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Smokeview (Version 5) - A Tool for Visualizing Fire Dynamics Simulation Data Volume III: Verification Guide

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National Institute of Standards and Technology
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Preface

Smokeview is a software tool designed to visualize numerical calculations generated by fire models such as the Fire Dynamics Simulator (FDS), a computational fluid dynamics (CFD) model of fire-driven fluid flow or CFAST, a zone fire model. This Guide is Volume 3 of the Smokeview Reference Guides. This guide presents a series of images derived from FDS and Smokeview. The intent is to to verify that the algorithms used by Smokeview for visualizing data are implemented correctly. These images are generated automatically through the use of scripts by first running FDS on a series of input cases and then running Smokeview, again using a set of scripts. The correctness of Smokeview may then be verified more easily as FDS and Smokeview are updated since the reference figures in this document may be generated simply and automatically.

Smokeview and associated documentation for Windows, Linux and Mac/OSX may be downloaded from http://fire.nist.gov/fds .

About the Author

Glenn Forney is a computer scientist at the Building and Fire Research Laboratory (BFRL) of NIST. He received a bachelors of science degree in mathematics from Salisbury State College in 1978 and a master of science and a doctorate in mathematics at Clemson University in 1980 and 1984. He joined the NIST staff in 1986 (then the National Bureau of Standards) and has since worked on developing tools that provide a better understanding of fire phenomena most notably Smokeview, a software tool for visualizing Fire Dynamics Simulation data.

Disclaimer

The US Department of Commerce makes no warranty, expressed or implied, to users of Smokeview, and accepts no responsibility for its use. Users of Smokeview assume sole responsibility under Federal law for determining the appropriateness of its use in any particular application; for any conclusions drawn from the results of its use; and for any actions taken or not taken as a result of analysis performed using this tools.

Smokeview and the companion program FDS is intended for use only by those competent in the fields of fluid dynamics, thermodynamics, combustion, and heat transfer, and is intended only to supplement the informed judgment of the qualified user. These software packages may or may not have predictive capability when applied to a specific set of factual circumstances. Lack of accurate predictions could lead to erroneous conclusions with regard to fire safety. All results should be evaluated by an informed user.

Throughout this document, the mention of computer hardware or commercial software does not constitute endorsement by NIST, nor does it indicate that the products are necessarily those best suited for the intended purpose.

Contents

List of Figures

Chapter 1

Overview

Smokeview is a scientific software tool designed to visualize numerical predictions generated by fire models such as the Fire Dynamics Simulator (FDS), a computational fluid dynamics (CFD) model of fire-driven fluid flow [1] or CFAST, a zone model of compartment fire phenomena [2]. The feature set and user interface for Smokeview is complex making it difficult to adequately test all of its features manually. A scripting capability has been added to Smokeview to solve this problem. Many of Smokeview's features may be now be run without user intervention through the use of scripts. A script is simply a text file containing one or more commands. Smokeview when *requested* by the user reads in this script and performs the actions listed. Some of these actions are loading data files, setting view points, setting times and most importantly rendering images. By designing a set of scenarios and corresponding images that demonstrate Smokeview's feature set, one may test Smokeview simply by 1) running one master batch file that generates all of the images of this document and 2) examining these images to ensure that Smokeview is working as expected.

This document then verifies that various Smokeview features are working as intended by presenting a series of images of FDS simulation results. A separate Guide [3] documents verification for FDS. One set of scripts is used to run FDS cases and a second set of scripts is used by Smokeview to generate images. The verification process then becomes much easier to accomplish since the use of scripts (*i.e.* a non manual methods) guarantees that consistent figures (same view points, same time points, same data files loaded *etc.*) are produced as new versions of this verification document are generated using updated version of FDS and/or Smokeview. Another way of looking at this verification process is to consider this document and the FDS verification document [3] as being a *live* not a static document, easily updated as algorithms in FDS and/or Smokeview are enhanced and improved.

Details on setting up and running FDS cases may be found in the FDS User's Guide [4]. Details on visualizing FDS simulated data using Smokeview may be found in the Smokeview User's Guide [5]. Details on some of the technical aspects used to implement algorithms in Smokeview may be found in the Smokeview Technical Guide [6].

The Smokeview version used to generate the verification figures in this document is

```
Smokeview 5.3.13 - Apr 15 2009

Version: 5.3.13
Smokeview Revision Number: 3758
Compile Date: Apr 15 2009
Platform: WIN32  (Intel C/C++)
```

FDS generated data is presumed to be correct. FDS has its own set of verification cases to test the correctness of the data. The purpose of the cases here is to confirm that data is drawn or visualized correctly.

In particular these cases confirm that correct files are loaded, data is scaled and drawn correctly, geometry is drawn correctly *etc*. Three types of verification cases are presented. The first set are the most important, those cases that verify that data is drawn correctly. The second set of cases verify that various geometric elements are drawn correctly and the third set verifies that the various options and underlying features are implemented and perform properly.

The FDS input files used for the verification cases are documented in Appendix A. The Smokeview scripts used to generate the verification figures are documented in Appendix B. Note that these input files and scripts are located in the FDS svn repository. In fact, the entries in the appendices are included directly from the repository so will be up to date as this document is regenerated.

Chapter 2

Data File Tests

The tests in this chapter verify whether visualization types such as surface contours (boundary files), iso-surfaces, particles, slice files *etc.* are working as intended. These verifications use the FDS input files `plume5c.fds` (see Appendix A.1) and `fireline.fds` (see Appendix A.2) to generate the simulation data and the Smokeview script files `plume5c.ssf` (see Appendix B.1) and `fireline.ssf` (see Appendix B.2) to generate the verification figures. The `plume5c.fds` test case is a simple fire plume with two blockages to make the smoke flow more complex. A portion of the gas phase and the upper blockage are both initialized to 600 °C (rather than 20 °C) in order to test the conversion of a known temperature data to the correct color (as shown in the colorbar). The `fireline.ssf` test case is a terrain test case. The center of the case has a *hill*. The fire line data displayed conforms to this hill.

2.1 Surface contours (Boundary Files)

Figure 2.1 presents images verifying the display of surface contours or boundary file data. A series of boundary file images are drawn at 0.0, 10.0 and 30.0 seconds. The temperature of the upper obstacle is initialized to 600 °C hence the red colors for the $t = 0.0$ images. The first column of images colors data at cell nodes using temperatures averaged at surrounding cell centers. The second column of images colors data using data values at cell centers. The FDS input file for this test is `plume5c.fds`. The images for this test were created automatically by running the smokeview script, `plume5c.ssf`.

2.2 Iso-surfaces

Figures 2.2 and 2.3 present images verifying the display of isosurfaces. A series of temperature isosurfaces are drawn at at 0.0, 10.0 and 30.0 seconds. A portion of the interior gas temperature is initialized to 600.0 °C hence the rectangular block that appears in the $t = 0.0$ images. The first column in figure 2.3 presents the iso-surface using points. The second column presents the iso-surface using triangulated outlines. The first column in figure 2.2 presents the iso-surface using a solid surface. The second column also presents the iso-surface using a solid surface but also includes normal vectors. The FDS input file for this test is `plume5c.fds`. The images for this test were created automatically by running the smokeview script, `plume5c.ssf`.

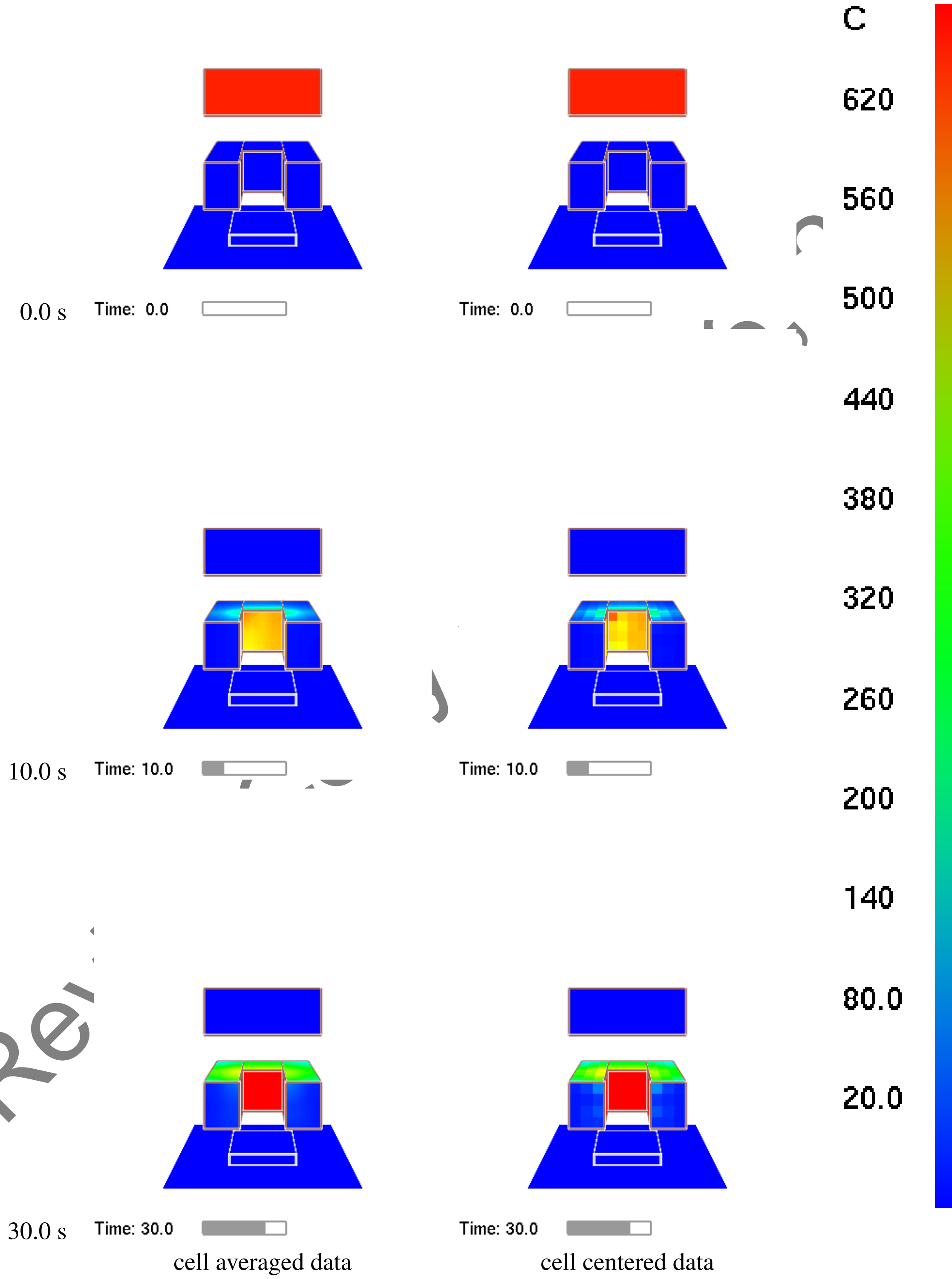


Figure 2.1: Boundary file test. The upper obstacle is initialized to 600.0 °C and should be red for the $t = 0.0$ images.

