ASSIGNMENT 5

SUBJECT CODE: CS 6630
SUBJECT: SCIENTIFIC VISUALIZATION

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PART A

Test Vector Volumes

FILES USED

CODE FILE: TestVecs.tcl
DATA FILES PROVIDED:TestMag0.tcl, TestMag1.tcl, TestMag2.tcl, TestVec0.tcl, TestVec1.tcl,TestVec2.tcl
VTK PIPELINE:

OUTLINEFILTER-->POLYDATAMAPPER-->ACTOR

LINESOURCE-->POLYDATAMAPPER-->ACTOR

TestVec0.vtk-->STRUCTUREDPOINTSREADER-->OUTPUT1

SPHERESOURCE-->OUTPUT2

OUTPUT1+OUTPUT2-->STREAMLINE-->OUTPUT3

OUTPUT3-->TUBEFILTER-->POLYDATAMAPPER-->ACTOR

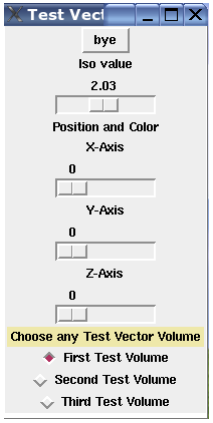
OUTPUT1+OUTPUT3-->PROBEFILTER-->OUTPUT4

CONESOURCE-->TRANSFORM-->TRANSFORMPOLYDATAMAPPER-->OUTPUT5

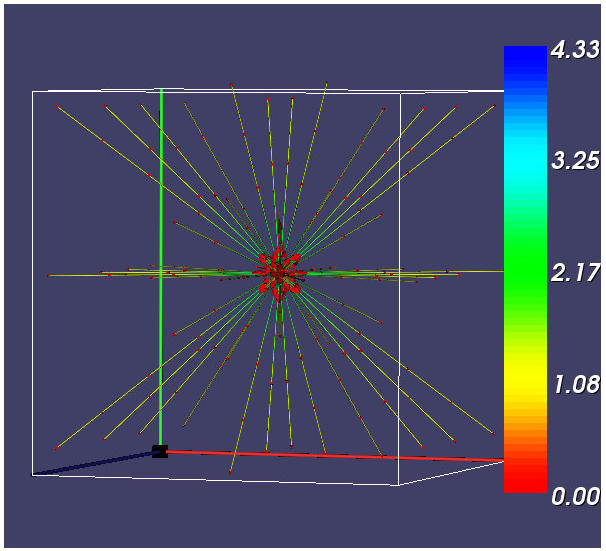
OUTPUT5+OUTPUT4-->GLYPH3D-->POLYDATAMAPPER-->ACTOR

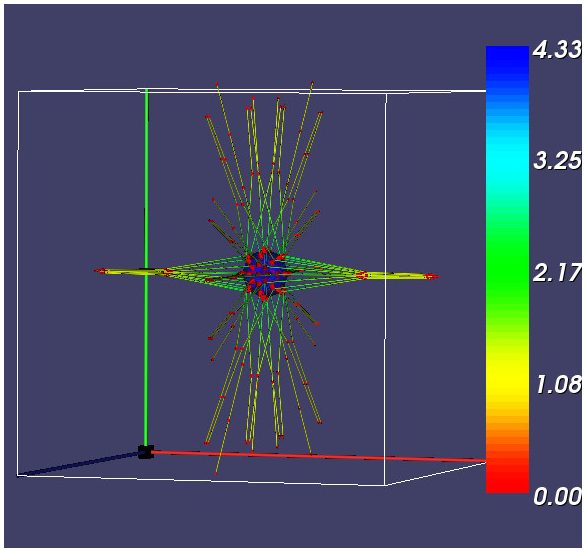
We are given three vector magnitude data to isosurface using VTKCONTOURFILTER to produce vector fields. First i used OUTLINEFILTER to get the outline for the given data set to visualize better.
We were given critical points for the test vector volumes. So I visualized vector field near critical points using VTKGLYPH3D using cones as the source. It gives us the nature of the critical points in the field. Then I used VTKSTREAMLINE filter to create stream line to know and visualize the vector data as whole. I then used VTKTUBEFILTER to wrap tubes around the streamlines. I colormapped the streamlines with HSV color table.

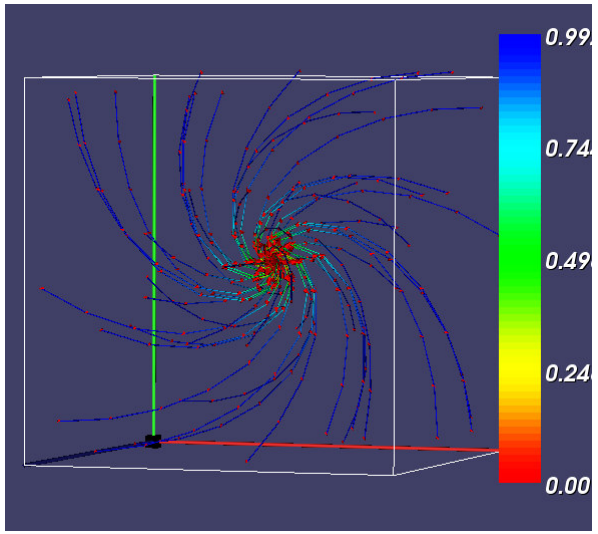
I have also provided gui to switch between three test volumes.

