VisIt Documentation

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Abstract

In this documentation, we will provide some basic and intermediate information about scientific data visualization by using VisIt. It includes about scalar and vectorial visualization and promotion of some pre-defined filters in VisIt software like slicing, threshold value, contours and etc. which is built based on VTK visualization toolkit. Also because VisIt is built based on VTK, we could write programmable filters by using Python or C++ languages to create more user defined data visualizations. At the end we will provide a useful manual in order to use parallel visualization on high performance computing facilities like Clemson University Palmetto cluster which can help students and faculties to create robust visualization from their big data structures.

Introduction

VisIt is a massively parallal visualization package which is built based on VTK visualization toolkit under Lawrence Livermore National Laboratory (LLNL) affilation. VisIt has some parallel visualization features which is make it suitable for big data structure visualization based on message passing interface (MPI) or NVIDIA CUDA GPU parallel computing. In this documentation some basic and intermediate information about how to deal with data structures and create visualization from them and extract useful information about scientific data structures will be provided and at the end of this documentation we will focus on running the VisIt on Palmetto cluster to deal with big data structures.

Downloading and installation of VisIt

VisIt is an open source software which is distributed under Lawrence Livermore National Laboratory (LLNL) affilation and you can download the pre-compiled binary files of VisIt from their official website. Also you can find a lot of useful tutorials on their official website to practice visualization techinques in this documentation.

VisIt visualization filters

As we said before VisIt is built on VTK visualization toolkit and so it can load a broad range of simulation output files. In order to open your data structure you could use from VisIt main menu File $\longrightarrow$ Open file... and then simply it will be loaded in your workstation. For example we loaded a medical imaging data structure to VisIt as is shown in Fig. 1.

So now we could examine each pre-defined filters on our loaded scalar field data structure. First filter we will study is the Contour filter in order to show each isosurface of our scalar field. You could choose the Contour filter by using Add $\longrightarrow$ Contour and then choose your field to visualize the isosurfaces of your data structure. In Fig. 2, the isosurfaces of loaded data structure is shown which represents the medical imaging of human skull at different pixel threshold values which build our scalar field. Also under Contour scalar field which is loaded to your VisIt main screen if you open the triangle at the left of scalar field and double click on Contour filter you will see the options of Contour filter such as changing the iso values and change the color and style of isosurfaces.

Also it is possible to do some mathematical and boolean operations on this filter. For example, if you want to create an slice from those isosurfaces, you could do this by right click on Contour filter and go to Operators $\longrightarrow$ Slicing $\longrightarrow$ Slice. Also you could define the normal vector and point of slicer plane and by clicking on Draw you will see the slices data structure which is created from those isosurfaces as is shown in Fig. 3.

Also in order to create three-dimensional slices you could use Operators $\longrightarrow$ Slicing $\longrightarrow$ ThreeSlice. In Fig. 4, the three-dimensional slices of loaded contour structure is shown as some isocurves.

Now, we learned some basic features of VisIt visualization package and in the next we will focus on vectorial field visualization like streamlines, bulk contour representation and etc. At the beginning, if you want to show your bulk