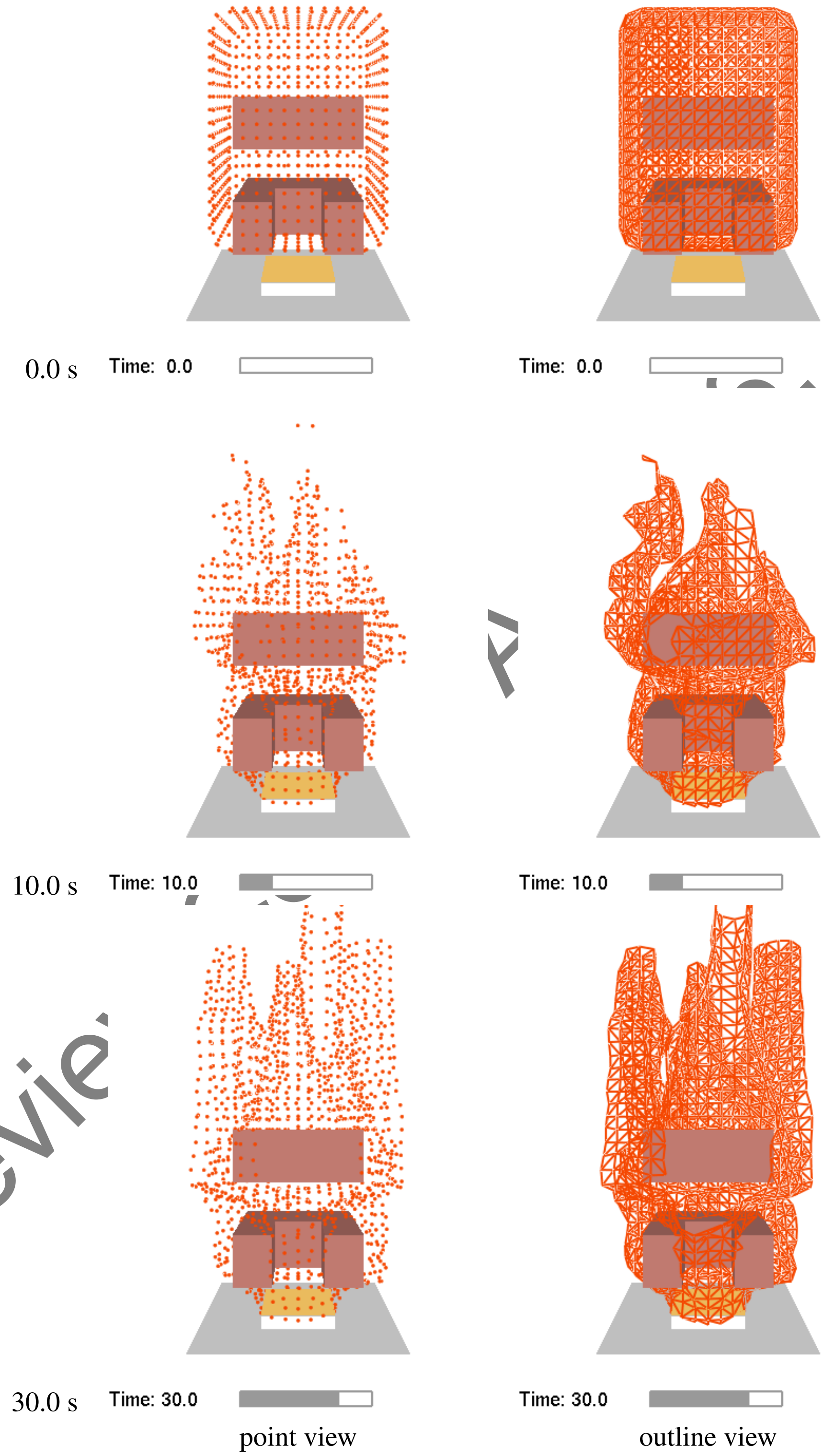


Figure 2.2: Isosurface file test 1. A portion of the interior gas temperature is initialized to 600.0 °C. The isosurface should surround this region for the $t = 0.0$ images.

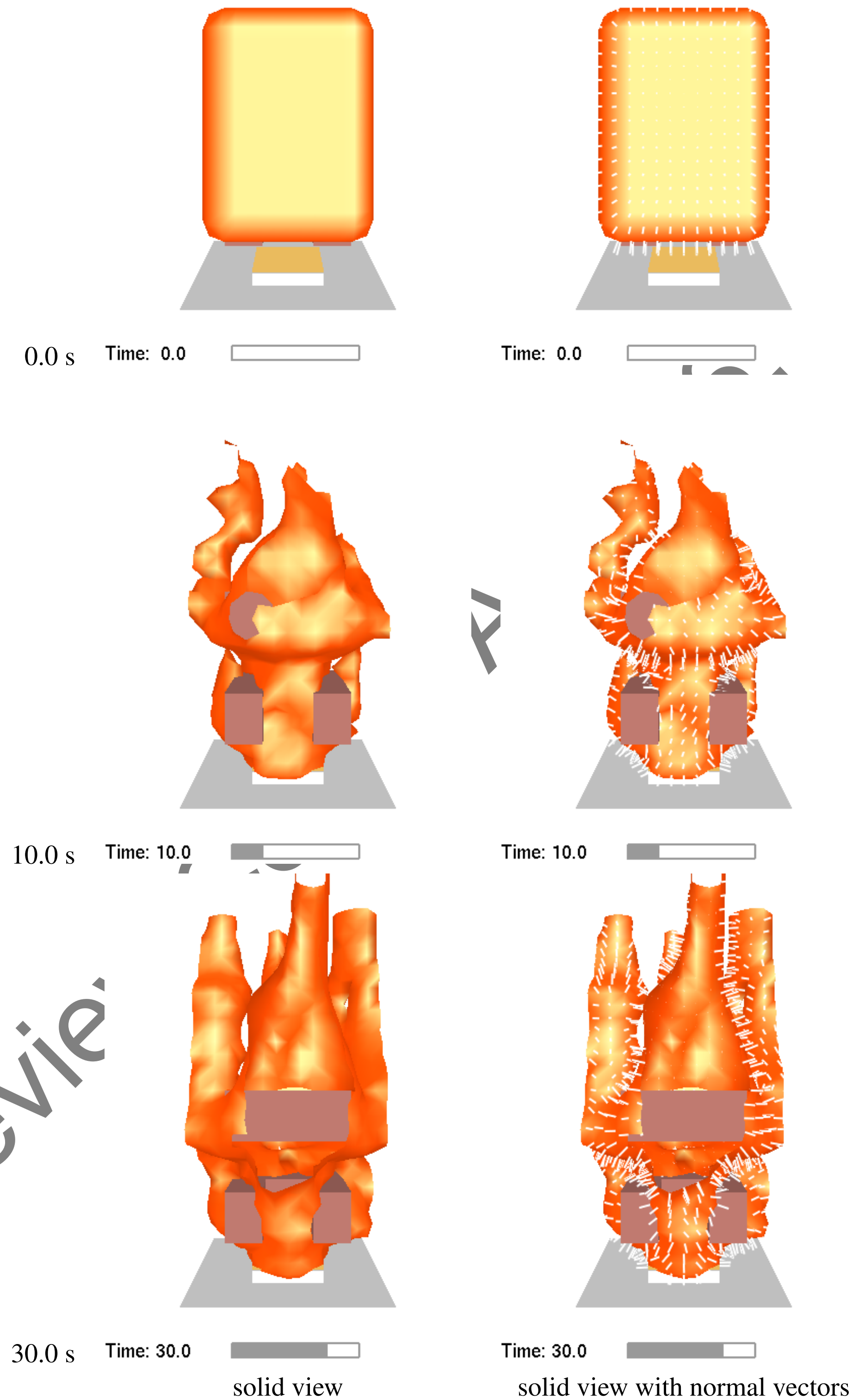


Figure 2.3: Isosurface file test 2. A portion of the interior gas temperature is initialized to 600.0 °C. The isosurface should surround this region for the $t = 0.0$ images.

2.3 Particles

Figures 2.4 presents images verifying the display of particles and streaks. Images are drawn at 1.0, 10.0 and 30.0 seconds. The first column shows particles while the second and third columns shows streaks with duration 0.5 s and 1.0 s. Streaks are a good way of visualizing motion in a still image (*i.e.* on paper) since the streak shows a history of where the particle has been. The FDS input file for this test is `plume5c.fds`. The images for this test were created automatically by running the smokeview script.

2.4 Slices

Figure 2.5 present images verifying the display of slices and vector slices. Images are drawn at 0.0, 10.0 and 30.0 seconds. A portion of the interior gas temperature is initialized to 600.0 °C corresponding to the red rectangular block appearing in the $t = 0.0$ images. The first column visualizes all of the data in the slice. The second data discards or chops data below 140 °C. Note that the color near the chopped boundary should match the color in the colorbar near 140.0 °C. Figure 2.6 present images verifying the display of vector slices. Again, vector slice file images are drawn at 5.0, 10.0 and 30.0 seconds. The first column draws all vectors while the second column discards or chops vectors below 140 °C. The FDS input file for this test is `plume5c.fds`. The images for this test were created automatically by running the smokeview script, `plume5c.ssf`.

2.5 3D Smoke

Figures 2.7 present images verifying the display of 3D smoke and fire (heat release per unit volume). A series of 3D smoke images are drawn at 1.0, 10.0 and 30.0 seconds. The images contain semi-transparent slices derived from both soot density and heat release rate per unit volume (HRRPUV) data. The FDS input file for this test is `plume5c.fds`. The images for this test were created automatically by running the smokeview script, `plume5c.ssf`.

2.6 Plot3D

Figure 2.8 present images verifying the display of PLOT3D contours. Three types of contours are available for visualizing PLOT3D data: line, stepped and continuous. This figure shows all three contour types. The FDS input file for this test is `plume5c.fds`. The images for this test were created automatically by running the smokeview script, `plume5c.ssf`.

2.7 Fire Lines

Figures 2.9 present images verifying the display of a fire line. A fire line is used with wildland fire simulations as an efficient method for visualizing the motion of a fire across the simulation. A fire line in the context of Smokeview is just a special case of a temperature slice file. The fire line slice is formed by setting the min and max temperature bounds to 20°C and 200°C respectively and chopping data below 150°C. The fire line slice file can then be made very small using Smokezip to compress it. Fire line images are drawn at 10.0, 20.0, 30.0 and 40.0 seconds. The fire lines conform to the hill going through the middle of the scene. The FDS input file for this test is `fire_line.fds`. The images for this test were created automatically by running the smokeview script, `fire_line.ssf`.

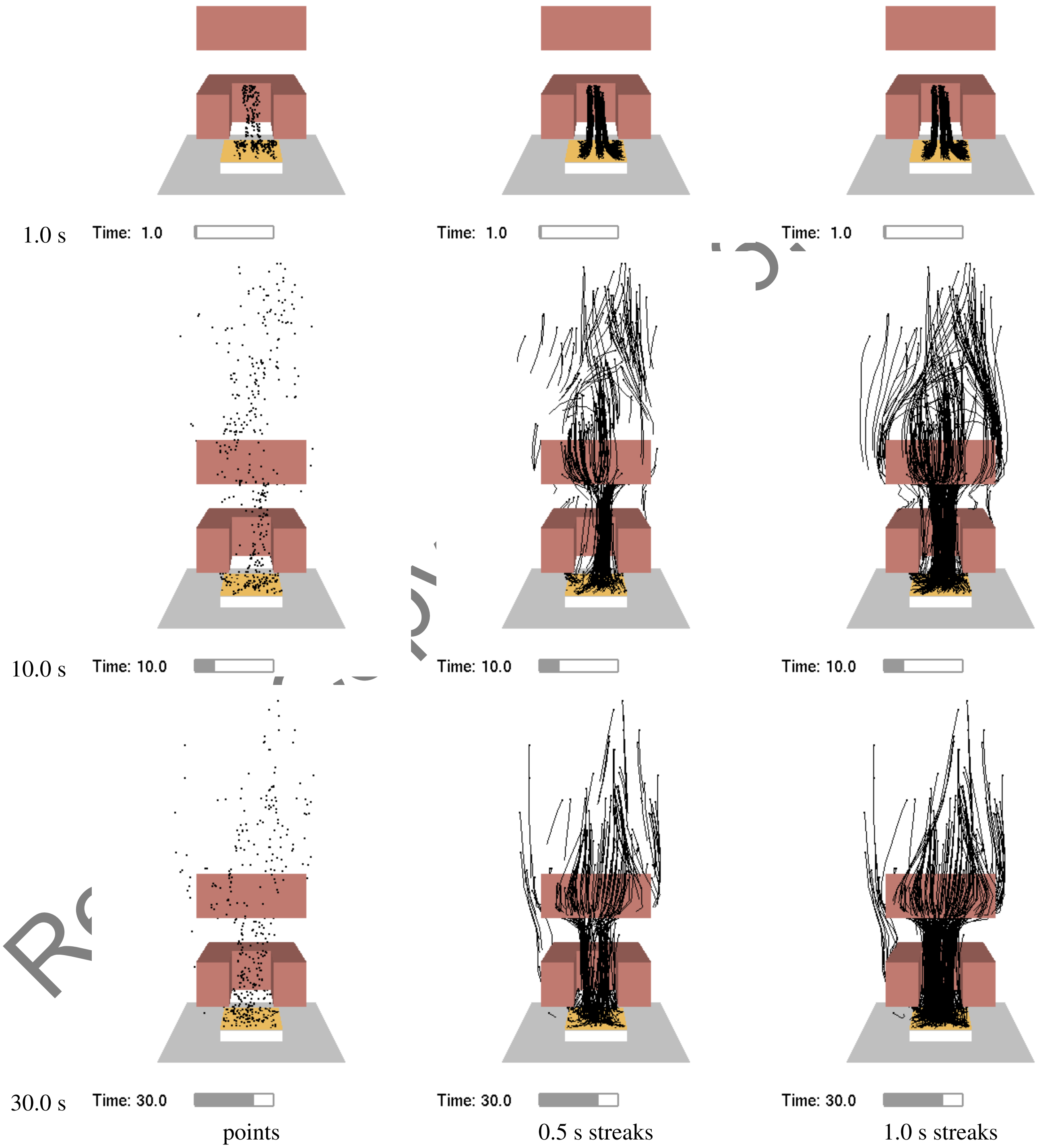


Figure 2.4: Particle file test.