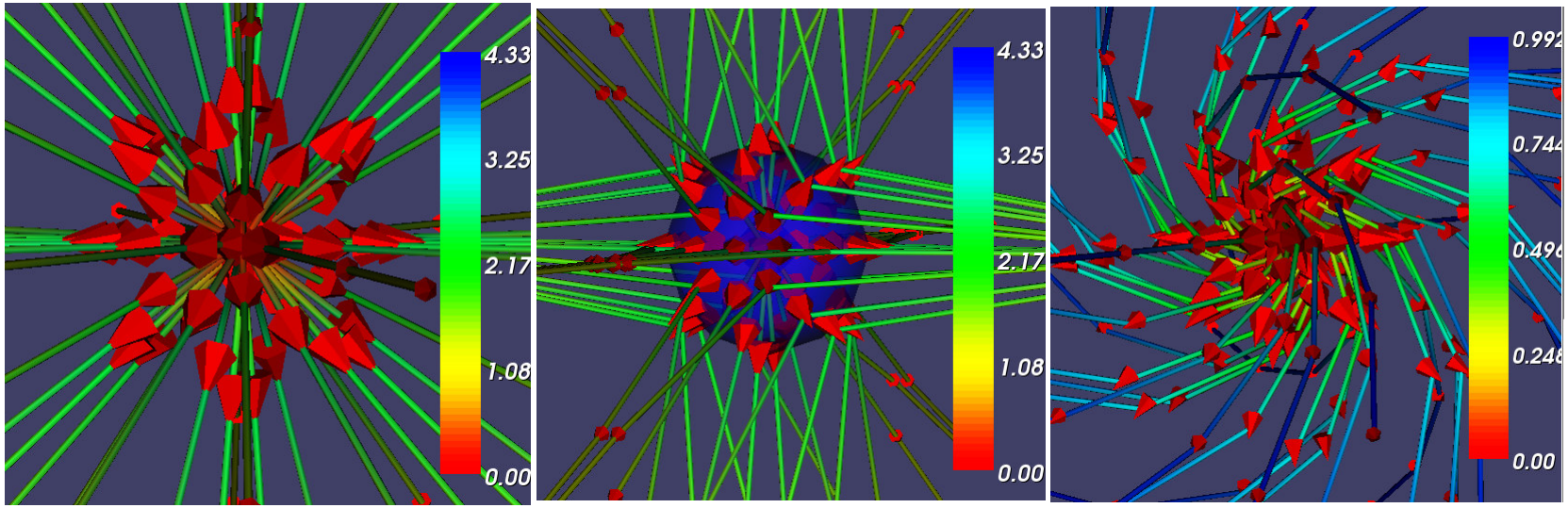


Following are the snapshots of the three test vector volumes. The critical point in the first vector field is a repelling node. The critical point in the second vector field is a saddle point. The critical point in the third vector field is an attracting focus.









PART B

Challenge Vector Volumes

FILES USED

CODE FILE: Chal_Vec0.tcl,Chal_Vec1.tcl
DATA FILES PROVIDED: ChalMag0.tcl, ChalMag1.tcl, ChalVec0.tcl, ChalVec1.tcl
VTK PIPELINE:

OUTLINEFILTER-->POLYDATAMAPPER-->ACTOR

LINESOURCE-->POLYDATAMAPPER-->ACTOR

ChalVec0.vtk-->STRUCTUREDPOINTSREADER-->OUTPUT1

SPHERESOURCE-->OUTPUT2

OUTPUT1+OUTPUT2-->STREAMLINE-->OUTPUT3

OUTPUT3-->RULEDSURFACEFILTER-->POLYDATAMAPPER-->ACTOR

OUTPUT1+OUTPUT3-->PROBEFILTER-->OUTPUT4

CONESOURCE-->TRANSFORM-->TRANSFORMPOLYDATAMAPPER-->OUTPUT5

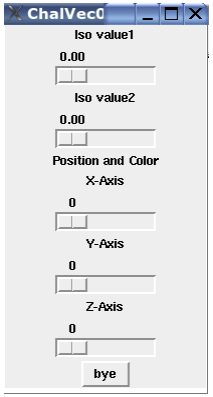
OUTPUT5+OUTPUT4-->GLYPH3D-->POLYDATAMAPPER-->ACTOR