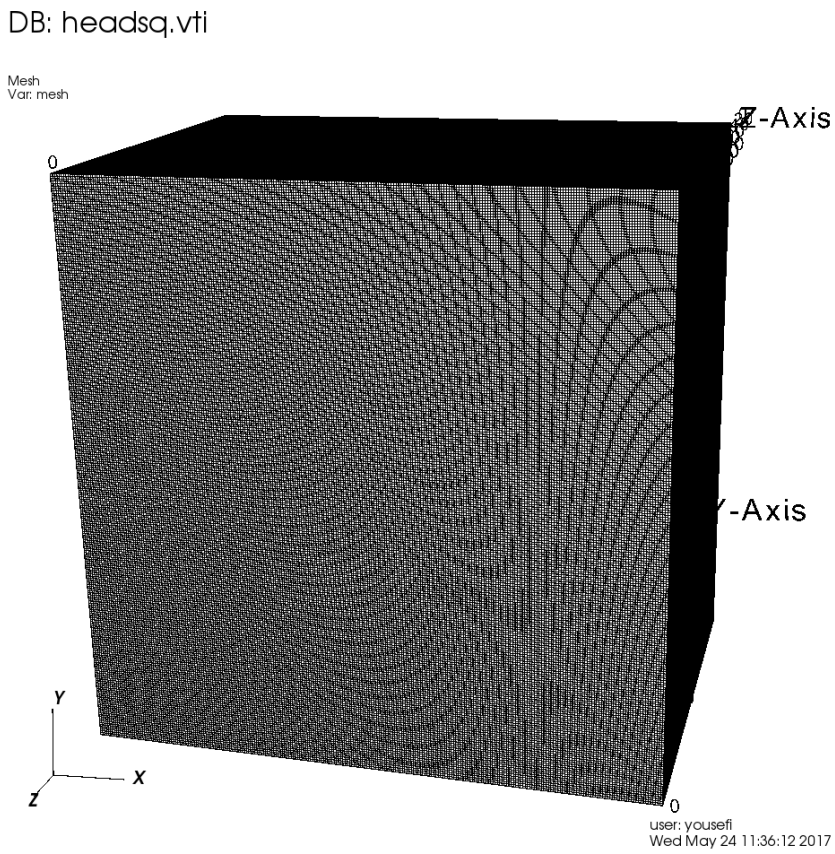

Figure 1: Loaded structured grid data to the VisIt main screen.

scalar or vectorial field magnitude as coloring contours, you could use Add $\longrightarrow$ Pseudocolor $\longrightarrow$ scalars and you will see the bulk contours as is shown in Fig. 5.

One of the best visualization filters to show the magnitude and direction of vectorial fields is streamline. Actually, streamline can use some pre-defined seed points and then do some integration over vectorial isocurves to extract the numerical values of vectorial field isocurves. You could choose streamline filter by using Add $\longrightarrow$ Streamline. Also you should choose your vectorial field and then by double clikcing on Streamline filter you should modify the pre-defined seed point selection model and integration algorithm to produce more powerful streamline visualization as is shown in Fig. 6.

Also you could show the deformed mesh to visualize for example mechanical deformation by using Add $\longrightarrow$ Mesh as is shown in Fig. 7.

Running VisIt on Clemson University Palmetto cluster

In order to deal with big data structures and create more powerful visualization, we should use high performance computing facilities like Clemson University

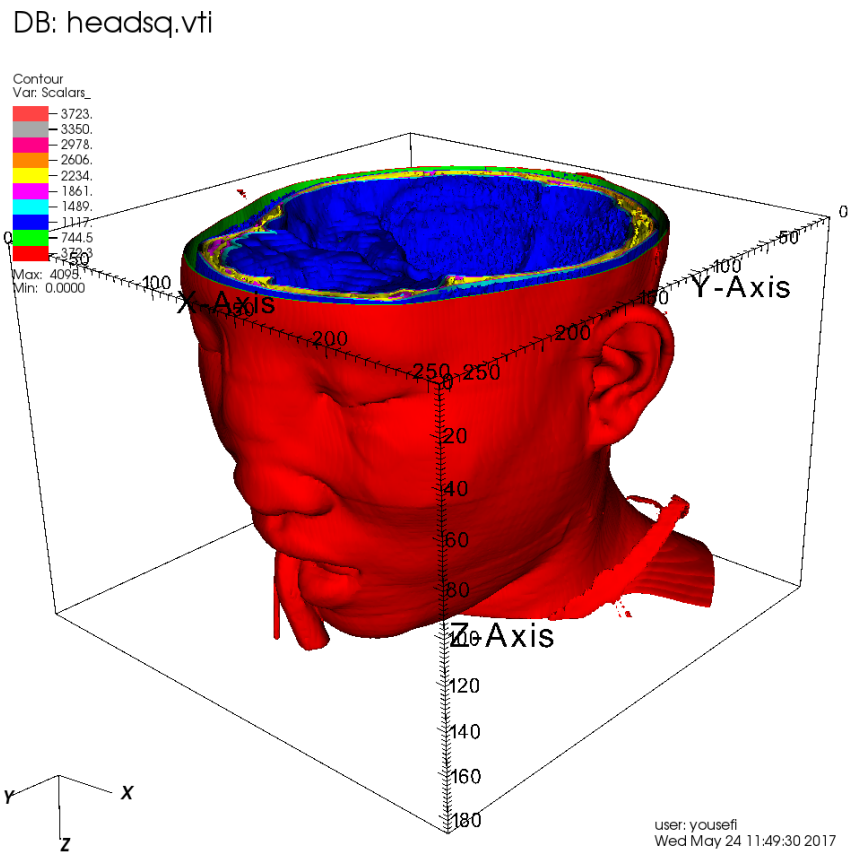

Figure 2: Contour of loaded structured grid data to the VisIt main screen.