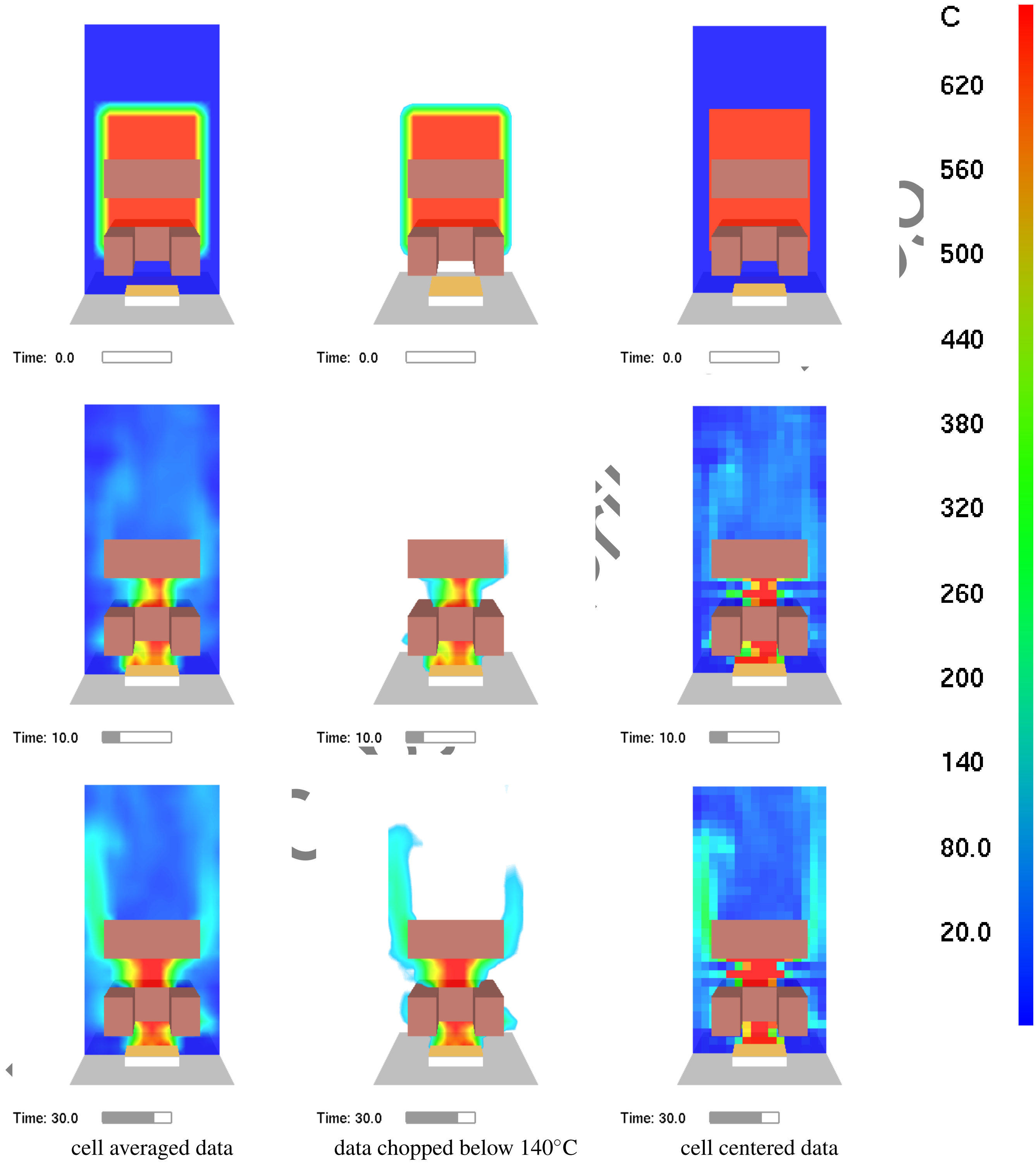


Figure 2.5: Slice file test. A portion of the interior gas temperature is initialized to 600.0 °C. The slice file in this region should be red for the $t = 0.0$ images. For the chopped contours, the color near the chop boundary should match the color near 140.0 in the colorbar.

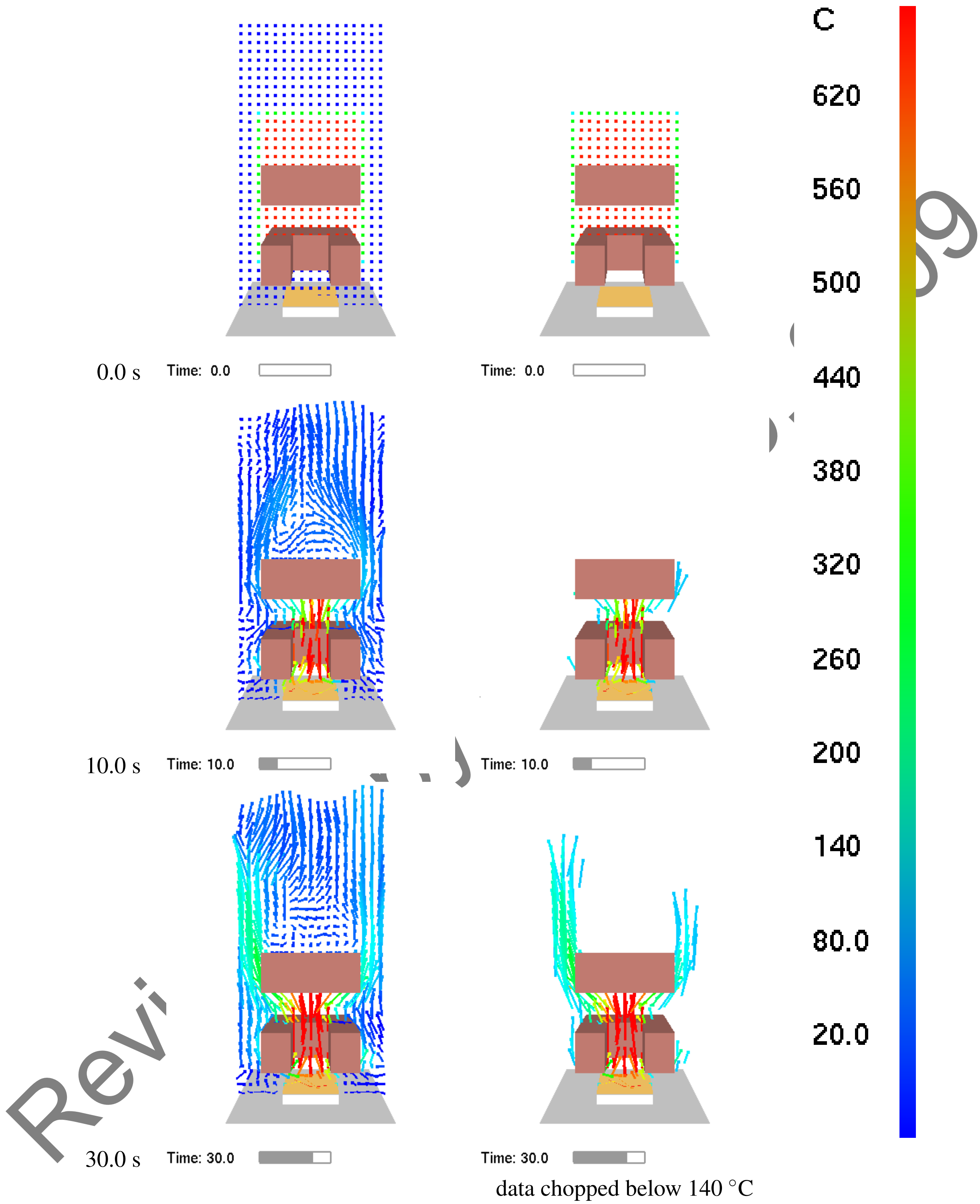
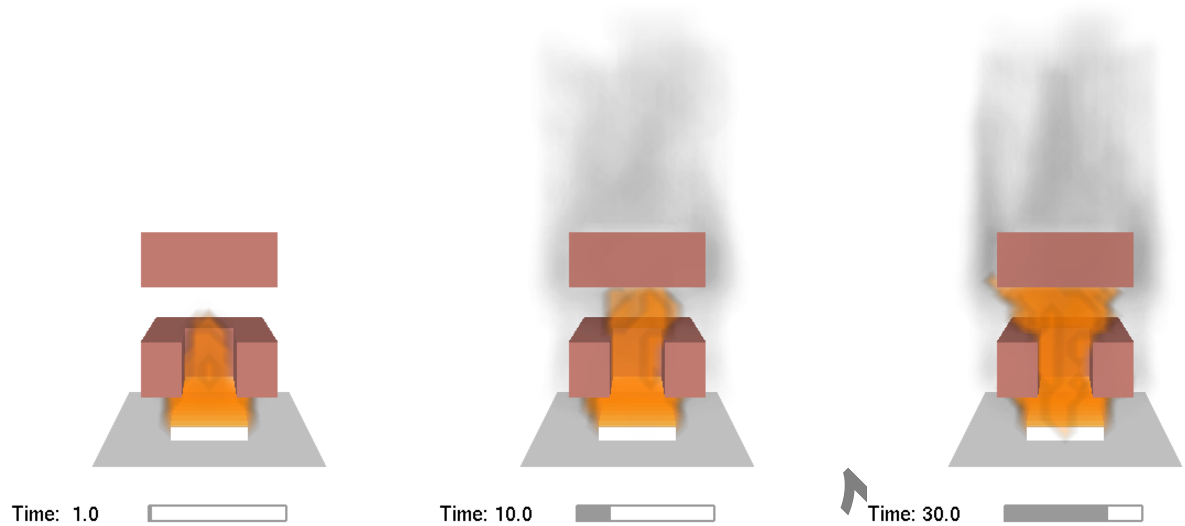
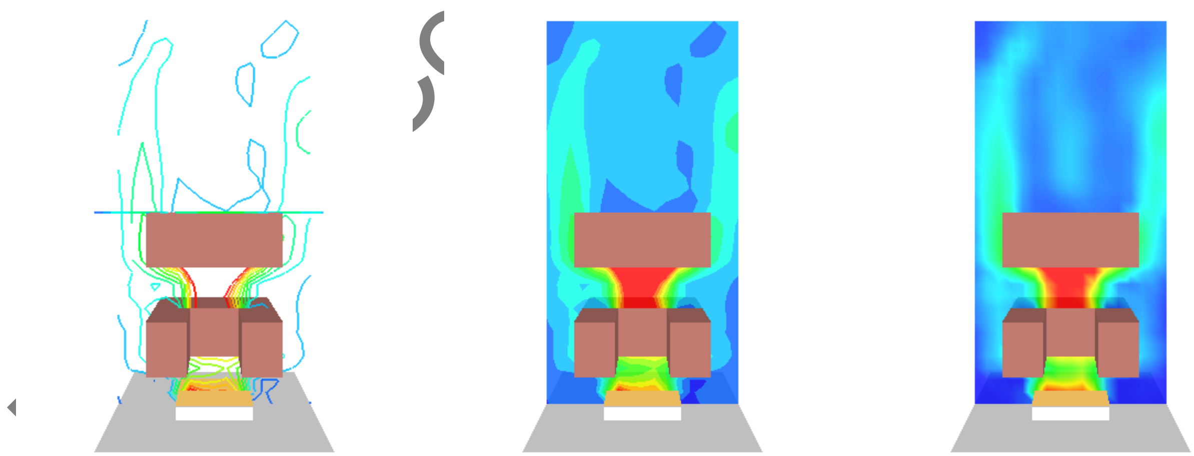


Figure 2.6: Vector slice file test. A portion of the interior gas temperature is initialized to 600.0 °C. The vectors in this region should be red for the $t = 0.0$ images. For the chopped contours, the color near the chop boundary should match the color near 140.0 in the colorbar.