We are given two challenge vector magnitude data to isosurface using VTKCONTOURFILTER to find critical points. I created a cube and three axes using VTKLINESOURCE to find the location of the critical points. I used two slider bars which control the iso value for the VTKCONTOURFILTER to locate them. For one slider i used the large range and for second slider i used a

range from 0.0 to 1.0 using resolution 0.01. I got four critical points (17,25,14) at isovalue 4, (25,15,19) at 4, (39,26,31) at 0.26, (16,17,25) at 0.68 for first Challenge volume. Then I got five critical points (20,30,20) at isovalue 2, (35,15,20) at 0.29, (55,15,20) at 0.29, (65,45,20) at 0.29, (45,45,20) at 0.29 for second Challenge volume. Then i used OUTLINEFILTER to get the outline for the given data set to visualize better. I visualized vector field near critical points using VTKGLYPH3D using cones as the source. It gives us the nature of the critical points in the field. Then I used VTKSTREAMLINE filter to create stream line to know and visualize the vector data as whole. I then used VTKRULEDSURFACEFILTER to create stream ribbon around the streamlines. I colormapped the streamlines with HSV color table.

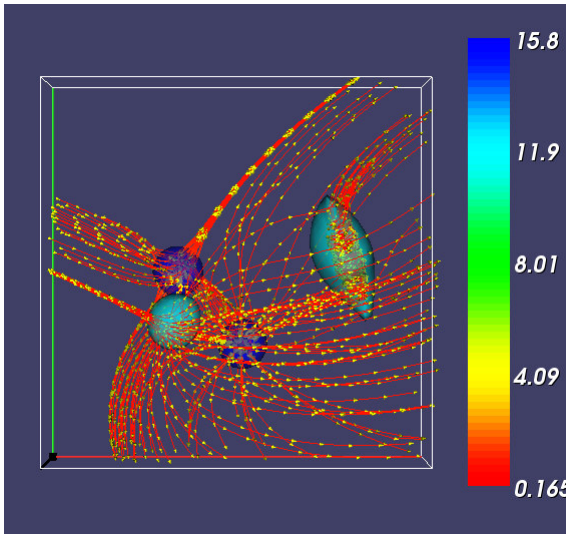
SL NO	DATASET TYPE	NO OF CRITICAL POINTS	LOCATION OF CRITICAL POINTS	TYPE OF NODE	MAGNITUDE
1	ChalVec0	4	17, 25, 14	Saddle	Low
			25, 15, 19	Repelling Focus	High
			39, 26, 31	Center	High
			16, 17, 25	Saddle	Low
2	ChalVec1	5	20, 30, 20	Repelling Focus	High
			35, 15, 20	Center	Low
			55, 15, 20	Center	Low
			65, 45, 20	Center	Low
			45, 45, 20	Center	Low

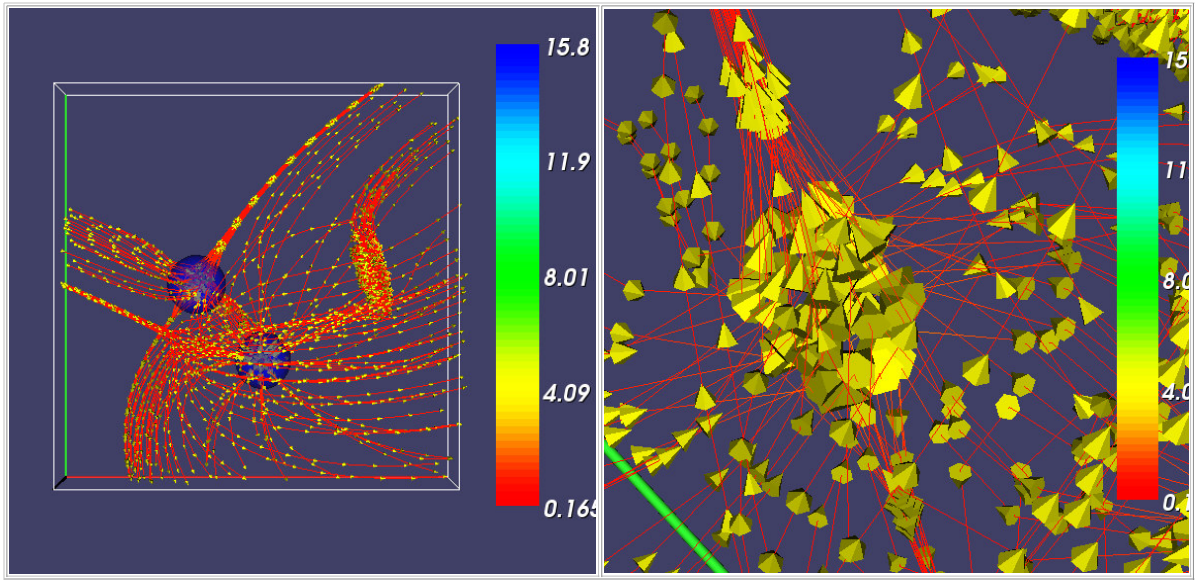
I put two slider bars for iso values so that we can see isosurfaces at more than two critical points and three sliders to position a cube in the place. The snapshot of the gui is as follows. I have added glyphs, streamlines and isosurfaces to visualize the vector field better.