Palmetto cluster. Fortunately, VisIt visualization package is available as pre-compiled module in Palmetto cluster and you could add it by using module add visit to your module lists. Also if you want to use VisIt on parallel mode you could follow these steps. First from Options $\longrightarrow$ Host profiles... you should choose the server/clinet settings as is shown in Fig. 8.

Then you could change your parallel configurations and using GPU CUDA to use parallel visualization as is shown in Fig. 9 and Fig. 10.

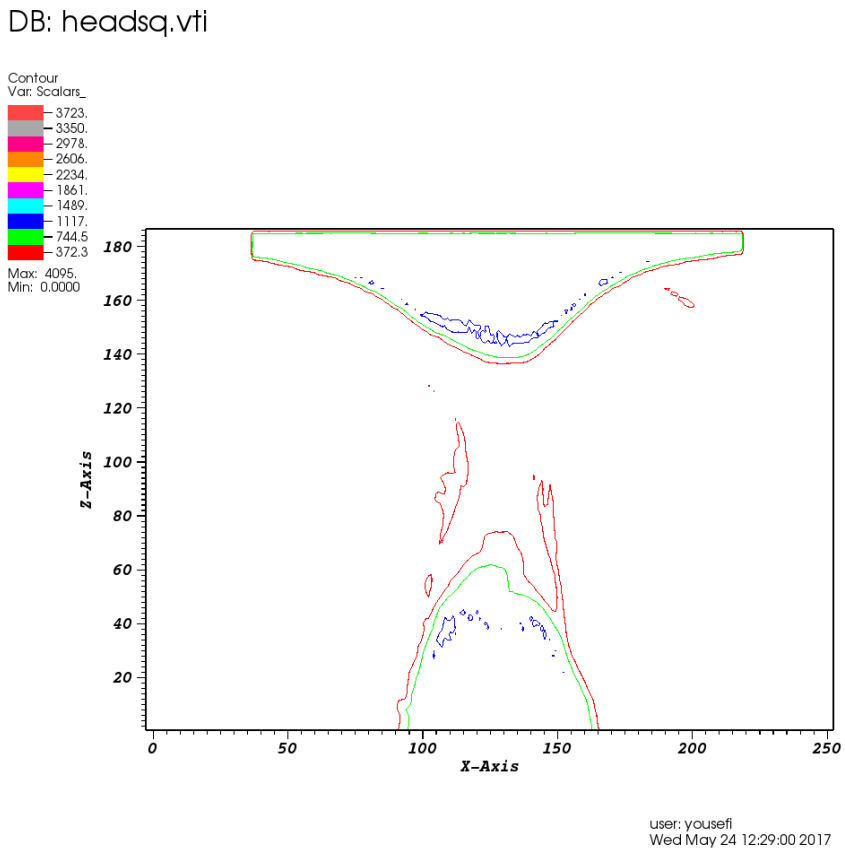

Figure 3: 2D slice of loaded structured grid data to the VisIt main screen.