1.0 s 10.0 s 30.0 s

Figure 2.7: 3D smoke file test.



step contours step contours continuous contours

Figure 2.8: PLOT3D file test showing three different types of temperature contours (line, stepped, continuous) .

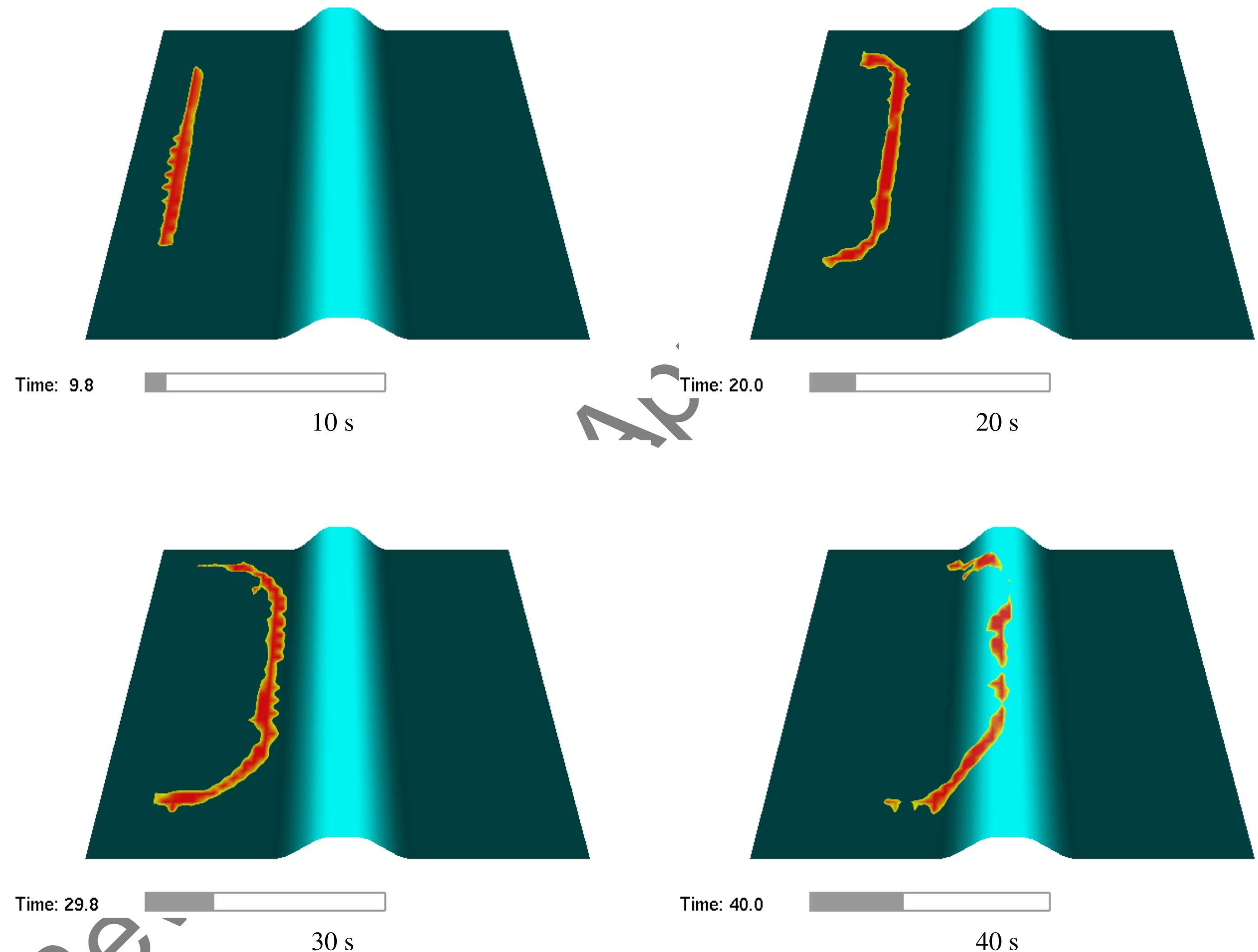


Figure 2.9: Fire line test. The fire line, a region of high temperature, follows the terrain as it progresses from left to right.

Chapter 3

Smoke Visualization Tests

Proper smoke visualization requires that smoke flow be both computed and drawn correctly. The FDS Verification Guide [3] addresses the question of correct computation in terms of soot/smoke production, transport *etc.* In this chapter it is presumed that the FDS component of verification is correct and considers the question "Is the smoke drawn correctly?". More precisely, given a known density and distribution of soot does the 3D smoke drawn by Smokeview match how *theory* suggests it should look. Presently, the main interest is in how smoke obscures objects in the background. Visualization effects due to light scattering are not modeled except to consider the smoke albedo when drawing its color.

The smoke drawing verification problem can be broken down into two steps. The first step is to verify that Smokeview can record or denote the correct grey level of smoke that is drawn. The second step is to verify that Smokeview can draw the correct shade of grey given a known soot density level.

3.1 Recording Smoke Levels

To record smoke grey levels, Smokeview makes use of a special FDS sensor or device. This device behaves like other FDS devices but has the additional property that when used by Smokeview, it displays the grey level as viewed by the observer. This grey level is displayed as a number between 0 and 255. The grey level is simply Smokeview's computation of the integrated *smoke thickness* along a path between the sensor location and the eye. These computations are performed by the video card using OpenGL, the graphics library used by Smokeview to visualize FDS scenarios. The user places a device of type `smoke_sensor` at a particular (x,y,z) location. Smokeview displays the sensor as a white disk with color (255,255,255) always oriented towards the observer. When drawing smoke that resides between the sensor and the observer (your eye) the smoke sensor is partially obscured by the smoke. Smokeview then alters the smoke sensor color according to how much and how thick the intervening smoke is. It does this by blending each smoke plane one plane at a time using the color and opacity levels of that plane.

Figure 3.1 illustrates an initial test of this process. It verifies that Smokeview correctly *knows* where the sensor is located and can correctly record its grey level even when surrounded by other objects of different colors. In this case, the smoke sensor is white and there is no intervening smoke. The background is a neutral grey with grey level of 128. The value displayed over the sensor then should always be 255 no matter how the scene is oriented. The figure shows two extreme orientations of the box containing the sensor.

Figure 3.2 shows two colorbars, both containing shades of grey. One shows white and near-white shades, the other shows black and near black shades. This figure illustrates the difficulty one has in distinguishing nearly equal shades and by inference the difficulty in distinguishing two smoke scenes drawn using nearly *amounts* of smoke. When comparing a computed smoke shade with the actual (as in Figure 3.4) one must keep in mind the eye's inability to distinguish nearly equal shades of grey.

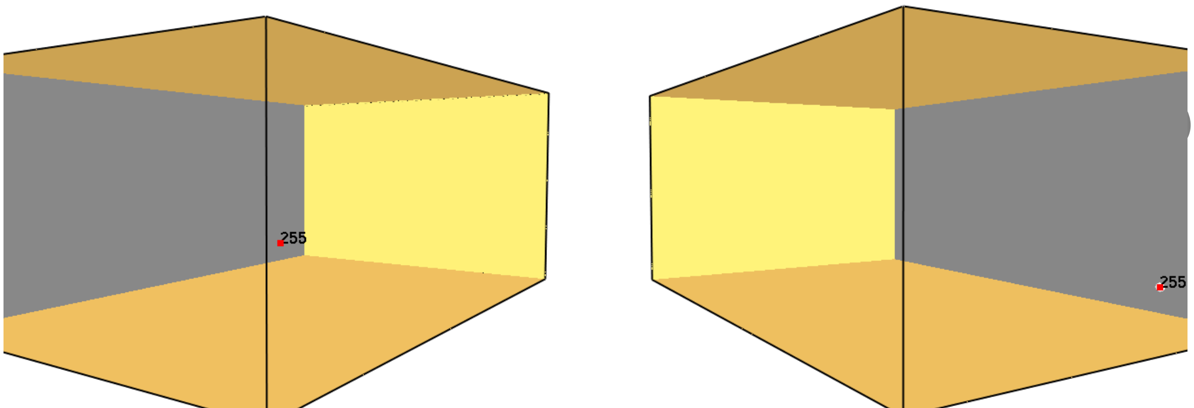


Figure 3.1: Smoke sensor test. A small white (255,255,255) smokesensor appears in front of a grey (128,128,128) obstacle. The red dot indicates where the smoke opacity is recorded.

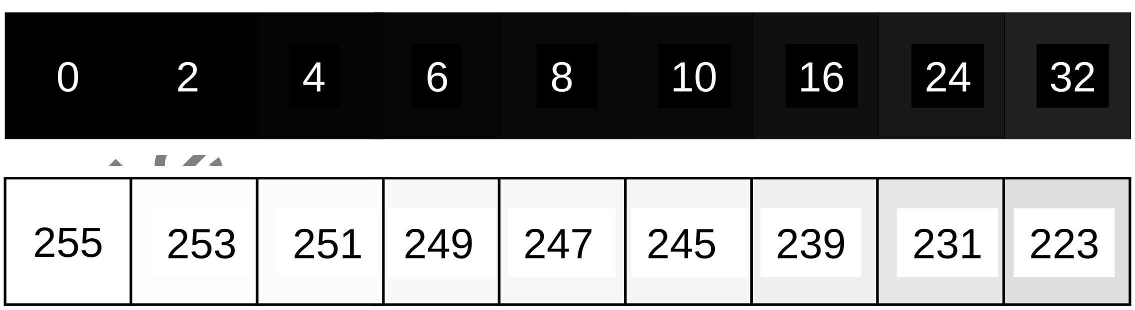


Figure 3.2: Shade of grey resolution test. The number within each square represents the shade of grey used to color that square, 0 for black and 255 for white. Adjacent squares are drawn with nearly equal shades testing the ability of sensors such as the eye, computer monitor or the printed page to distinguish them.