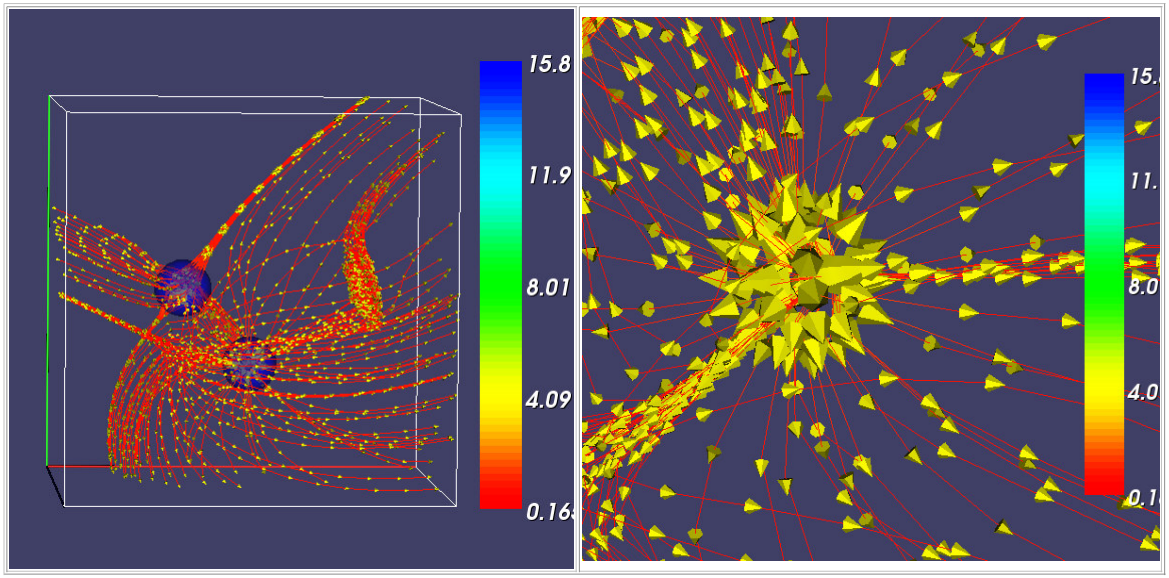


Challenge Vector Volume I (ChalVec0)

Following are the snapshots of the visualization of the vector volume ChalVec0.vtk. The first snapshot shows all the points with glyphs, streamlines and isosurfaces. Second row shows the visualization of critical point (17,25,14) at isovalue 4. In the left image(with left blue colored isosurfaced critical point), direction and alignment of glyphs and the streamlines clearly show that point at (17,25,14) is a saddle point. The right image shows that citical point in the whole visualization of the field. It is indicated by isosurfacing at the critical point. Third row shows the visualization of critical point (25,15,19) at isovalue 4 . In the left image(with blue colored isosurface at the center), repelling of streamlines and alignment of the glyphs clearly show that point at (25,15,19) is a repelling node. The right image shows that citical point in the whole visualization of the field which is indicated by isosurfacing at the critical point.