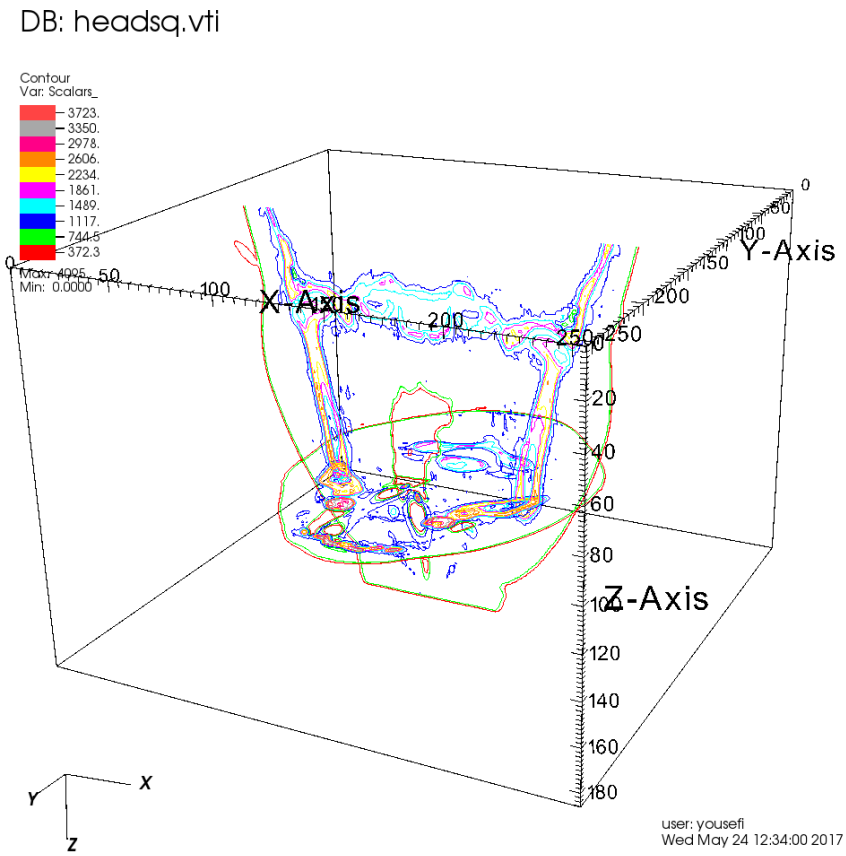

Figure 4: 3D slice of loaded structured grid data to the VisIt main screen.

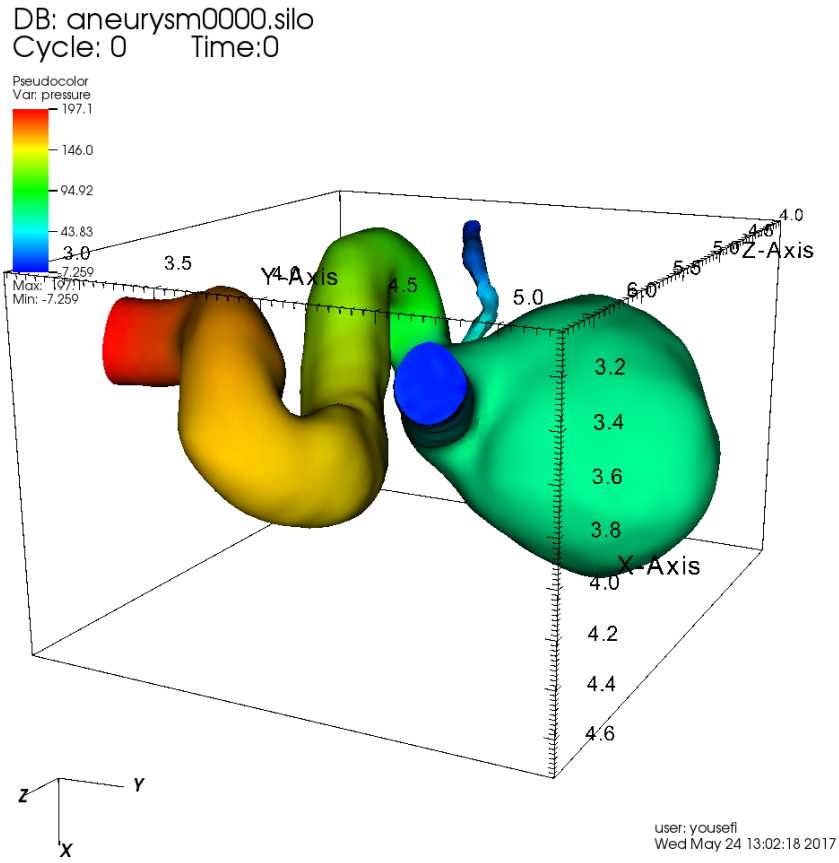

Figure 5: Bulk contour of loaded unstructured grid data (aneurysm fluid dynamics simulation) to the VisIt main screen.