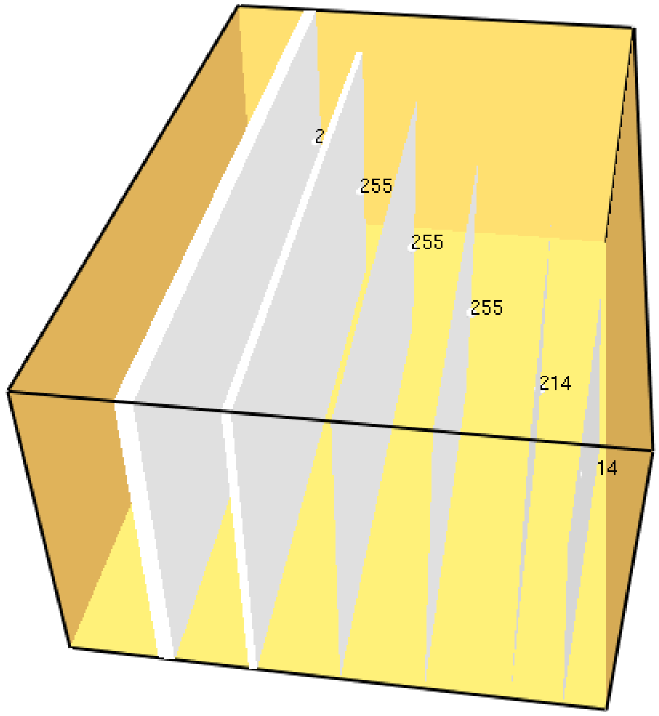


Figure 3.3: Side view of the numerical smoke test compartment. Walls are placed at 0.4 m, 1.0 m, 2.0 m, 3.0 m, 4.0 m and 5.0 m from the front to make the theoretical grey levels work out to 8, 16, 32, 64, 128 and 192 .

3.2 Verifying Smoke Levels

The strategy for verifying smoke levels in Smokeview is to set up an FDS case with constant smoke density throughout the domain. The smoke density and the mass extinction coefficient are chosen in concert to generate a predetermined opacity for a given path length. These predetermined opacities or grey levels are 8, 16, 32, 64, 128 and 192. Beer's law in the form of

$$\alpha = 255 \exp(-KS\Delta x)$$

is used to relate these predetermined opacities to path length where α is a scaled opacity (from 0 to 255 rather than the usual 0.0 to 1.0), K is the mass extinction coefficient, S is the soot density and Δx is the path length. For the verification case it is assumed that S is constant enabling α to be computed simply.

Figure 3.3 shows a side view of the numerical smoke box used to perform this test. In addition to the walls surrounding the box, this box consists of six parallel walls within the box spaced 1.0 m apart. The widths increase from one wall to the next (from front to back) so that when looking at the box from the front a different distance or path length occurs between the observer and the portion of the wall that is visible. Again, the spacing between the walls, the distance between the walls and the observer and the initial soot densities is chosen so that the computed smoke obscurations work out to *nice* values.

Figure 3.4 shows quantitative tests of the smoke opacity calculation performed in Smokeview for two different FDS grid resolutions and three different skip levels.[1] This figure also gives the predicted shades

[1] Smokeview allows one to skip grid planes when visualizing smoke. The smoke opacity is adjusted by Smokeview to account

of grey based upon the inputted soot densities, mass extinction coefficient and path lengths. The smoke visualization algorithm is verified then if the shades of grey in the Smokeview visualizations match the corresponding predicted shades of grey. Each shaded rectangle is accompanied by a numerical value that can also be used to judge whether the visualization is verified.

The numbers displayed in this Figure 3.4 represent the shade of the underlying rectangle. These numbers may be verified by using a program such as Adobe Photoshop to examine the pixel values of this rectangular region. The numbers are verified when they match the pixel values as reported by Photoshop or any other program that can report image values..

When soot densities are constant, smoke grey level or opacity, α may be computed by using

$$\alpha = 255\exp(-KS\Delta x) \tag{3.1}$$

where $K = 8700$ m^2/kg is the mass extinction value, $S = 79.67$ mg/m^3 is the soot density and Δx is the smoke path length. Solving equation (3.1) for Δx gives

$$\Delta x = -\frac{\ln(\alpha/255)}{KS} \tag{3.2}$$

Path lengths (smoke sensor locations) are chosen to obtain grey levels (α) of 192, 128, 64, 32, 16 and 8. These path lengths may be found by substituting these grey levels into equation (3.2) to obtain Δx values of 0.41 m, 1.0 m, 2.0 m, 3.0 m, 4.0 m and 5.0 m respectively. The walls in `smoketest2.fds` are placed at these distances from the front of the simulation domain. Comparing the Smokeview generated smoke levels with theoretical values one finds as expected that better results are achieved when using a more refined grid (0.1 m rather than 0.2 m) and using all planes (no skipping).

for the skips.

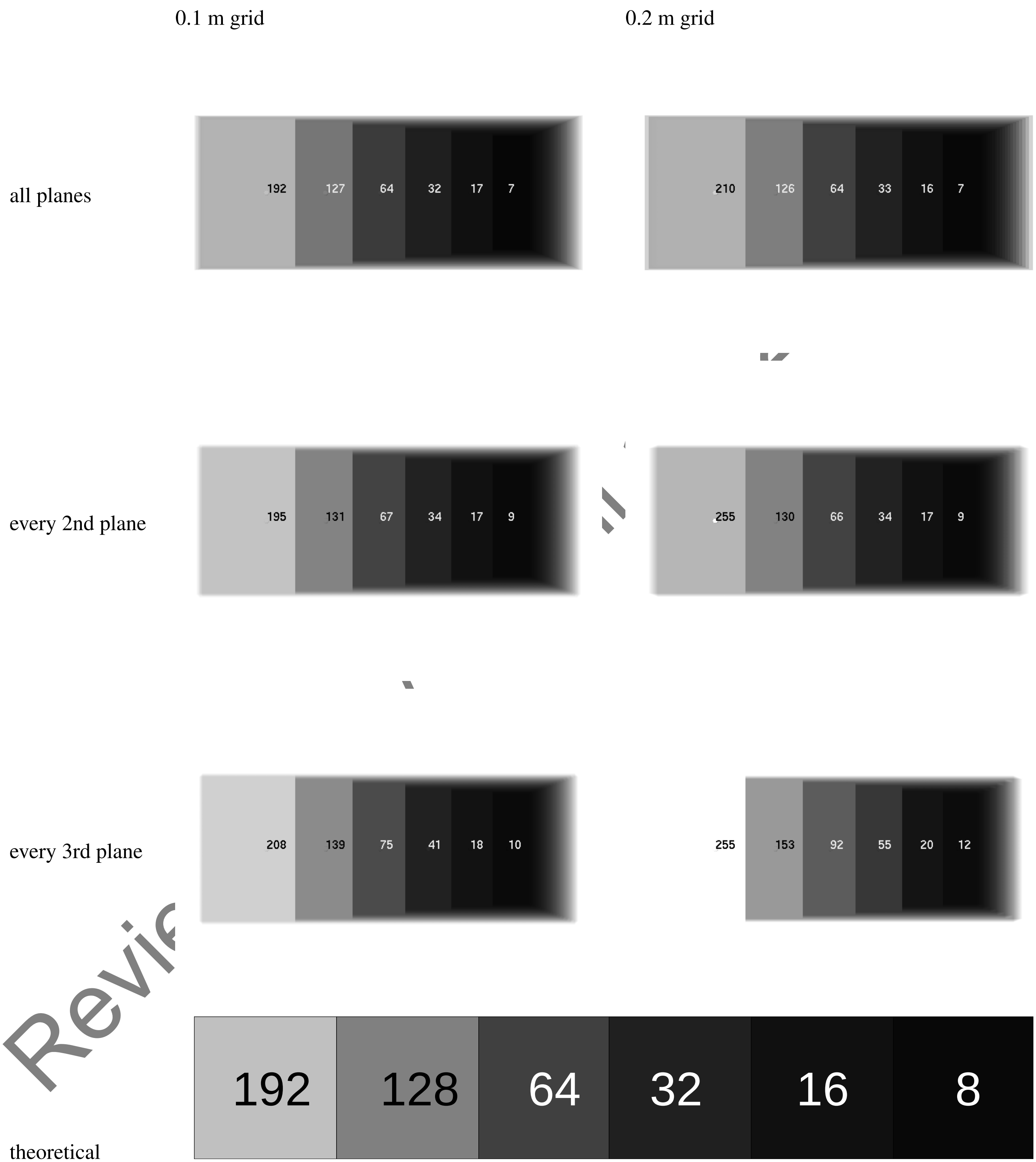


Figure 3.4: 3D smoke file test 2. A quantitative test of the smoke opacity calculation in Smokeview. This test simplifies the general case by assuming a uniform distribution of smoke. The test is repeated for two grid resolutions and three grid spacings. The FDS input file is set up to result in theoretical grey levels of 8, 16, 32, 64, 128 and 192 for the different regions of the test.

Chapter 4

Other Tests

4.1 Obstacles

Figure 4.1 tests obstacle display. This figure shows obstacles drawn three different ways, as solids, as outlines or hidden.

4.2 Vents

Figure 4.2 tests vent display. This figure shows all vents displayed, only vents that are not of type open displayed of hides all vents.

4.3 Conversion to Color

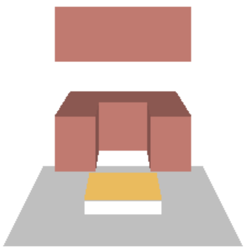
Smokeview converts data values to color using a linear scaling of the form

$$C_i = 255\frac{V_i - V_{min}}{V_{max} - V_{min}}$$

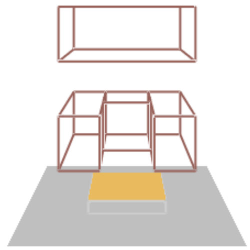
where C_i is an index into a color table between 0 and 255, V_{min} and V_{max} are data bounds and V_i is a data value to be converted. Figure 4.3 presents images verifying the conversion of data to colors. The input file, `colorconv.fds` (see Appendix A.6), for this test was set up so that initially the left half of the domain (it is a 2D case) is 20 °C and the right half is 100 °C. The images for this test were created automatically by running the smokeview script, `colorconv.ssf` (see Appendix B.6).

4.4 GPU Test

Figure 4.4 tests whether Smokeview produces identical images when using the GPU and CPU for drawing 3D smoke. The first column shows CPU generated images at 5, 10 and 30 seconds while the second column shows GPU generated images at the same times. The corresponding images in each column should be identical.



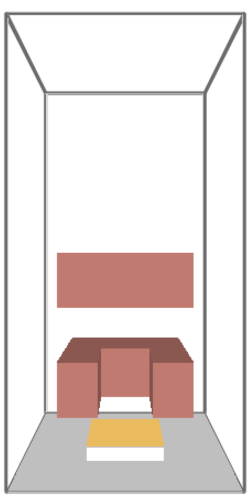
solid view of obstacles



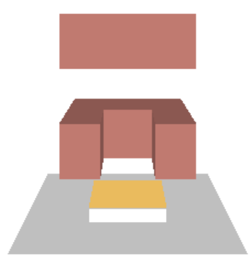
outline view of obstacles

obstacles hidden

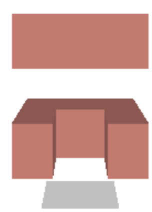
Figure 4.1: Obstacle view test.



show all vents



show only vents that are not open vents



vents hidden

Figure 4.2: Vent view test.