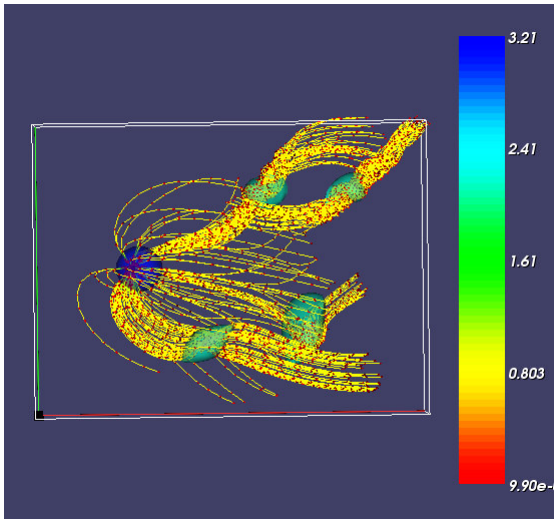


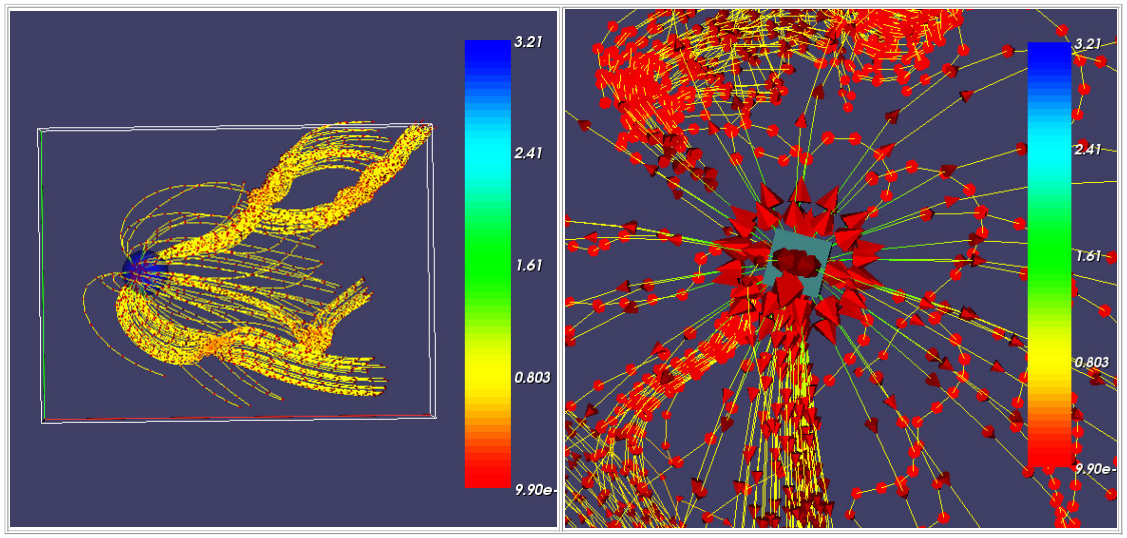


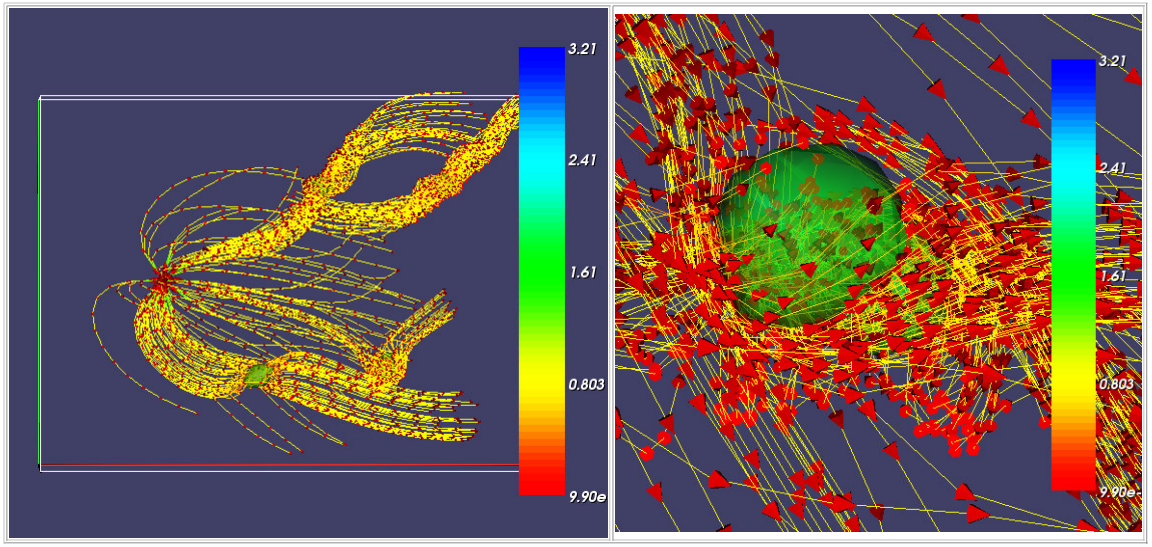


Challenge Vector Volume II(ChalVec1)

Following are the snapshots of the visualization of the vector volume ChalVec1.vtk. The first snapshot shows all the points with glyphs, streamlines and isosurfaces. Second row shows the visualization of critical point (20,30,20) at isovalue 2. The left image shows the close-up view of the point.In that image, repelling of streamlines and alignment of the glyphs clearly show that point at (20,30,20) is a repelling node. The right image shows that citical point in the whole visualization of the field. It is indicated by isosurfacing at the critical point. Third row shows the visualization of critical point (35,15,20) at 0.29. In the left image, alignment of glyphs and the streamlines direction clearly show that point at (35,15,20) is a center point. The right image shows that citical point in the whole visualization of the field which is indicated by isosurfacing at the critical point.


