounding box.	1 (on)
BOX_ASPECT_RATIO	x, y, z	Specify three floats which define the aspect ratio of the Vis5D bounding box.	0.0 0.0 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.	0.0 500.0 500.0
LIGHT0_AMBIENT	r, g, b	Specify r, g, b values for the ambient lighting component of light0.	0.3 0.3 0.3
LIGHT0_DIFFUSE	r, g, b	Specify r, g, b values for the diffuse lighting component of light0.	0.4 0.4 0.4
LIGHT0_SPECULAR	r, g, b	Specify r, g, b values for the specular lighting component of light0.	1.0 1.0 1.0
LIGHT_AMBIENT	r, g, b	Specify r, g, b values for ambient scene lighting.	0.2 0.2 0.2

2.4 Variable Assignments

Keyword	Arguments	Specifications	Default Values
VELOCITY_ONE_FIELDS	uFld, vFld, wFld	Specify the name for the data fields representing the U, V, W components of velocity vector one.	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.	U V W
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. .	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
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.
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: varName, label, altName, varValue, red, green, blue, alpha Color-graded according to second var:	For Mono: 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

Keyword	Arguments	Specifications
	varName, label, altName, varValue, c1, ctCurve, ctBias, ctPower, ctAlpha	altName to the varName. Specify the red, green, blue, and alpha values to use. For Color-graded: 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. 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.
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

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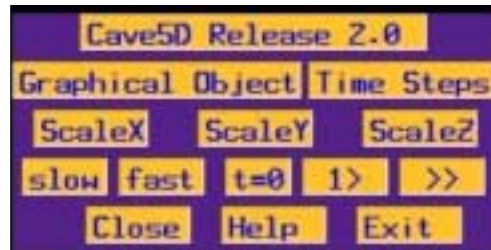
This is the first panel that is displayed when the left button is pressed. Below you will find descriptions for each of the buttons...

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

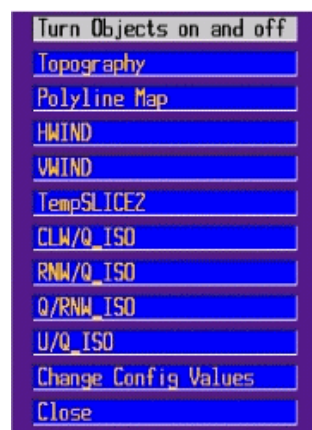| Button	Description
	changed, this button will bring you back to the time step you specified as the start time.
1>	Move forward 1 time step.
>>	Toggle animation on and off.
Close	Closes the Master panel.
Help	Displays the Help Menu panel.
Exit	Exits Cave5D.

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.
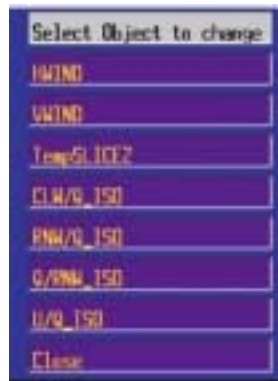
3.2.4 Select Variable Panel

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.
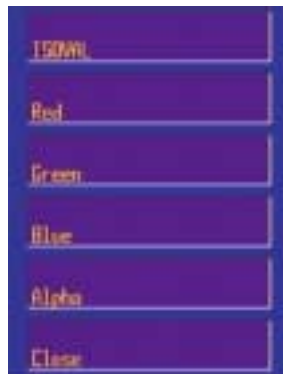
3.2.5 Create Change Panel

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.

3.2.6 Time Step Panels

There are 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. The current start and stop times are shown on the 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.