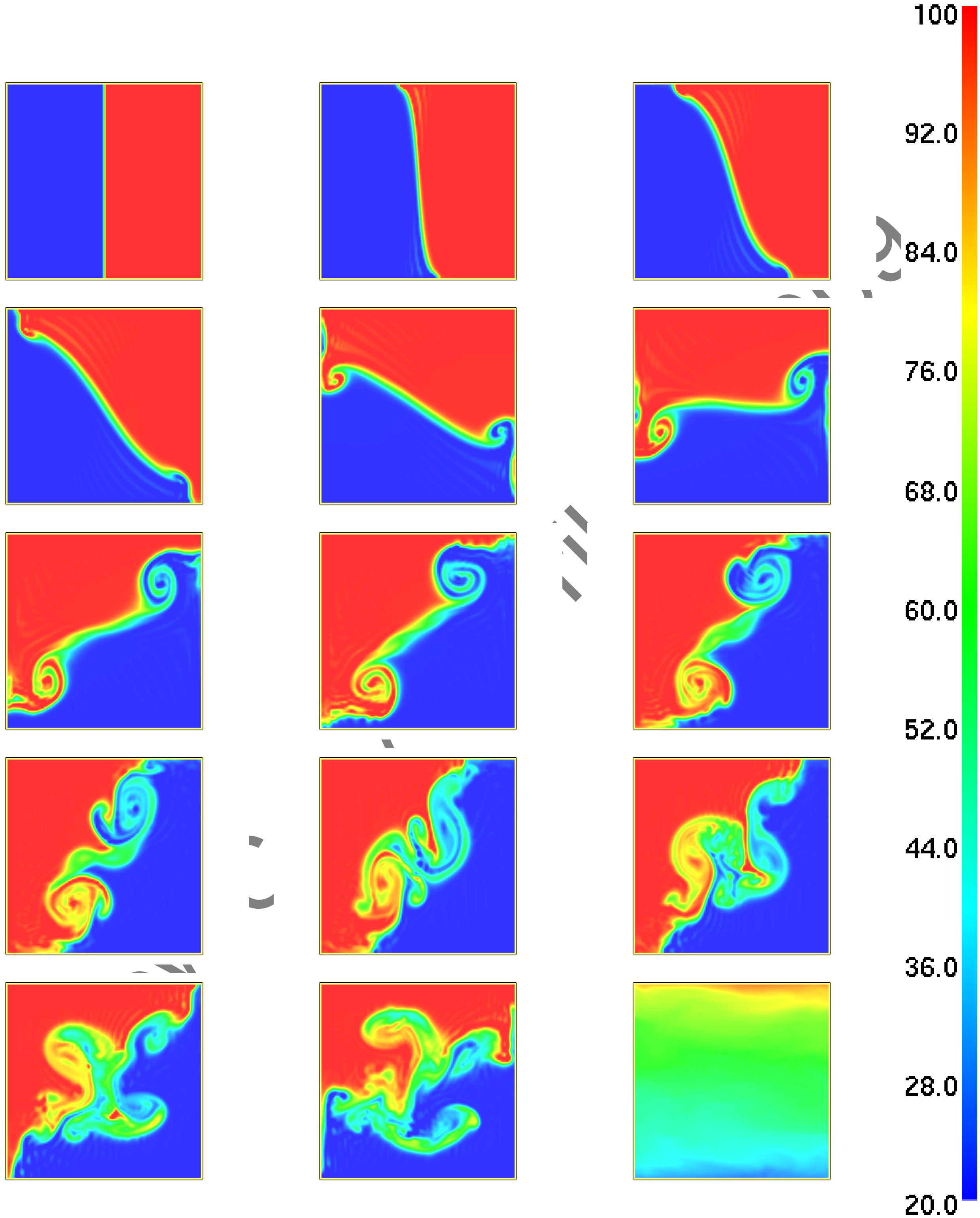
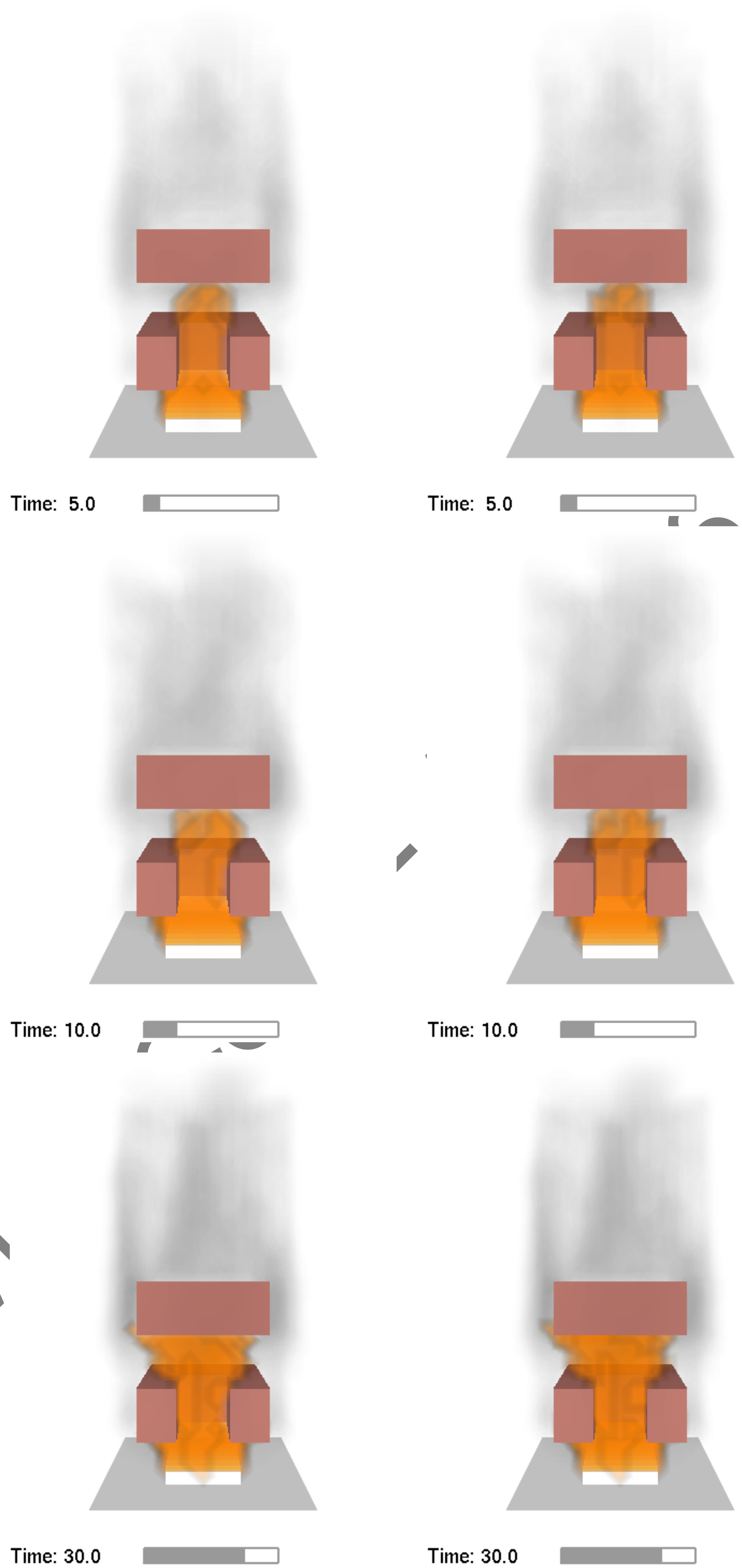


Figure 4.3: Color conversion test. Temperature between 20 °C and 100 °C are converted to colors between blue and red.



CPU generated GPU generated

Figure 4.4: GPU smoke drawing test

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[6] G.P. Forney. Smokeview (Version 5), A Tool for Visualizing Fire Dynamics Simulation Data, Volume II: Technical Reference Guide. NIST Special Publication 1017-1B, National Institute of Standards and Technology, Gaithersburg, Maryland, May 2009.

Appendix A

Input Files

A.1 plume5c

```
&HEAD CHID='plume5c',TITLE='Plume whirl case SVN $Revision: 3625 $' /

  same as plume5a except there is a blockage in the middle of the scene to block the flow
  The purpose of this case is to demonstrate the curved flow (via streak lines) that results.

&MESH IJK=16,16,32, XB=0.0,1.6,0.0,1.6,0.0,3.2 /

&DUMP NFRAMES=400 /

&INIT XB=0.2,1.4,0.2,1.4,0.5,2.2  TEMPERATURE=600.0 /

&TIME TWFIN=40. /  Total simulation time

&MATL ID                    = 'FABRIC'
      FYI                   = 'Properties completely fabricated'
      SPECIFIC_HEAT         = 1.0
      CONDUCTIVITY          = 0.1
      DENSITY               = 100.0
      N_REACTIONS           = 1
      NU_FUEL               = 1.
      REFERENCE_TEMPERATURE = 350.
      HEAT_OF_REACTION      = 3000.
      HEAT_OF_COMBUSTION    = 15000. /

&MATL ID                    = 'FOAM'
      FYI                   = 'Properties completely fabricated'
      SPECIFIC_HEAT         = 1.0
      CONDUCTIVITY          = 0.05
      DENSITY               = 40.0
      N_REACTIONS           = 1
      NU_FUEL               = 1.
      REFERENCE_TEMPERATURE = 350.
      HEAT_OF_REACTION      = 1500.
      HEAT_OF_COMBUSTION    = 30000. /

&SURF ID             = 'UPHOLSTERY_LOWER'
      FYI            = 'Properties completely fabricated'
      RGB            = 151,96,88
      BURN_AWAY      = .FALSE.
      MATL_ID(1:2,1) = 'FABRIC','FOAM'
      THICKNESS(1:2) = 0.002,0.1
/

&SURF ID             = 'UPHOLSTERY_UPPER'
      FYI            = 'Properties completely fabricated'
      RGB            = 151,96,88
```

```
      BURN_AWAY      = .FALSE.
      MATL_ID(1:2,1) = 'FABRIC','FOAM'
      THICKNESS(1:2) = 0.002,0.1
      TMP_INNER      = 600.0
/

&SURF ID='BURNER',HRRPUA=600.0,PART_ID='tracers' /  Ignition source

&VENT XB=0.5,1.1,0.5,1.1,0.1,0.1,SURF_ID='BURNER' /  fire source on kitchen stove

&OBST XB=0.5,1.1,0.5,1.1,0.0,0.1 /
&OBST XB=0.3,1.3,0.3,1.3,0.4,0.8 SURF_ID='UPHOLSTERY_LOWER'/
&HOLE XB=0.6,1.0,0.2,0.8,0.3,0.9 /
&OBST XB=0.3,1.3,0.3,1.3,1.2,1.6 SURF_ID='UPHOLSTERY_UPPER' /

&VENT XB=0.0,1.6,0.0,0.0,0.0,3.2,SURF_ID='OPEN'/
&VENT XB=1.6,1.6,0.0,1.6,0.0,3.2,SURF_ID='OPEN'/
&VENT XB=0.0,1.6,1.6,1.6,0.0,3.2,SURF_ID='OPEN'/
&VENT XB=0.0,0.0,0.0,1.6,0.0,3.2,SURF_ID='OPEN'/
&VENT XB=0.0,1.6,0.0,1.6,3.2,3.2,SURF_ID='OPEN'/

&ISOF QUANTITY='TEMPERATURE',VALUE(1)=100.0 /  Show 3D contours of temperature at 100 C
&ISOF QUANTITY='TEMPERATURE',VALUE(1)=200.0 /  Show 3D contours of temperature at 200 C
&ISOF QUANTITY='TEMPERATURE',VALUE(1)=620.0 /  Show 3D contours of temperature at 620 C
&ISOF QUANTITY='MIXTURE_FRACTION',VALUE(1)=0.07 /  Show 3D contours of mixture fraction at 0.07

&PART ID='tracers',MASSLESS=.TRUE., SAMPLING_FACTOR=10 /  Description of massless tracer particles. Apply at a
                                                             solid surface with the PART_ID='tracers'

&SLCF PBX=0.8,QUANTITY='TEMPERATURE',VECTOR=.TRUE. /  Add vector slices colored by temperature
&SLCF PBY=0.8,QUANTITY='TEMPERATURE',VECTOR=.TRUE. /
&SLCF PBZ=0.4,QUANTITY='TEMPERATURE',VECTOR=.TRUE. /
&SLCF PBZ=1.6,QUANTITY='TEMPERATURE',VECTOR=.TRUE. /
&SLCF PBZ=3.2,QUANTITY='TEMPERATURE',VECTOR=.TRUE. /
&SLCF XB=0.0,1.6,0.0,1.6,0.0,3.2, QUANTITY='TEMPERATURE',VECTOR=.TRUE. / 3D slice

&SLCF PBX=0.8,QUANTITY='TEMPERATURE',CELL_CENTERED=.TRUE. /
&SLCF PBY=0.8,QUANTITY='TEMPERATURE',CELL_CENTERED=.TRUE. /
&SLCF PBZ=0.4,QUANTITY='TEMPERATURE',CELL_CENTERED=.TRUE. /
&SLCF PBZ=1.6,QUANTITY='TEMPERATURE',CELL_CENTERED=.TRUE. /
&SLCF PBZ=3.2,QUANTITY='TEMPERATURE',CELL_CENTERED=.TRUE. /

&BNDF QUANTITY='GAUGE_HEAT_FLUX' /  Common surface quantities. Good for monitoring fire spread.
&BNDF QUANTITY='BURNING_RATE' /
&BNDF QUANTITY='WALL_TEMPERATURE' /
&BNDF QUANTITY='WALL_TEMPERATURE' CELL_CENTERED=.TRUE. /
```