3.21
2.41
1.61
0.803
9.90e-


3.21
2.41
1.61
0.803
9.90e-
3.21
2.41
1.61
0.803
9.90e-



PART C

Divergence, Curl, Curl Magnitude

FILES USED

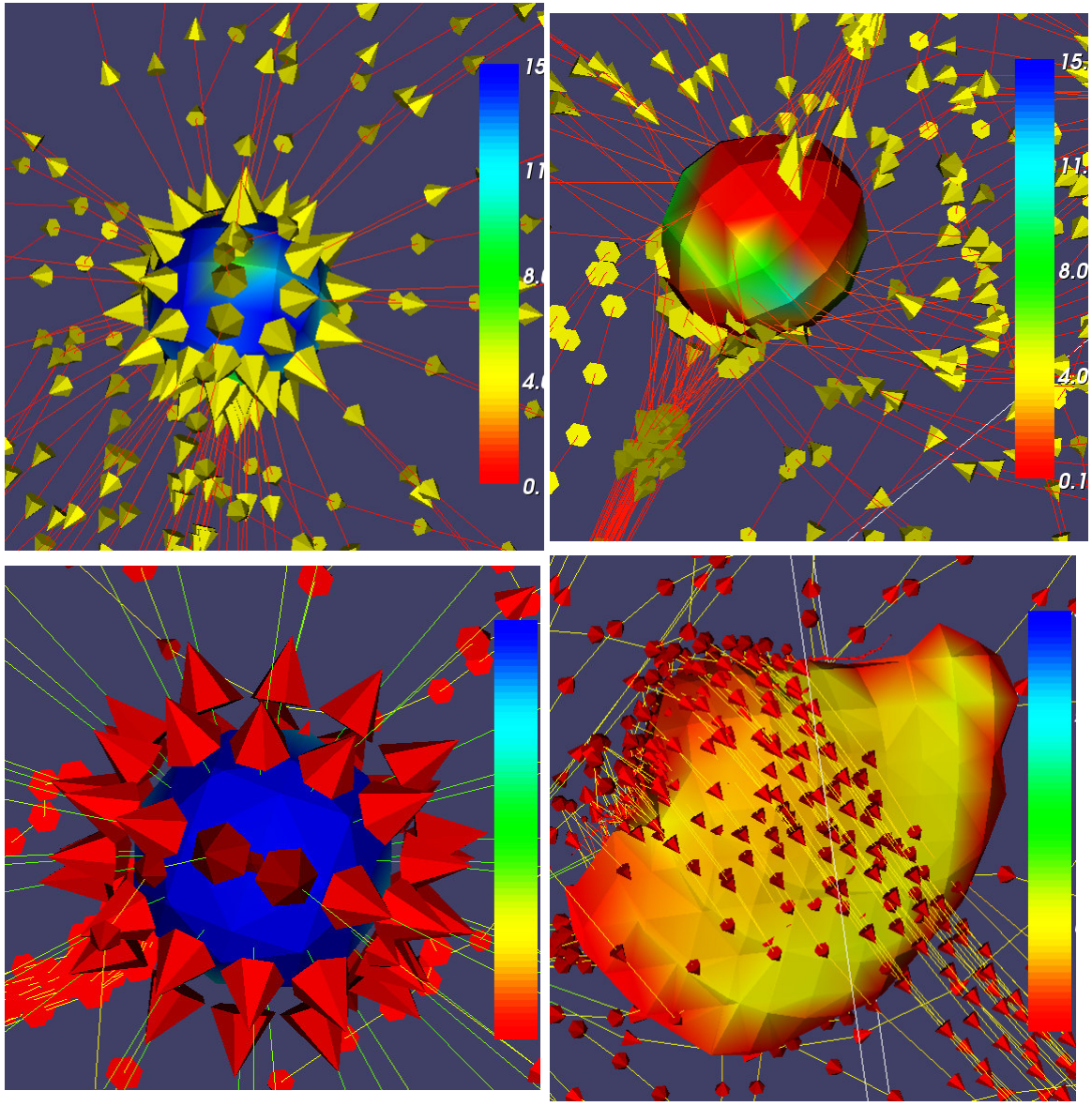
CODE FILE: divergence0.tcl, divergence1.tcl, curl0.tcl, curl_0.tcl, curl1.tcl curl_1.tcl global.tcl
DATA FILES PROVIDED: ChalMag0.tcl, ChalMag1.tcl, ChalVec0.tcl, ChalVec1.tcl ChalDMag0.vtk, ChalDMag1.vtk, ChalCMa0.vtk, ChalCMa1.vtk ChalCur0.vtk ChalCur1.vtk

Divergence

Definition: Divergence is the amount of change in the vector field. At a given point, the divergence of a vector field is just a single number that represents how much the flow is expanding at that point.

We were given two sets of divergence data as set0 and set1. I isosurfaced the vector magnitude, but colored the surface with values from the divergence field.

Below are the two points where the divergence is high and low. In the first row, the left image shows the high divergence because it is mapped to blue color. One can easily see that the flow lines are much expanded and are showing the divergence property well. In the right image, the red color is mapped to the point in the field showing that it has low divergence. The streamlines are not very divergent and separated. The second row snapshots shows the same for divergent data1



1] What is the relationship between the vector magnitude and the divergence?

Ans] Both divergence and vector magnitude are directly related. Low divergence indicates low vector magnitude and high divergence indicates high vector magnitude.

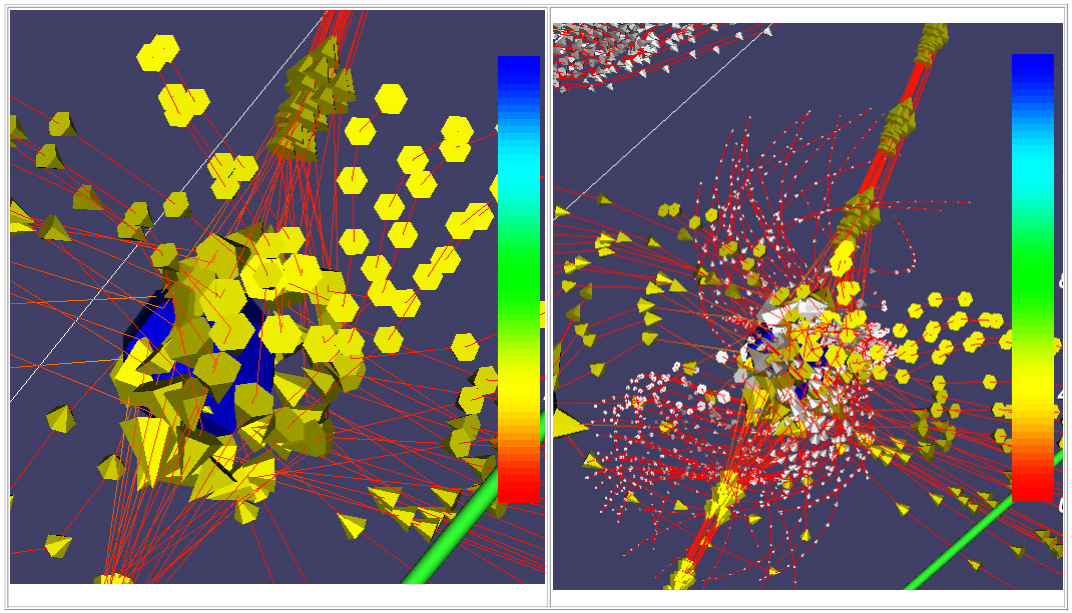
Curl

Definition: Curl indicates the nature of the flow lines around the critical point in the vector field. It shows the degree of curvature in the field. The curl of a vector field is slightly more complicated than the divergence. It captures the idea of how a fluid may rotate.

Curl Magnitude

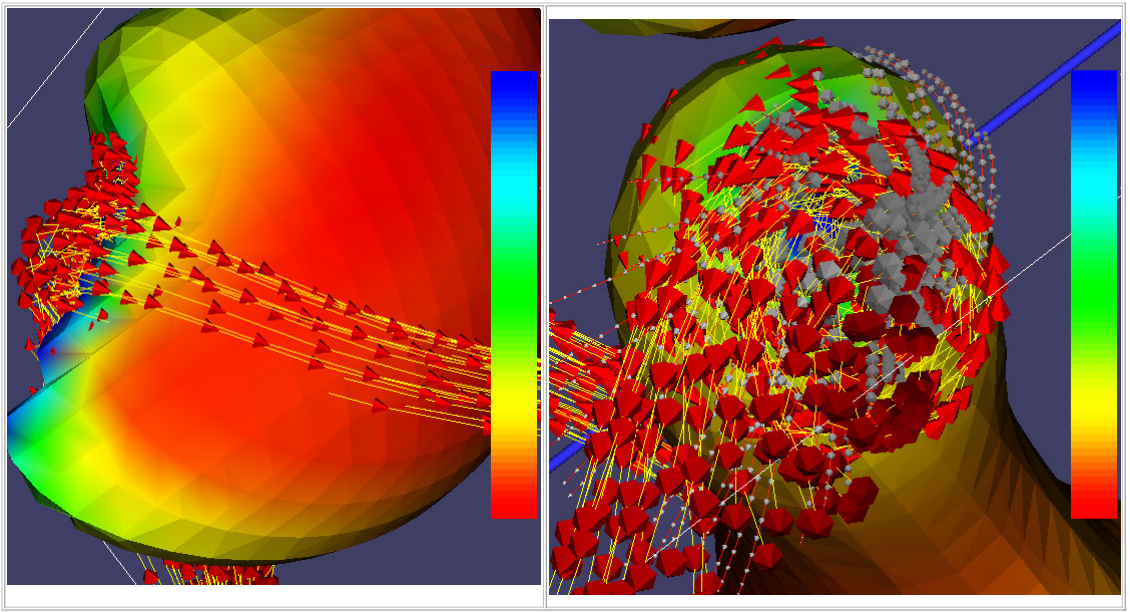
Definition: Curl magnitude indicates the scalar quantity or the value of the curvature at a particular point.