A.2 fire_line

```
&HEAD CHID='fire_line', TITLE='test FIRE_LINE keyword,SVN $Revision: 3625 $' /
&MISC ISOTHERMAL=.FALSE.,RADIATION=.TRUE.,U0=1,TERRAIN_CASE=.TRUE. /
&TIME TWFIN=60. /

1 grid
&MESH IJK=50,50,25, XB=0,50,-25,25,0,25 /

&TIME TWFIN=120. /

&REAC ID='WOOD'
      FYI='Ritchie, et al., 5th IAFSS, C_3.4 H_6.2 O_2.5, dHc = 15MW/kg'
      SOOT_YIELD = 0.02
      O          = 2.5
      C          = 3.4
      H          = 6.2
      HEAT_OF_COMBUSTION = 17700 /
&SPEC ID='WATER VAPOR' /
```

```
- GRASS AU F19
&PART ID='GRASS',TREE=.TRUE.,QUANTITIES='VEG_TEMPERATURE',
      VEG_INITIAL_TEMPERATURE=25.,
      VEG_SV=12240.,VEG_MOISTURE=0.06,VEG_CHAR_FRACTION=0.20,
      VEG_DRAG_COEFFICIENT=0.375,VEG_DENSITY=512.,VEG_BULK_DENSITY=0.626,
      VEG_BURNING_RATE_MAX=0.45,VEG_DEHYDRATION_RATE_MAX=0.45,
      VEG_REMOVE_CHARRED=.TRUE. /
&SPEC ID='WATER VAPOR' /

- Grass Properties
&PART ID='AUF19GRASS',TREE=.TRUE.,QUANTITIES='DROPLET_TEMPERATURE',
      VEG_INITIAL_TEMPERATURE=20.,
      VEG_SV=12240.,VEG_MOISTURE=0.058,VEG_CHAR_FRACTION=0.20,
      VEG_DRAG_COEFFICIENT=0.375,VEG_DENSITY=512.,VEG_BULK_DENSITY=0.626,
      VEG_BURNING_RATE_MAX=0.45,VEG_DEHYDRATION_RATE_MAX=0.45,
      VEG_REMOVE_CHARRED=.TRUE. /

- Ignitor fire
&SURF ID='LINEFIRE',HRRPUA=240,RAMP_Q='RAMPIGN',RGB=255,0,0 /
&RAMP ID='RAMPIGN',T=0,F=0 /
&RAMP ID='RAMPIGN',T=1,F=0 /
&RAMP ID='RAMPIGN',T=2,F=1 /
&RAMP ID='RAMPIGN',T=10,F=1 /
&RAMP ID='RAMPIGN',T=11,F=0 /
&VENT XB=5,6,-15,15,0,0,SURF_ID='LINEFIRE' /

&SURF ID='WIND',VEL=-1 /
&VENT XB =  0,  0, -25,  25,  0, 25, SURF_ID = 'WIND' /
&VENT XB = 50, 50, -25,  25,  0, 25, SURF_ID = 'OPEN' /
&VENT XB =  0, 50, -25, -25,  0, 25, SURF_ID = 'OPEN' /
&VENT XB =  0, 50,  25,  25,  0, 25, SURF_ID = 'OPEN' /
&VENT XB =  0, 50, -25,  25, 25, 25, SURF_ID = 'OPEN' /

- Hill and grass on slope
-- Grass on flat upwind of hill
&TREE XB=5,20,-20,20,0,1,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /

-- upslope
&OBST XB=20,21,-25,25, 0, 1 /
&TREE XB=20,21,-20,20, 1, 2,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /
&OBST XB=21,22,-25,25, 0, 2 /
&TREE XB=21,22,-20,20, 2, 3,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /
&OBST XB=22,23,-25,25, 0, 3 /
&TREE XB=22,23,-20,20, 3, 4,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /
&OBST XB=23,24,-25,25, 0, 4 /
&TREE XB=23,24,-20,20, 4, 5,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /

-- flat top
&OBST XB=24,28,-25,25, 0, 4 /
&TREE XB=24,28,-20,20, 4, 5,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /

-- downslope
&OBST XB=28,29,-25,25, 0, 3 /
&TREE XB=28,29,-20,20, 3, 4,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /
&OBST XB=29,30,-25,25, 0, 2 /
&TREE XB=29,30,-20,20, 3, 3,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /
&OBST XB=30,31,-25,25, 0, 1 /
&TREE XB=30,31,-20,20, 1, 2,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /

-- grass down wind of hill
&TREE XB=31,45,-20,20, 0, 1,PART_ID="AUF19GRASS",FUEL_GEOM="RECTANGLE" /


- Outputs
&DUMP NFRAMES=600 /
&SLCF QUANTITY='TEMPERATURE',VECTOR=.TRUE. AGL_SLICE=1.0/
&SLCF FIRE_LINE=.TRUE./
```

```
&TAIL /
```

A.3 smoke_sensor

```
&HEAD CHID='smoke_sensor', TITLE='Test smokesensor device, SVN $Revision: 2182 $' /

  A small white (255,255,255) smokesensor appears over top a grey (128,128,128) obstacle.
  A red dot indicates where the smoke opacity is recorded and should appear in the middle of the
  sensor.  Another check is that the sensor should display 255 (the color fo the sensor) not
  128 (the color of the background).

&MESH IJK=100,64,40, XB=0.0,10.0,0.0,6.4,0.0,4.0 /

&TIME T_END=1.0 /

 define fuel so that it only contains carbon and yields 100% soot
 so that MASS_FRACTION(2) may be used to define soot density directly

&REAC ID         = 'CARBONSOOT'
      FYI        = 'ficticious fuel, 100% soot'
      SOOT_YIELD = 1.0
      SOOT_H_FRACTION = 0.0
      N          = 0.0
      C          = 1.0
      H          = 0.0
      O          = 0.0
      MASS_EXTINCTION_COEFFICIENT=8700.0
 /

&INIT MASS_FRACTION(2)=0.00007967 DENSITY=1.0/

&OBST XB=0.0,10.0,6.3,6.4,0.0,4.0 RGB=128,128,128/
&PROP ID='smoketest' SMOKEVIEW_ID='smokesensor' /
&DEVC XYZ=8.5,6.0,0.50, ID='vis1' QUANTITY='TEMPERATURE' PROP_ID='smoketest' /

&TAIL /
```

A.4 smoke_test

```
&HEAD CHID='smoke_test', TITLE='Verify Smokeview Smoke3D Feature, SVN $Revision: 2182 $' /

  A quantitative test of the smoke opacity calculation in Smokeview.  This test simplifies
  the general case by assuming a uniform distribution of smoke.  Smoke grey levels are computed
  using

     grey level (GL) = 255*exp(-K*S*DX)

  where K=8700 m2/kg is the mass extinction value, S=79.67 mg/m3 is the soot sensity
  and DX is the path length through the smoke.  This equation is inverted to obtain

    DX = -LN(GL/255)/(K*S)

  and is used to place smoke sensors at particular distances so that the predicted
  grey levels are 192, 128, 64, 32, 16 and 8 .

&MESH IJK=100,64,40, XB=0.0,10.0,0.0,6.4,0.0,4.0 /

&TIME T_END=1.0 /

 specify soot density using MASS_FRACTION(2)
```

```
 define fuel so that it only contains carbon and yields 100% soot
 so that MASS_FRACTION(2) may be used directly to define soot density

&REAC ID         = 'CARBONSOOT'
      FYI        = 'ficticious fuel, 100% soot'
      SOOT_YIELD = 1.0
      SOOT_H_FRACTION = 0.0
      N          = 0.0
      C          = 1.0
      H          = 0.0
      O          = 0.0
      MASS_EXTINCTION_COEFFICIENT=8700.0
 /

&INIT MASS_FRACTION(2)=0.00007967 DENSITY=1.0/

&OBST XB=0.0,2.5, 0.45,0.5,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,4.0, 1.05,1.1,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,5.5, 2.05,2.1,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,7.0, 3.05,3.1,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,8.5, 4.05,4.2,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,10.0,5.05,5.3,0.0,4.0, RGB=255,255,255 /

&PROP ID='smoketest' SMOKEVIEW_ID='smokesensor' /
&DEVC XYZ=1.75,0.45,2.00, QUANTITY='visibility', ID='vis1' PROP_ID='smoketest' /
&DEVC XYZ=3.25,1.05,2.00, QUANTITY='visibility', ID='vis2' PROP_ID='smoketest' /
&DEVC XYZ=4.75,2.05,2.00, QUANTITY='visibility', ID='vis3' PROP_ID='smoketest' /
&DEVC XYZ=6.25,3.05,2.00, QUANTITY='visibility', ID='vis4' PROP_ID='smoketest' /
&DEVC XYZ=7.75,4.05,2.00, QUANTITY='visibility', ID='vis5' PROP_ID='smoketest' /
&DEVC XYZ=9.25,5.05,2.00, QUANTITY='visibility', ID='vis6' PROP_ID='smoketest' /

&SLCF PBX=5.0, QUANTITY='soot density' /
&SLCF PBY=5.0, QUANTITY='soot density' /
&SLCF PBZ=2.0, QUANTITY='soot density' /

&TAIL /
```


A.5 smoke_test2

```
&HEAD CHID='smoke_test2', TITLE='Verify Smokeview Smoke3D Feature, SVN $Revision: 2155 $' /

&MESH IJK=40,40,40, XB=0.0,10.0,0.0,10.0,0.0,4.0 /

&TIME T_END=1.0 /

 specify soot density using MASS_FRACTION(2)


 define fuel so that it only contains carbon and yields 100% soot
 so that MASS_FRACTION(2) may be used to define soot density directly

&REAC ID         = 'CARBONSOOT'
      FYI        = 'ficticious fuel, 100% soot'
      SOOT_YIELD = 1.0
      SOOT_H_FRACTION = 0.0
      N          = 0.0
      C          = 1.0
      H          = 0.0
      O          = 0.0
      MASS_EXTINCTION_COEFFICIENT=8700.0
 /

&INIT MASS_FRACTION(2)=0.00007967 DENSITY=1.0/
```

```
&OBST XB=0.0,2.5, 0.4,0.5,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,4.0, 1.0,1.1,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,5.5, 2.0,2.1,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,7.0, 3.0,3.1,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,8.5, 4.1,4.2,0.0,4.0, RGB=255,255,255 /
&OBST XB=0.0,10.0,5.2,5.3,0.0,4.0, RGB=255,255,255 /

&SLCF PBX=5.0, QUANTITY='soot density' /
&SLCF PBY=5.0, QUANTITY='soot density' /
&SLCF PBZ=2.0, QUANTITY='soot density' /

&PROP ID='smoketest' SMOKEVIEW_ID='smokesensor' /
&DEVC XYZ=1.75,0.30,2.00, QUANTITY='visibility', ID='vis2' PROP_ID='smoketest' /
&DEVC XYZ=3.25,0.90,2.00, QUANTITY='visibility', ID='vis3' PROP_ID='smoketest' /
&DEVC XYZ=4.75,1.90,2.00, QUANTITY='visibility', ID='vis4' PROP_ID='smoketest' /
&DEVC XYZ=6.25,2.90,2.00, QUANTITY='visibility', ID='vis5' PROP_ID='smoketest' /
&DEVC XYZ=7.75,4.00,2.00, QUANTITY='visibility', ID='vis6' PROP_ID='smoketest' /
&DEVC XYZ=9.25,5.10,2.00, QUANTITY='visibility', ID='vis7' PROP_ID='smoketest' /


&TAIL /
```