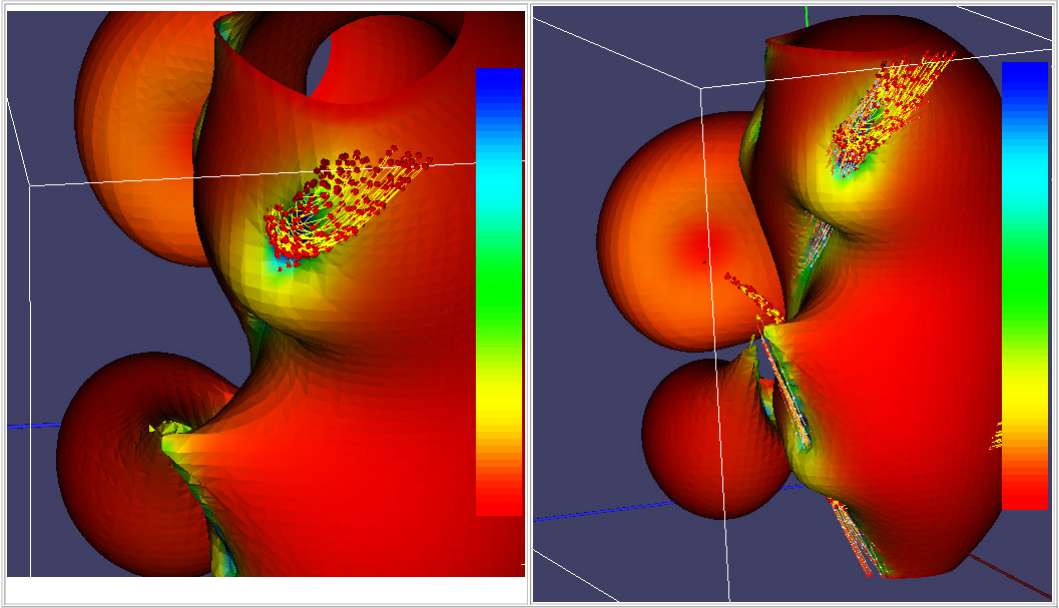
We were given two sets of curl field data and curl magnitude data. I found two points where the curl magnitude is high but vector magnitude is low. Below are the snapshots of visualization using first set of curl and curl magnitude data sets. In the first row, left image shows the point where curl is high by mapping the point on the field by blue color. The right image shows the curl field along with the vector field. The stream lines with white glyphs shows the curl field lines. The curl field lines are showing how curved the field is at that point.



Below are the images for the Curl magnitude1 and vector field 1

In the left image the streamlines near the blue color itself show how curved the field lines are at the point. The right image shows the vector streamlines as well as the curl magnitude at the point in the field. In the right image, the curl stream lines showing curl path indicates how curved the field at the point is. the second row shows the points in the next set of curl and curl magnitude data set.

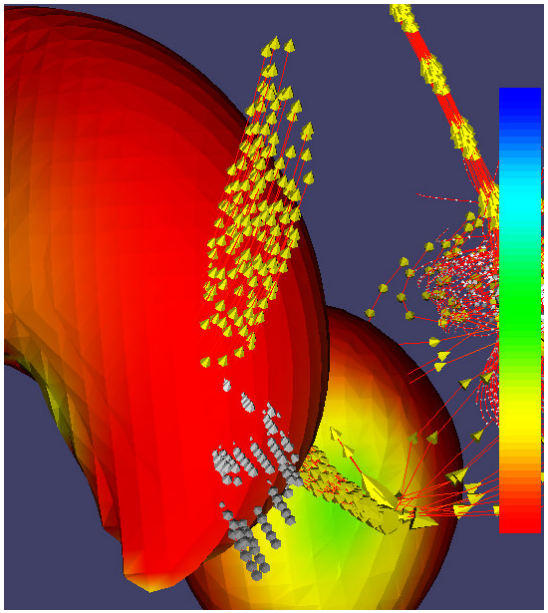




2] Describe how your visualizations demonstrate the relationship between the direction of the curl vector and the local changes in the vector field.

Ans] Above images clearly show the relationship between the direction of the curl vector and the local changes in the vector field. Curl field lines show the direction of the curl field whereas the vector field lines show the direction of the curl using streamlines and glyphs. The direction of the curl vector indicates how the curved lines in the field are oriented.

Derivative Global Viz



To provide global field structure , I have used divergence data and curl field data with vector field information. In the above image the red color clearly shows low divergence at the point and the field lines with white glyphs which are curl field lines show the orientation of the curvature field.

3]Does showing divergence and curl information help give a better "picture" of the over-all structure of the field?

Ans] Yes, divergence and curl provides over all structure of the field in a better way. Divergence conveys amount of change in the field where as curl provides who curved the field lines at the point. They helps to provide a global picture of the field.