A.6 colorconv

A simple two-dimensional case testing data to color conversion

```
&HEAD CHID='colorconv', TITLE='Test data to color conversion, SVN $Revision: 2243 $' /
&DUMP NFRAMES=4000 /

&MESH IJK=100,1,100, XB=0.0,100.0,-1.0,1.0,0.0,100.0 /
&SURF ID='COOLWALL' TMP_FRONT=20.0 /
&SURF ID='HOTWALL' TMP_FRONT=100.0 /
&SURF ID='INSWALL' ADIABATIC=.TRUE. /

&TIME T_END=1000.0 /

&MISC RADIATION=.FALSE. /
&INIT XB= 0.0, 50.0,-2.0,2.0,0.0,100.0, TEMPERATURE=20. /
&INIT XB=50.0,100.0,-2.0,2.0,0.0,100.0, TEMPERATURE=100. /

&OBST XB= 0.0, 100.0, -2.0,2.0,0.0,1.0, SURF_ID='COOLWALL' /
&OBST XB= 0.0, 100.0, -2.0,2.0,99.0,100.0, SURF_ID='HOTWALL' /
&OBST XB= 0.0, 1.0, -2.0, 2.0, 1.0, 99.0 SURF_ID='INSWALL' /
&OBST XB= 99.0, 100.0, -2.0, 2.0, 1.0, 99.0 SURF_ID='INSWALL' /

&SLCF PBY=0.0, QUANTITY='TEMPERATURE' /

&TAIL /
```

Appendix B

Smokeview Scripts

B.1 plume5c

```
// put rendered files in specified directory

RENDERDIR
 ..\..\Manuals\SMV_5_Verification_Guide\scriptfigures

// render slice files

UNLOADALL
LOADINIFILE
 plume5c_slice.ini
LOADFILE
 plume5c_05.sf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_slice_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_slice_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_slice_30

// render cell centered slice files

UNLOADALL
LOADINIFILE
 plume5c_slice_cell.ini
LOADFILE
 plume5c_26.sf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_slice_cell_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_slice_cell_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_slice_cell_30

// render slice files with data chopping
```

```
UNLOADALL
LOADINIFILE
 plume5c_slicechop.ini
LOADFILE
 plume5c_05.sf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_slice_chop_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_slice_chop_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_slice_chop_30

// render vector slice files

UNLOADALL
LOADINIFILE
 plume5c_vslice.ini
LOADVFILE
 plume5c_05.sf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_vslice_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_vslice_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_vslice_30

// render vector slice files with chopping

UNLOADALL
LOADINIFILE
 plume5c_vslicechop.ini
LOADVFILE
 plume5c_05.sf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_vslicechop_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_vslicechop_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_vslicechop_30

// render iso files (solid)

UNLOADALL
UNLOADALL
LOADINIFILE
 plume5c_iso.ini
LOADFILE
 plume5c_01.iso
SETTIMEVAL
```

```
 0.0
RENDERONCE
 plume5c_iso_solid_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_iso_solid_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_iso_solid_30

// render iso files (solid with normals)

LOADINIFILE
 plume5c_iso_normal.ini
LOADFILE
 plume5c_01.iso
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_iso_solid_normal_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_iso_solid_normal_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_iso_solid_normal_30

// render iso files (outline)

LOADINIFILE
 plume5c_iso_outline.ini
UNLOADALL
LOADFILE
 plume5c_01.iso
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_iso_outline_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_iso_outline_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_iso_outline_30

// render iso files (points)

LOADINIFILE
 plume5c_iso_points.ini
UNLOADALL
LOADFILE
 plume5c_01.iso
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_iso_points_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_iso_points_10
SETTIMEVAL
 30.05
```

```
RENDERONCE
 plume5c_iso_points_30

// render particle files using points

LOADINIFILE
 plume5c_part.ini
UNLOADALL
LOADFILE
 plume5c.prt5
PARTCLASSCOLOR
 Uniform color
SETTIMEVAL
 1.05
RENDERONCE
 plume5c_part_01
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_part_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_part_30

// render particle files using streaks

UNLOADALL
LOADINIFILE
 plume5c_part_streak.ini
LOADFILE
 plume5c.prt5
PARTCLASSCOLOR
 Uniform color
SETTIMEVAL
 1.05
RENDERONCE
 plume5c_part_streak_01
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_part_streak_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_part_streak_30

// render particles using streaks (different length)

UNLOADALL
LOADINIFILE
 plume5c_part_streak2.ini
LOADFILE
 plume5c.prt5
PARTCLASSCOLOR
 Uniform color
SETTIMEVAL
 1.05
RENDERONCE
 plume5c_part_streak2_01
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_part_streak2_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_part_streak2_30
```

```
// render boundary files

UNLOADALL
LOADINIFILE
 plume5c_bound.ini
LOADFILE
 plume5c_03.bf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_bound_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_bound_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_bound_30

// render cell centered boundary files

UNLOADALL
LOADINIFILE
 plume5c_bound.ini
LOADFILE
 plume5c_04.bf
SETTIMEVAL
 0.0
RENDERONCE
 plume5c_bound_cell_00
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_bound_cell_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_bound_cell_30

// render 3D smoke files

UNLOADALL
LOADFILE
 plume5c_01.s3d
LOADFILE
 plume5c_02.s3d
SETTIMEVAL
 1.05
RENDERONCE
 plume5c_smoke_01
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_smoke_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_smoke_30

// render PLOT3D stepped contours

UNLOADALL
LOADINIFILE
 plume5c_plot3d_step.ini
LOADPLOT3D
 1 40.0
```

```
RENDERONCE
 plume5c_plot3d_step

// render PLOT3D line contours

UNLOADALL
LOADINIFILE
 plume5c_plot3d_line.ini
LOADPLOT3D
 1 40.0
RENDERONCE
 plume5c_plot3d_line

// render PLOT3D continuous contours

UNLOADALL
LOADINIFILE
 plume5c_plot3d_shaded.ini
LOADPLOT3D
 1 40.0
RENDERONCE
 plume5c_plot3d_shaded


// render OBSTs using solid view

UNLOADALL
LOADINIFILE
 plume5c_solid.ini
RENDERONCE
 plume5c_solid

// render OBSTs using outline view

LOADINIFILE
 plume5c_outline.ini
RENDERONCE
 plume5c_outline

// render geometry using hidden view (ie don't draw OBSTs)

LOADINIFILE
 plume5c_hidden.ini
RENDERONCE
 plume5c_hidden

// render PLOT3D stepped contours

UNLOADALL
LOADINIFILE
 thouse5_plot3d.ini
LOADFILE
 thouse5_0001_00000061_00.q
SETVIEWPOINT
 view 2
RENDERONCE
 thouse5_plot3d_step


// render vents - don't show open vents

LOADINIFILE
 plume5c_noopenvents.ini
SETVIEWPOINT
 external
RENDERONCE
 plume5c_noopen
```

```
// render vents - don't show any vents

LOADINIFILE
 plume5c_novents.ini
SETVIEWPOINT
 external
RENDERONCE
 plume5c_novents

// render vents - show all vents

LOADINIFILE
 plume5c_allvents.ini
SETVIEWPOINT
 external
RENDERONCE
 plume5c_allvents

// render 3D smoke GPU off

UNLOADALL
LOADINIFILE
 plume5c_nongpu.ini
LOADFILE
 plume5c_01.s3d
LOADFILE
 plume5c_02.s3d
SETTIMEVAL
 5.05
RENDERONCE
 plume5c_smoke_nongpu_05
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_smoke_nongpu_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_smoke_nongpu_30

// render 3D smoke GPU on

UNLOADALL
LOADINIFILE
 plume5c_gpu.ini
LOADFILE
 plume5c_01.s3d
LOADFILE
 plume5c_02.s3d
SETTIMEVAL
 5.05
RENDERONCE
 plume5c_smoke_gpu_05
SETTIMEVAL
 10.05
RENDERONCE
 plume5c_smoke_gpu_10
SETTIMEVAL
 30.05
RENDERONCE
 plume5c_smoke_gpu_30
```

B.2 fire_line

```
RENDERDIR
 ..\..\Manuals\SMV_5_Verification_Guide\scriptfigures
SETVIEWPOINT
 view 1
LOADFILE
 fire_line_05.sf
SETTIMEVAL
 10.05
RENDERONCE
 fire_line_fireline_10
SETTIMEVAL
 20.05
RENDERONCE
 fire_line_fireline_20
SETTIMEVAL
 30.05
RENDERONCE
 fire_line_fireline_30
SETTIMEVAL
 40.05
RENDERONCE
 fire_line_fireline_40
```

B.3 smoke_sensor

```
RENDERDIR
 ..\..\Manuals\SMV_5_Verification_Guide\scriptfigures
SETVIEWPOINT
 external
RENDERONCE
 smoke_sensor_c
SETVIEWPOINT
 view 1
RENDERONCE
 smoke_sensor_l
SETVIEWPOINT
 view 2
RENDERONCE
 smoke_sensor_r
```

B.4 smoke_test

```
RENDERDIR
 ..\..\Manuals\SMV_5_Verification_Guide\scriptfigures
UNLOADALL
LOADFILE
 smoke_test_01.s3d
SETTIMEVAL
 0.159000
LOADINIFILE
 smoke_test_all.ini
RENDERONCE
 smoke_test_all
LOADINIFILE
 smoke_test_every2.ini
RENDERONCE
 smoke_test_every2
LOADINIFILE
 smoke_test_every3.ini
RENDERONCE
 smoke_test_every3
```

```
UNLOADALL
LOADINIFILE
 smoke_test.ini
SETVIEWPOINT
 view 1
RENDERONCE
 smoke_test_side
```

B.5 smoke_test2

```
RENDERDIR
 ..\..\Manuals\SMV_5_Verification_Guide\scriptfigures
UNLOADALL
LOADFILE
 smoke_test2_01.s3d
SETTIMEVAL
 0.159000
LOADINIFILE
 smoke_test2_all.ini
RENDERONCE
 smoke_test2_all
LOADINIFILE
 smoke_test2_every2.ini
RENDERONCE
 smoke_test2_every2
LOADINIFILE
 smoke_test2_every3.ini
RENDERONCE
 smoke_test2_every3
```

B.6 colorconv

```
RENDERDIR
 ..\..\Manuals\SMV_5_Verification_Guide\scriptfigures
LOADINIFILE
 colorconv_slice.ini
LOADFILE
 colorconv_01.sf
SETTIMEVAL
 0.000000
RENDERONCE
 colorconv_slice_00000
SETTIMEVAL
 2.557976
RENDERONCE
 colorconv_slice_00025
SETTIMEVAL
 5.039277
RENDERONCE
 colorconv_slice_00050
SETTIMEVAL
 7.506437
RENDERONCE
 colorconv_slice_00075
SETTIMEVAL
 10.023949
RENDERONCE
 colorconv_slice_00100
SETTIMEVAL
 12.538355
RENDERONCE
 colorconv_slice_00125
SETTIMEVAL
```

```
 15.063926
RENDERONCE
 colorconv_slice_00150
SETTIMEVAL
 17.526268
RENDERONCE
 colorconv_slice_00175
SETTIMEVAL
 20.040606
RENDERONCE
 colorconv_slice_00200
SETTIMEVAL
 22.521618
RENDERONCE
 colorconv_slice_00225
SETTIMEVAL
 25.042652
RENDERONCE
 colorconv_slice_00250
SETTIMEVAL
 27.545835
RENDERONCE
 colorconv_slice_00275
SETTIMEVAL
 30.060387
RENDERONCE
 colorconv_slice_00300
SETTIMEVAL
 32.531887
RENDERONCE
 colorconv_slice_00325
SETTIMEVAL
 35.000896
RENDERONCE
 colorconv_slice_00350
SETTIMEVAL
 1000.157959
RENDERONCE
 colorconv_slice_10000
UNLOADALL
```