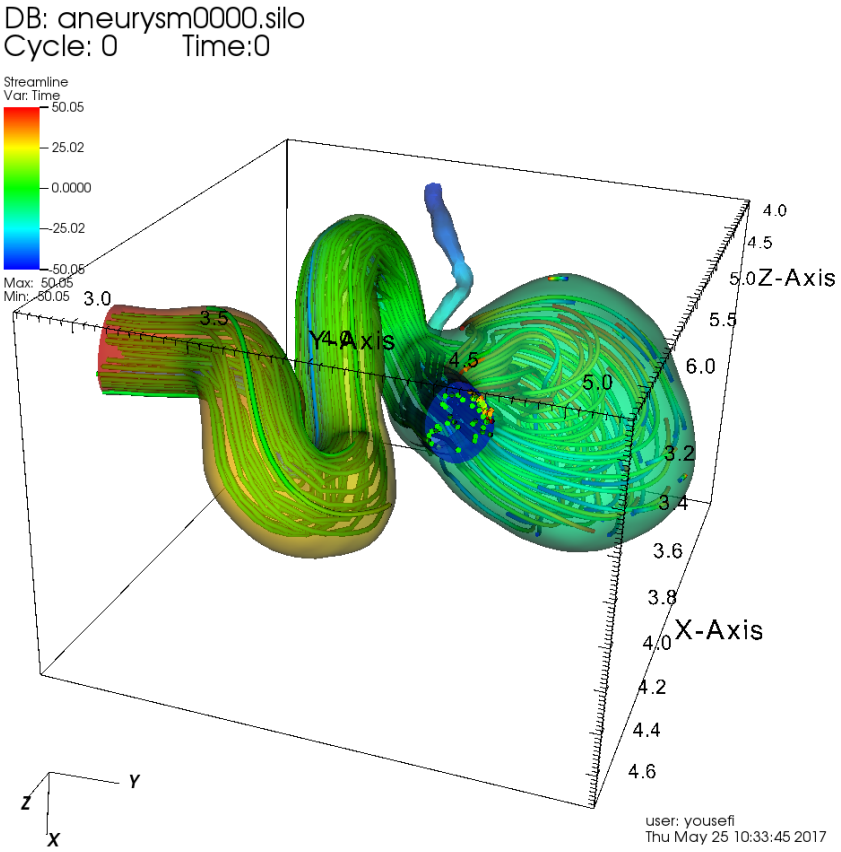

Figure 6: Streamlines of loaded unstructured grid data (aneurysm fluid dynamics simulation) to the VisIt main screen.

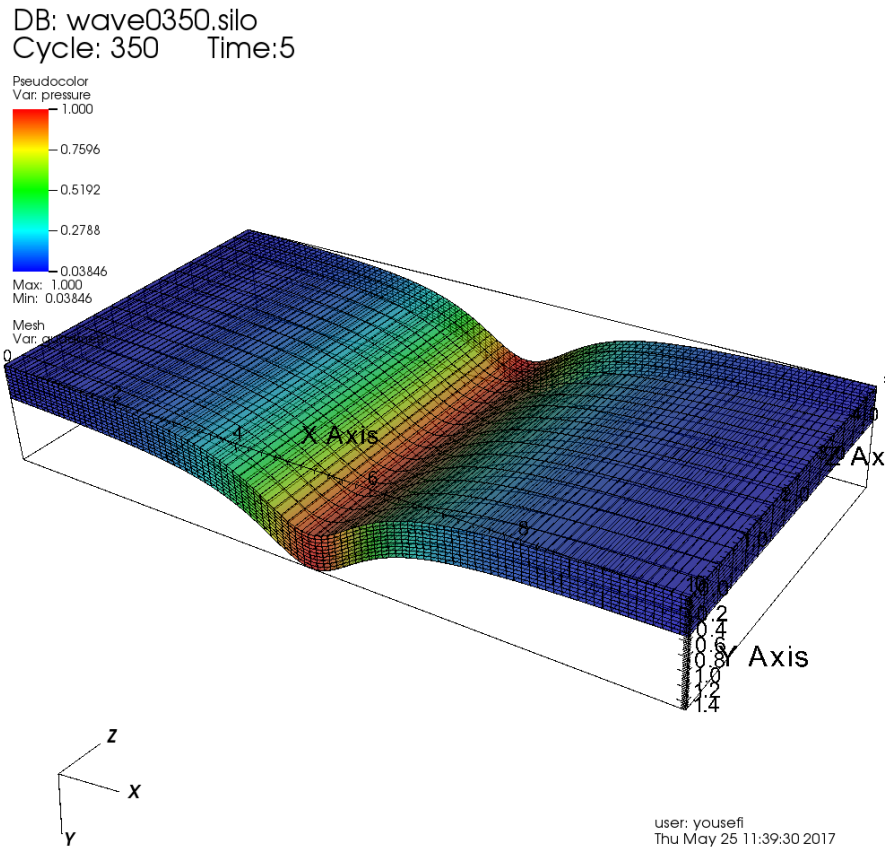

Figure 7: Deformed mesh visualization of structured grid which is loaded to the VisIt main screen.

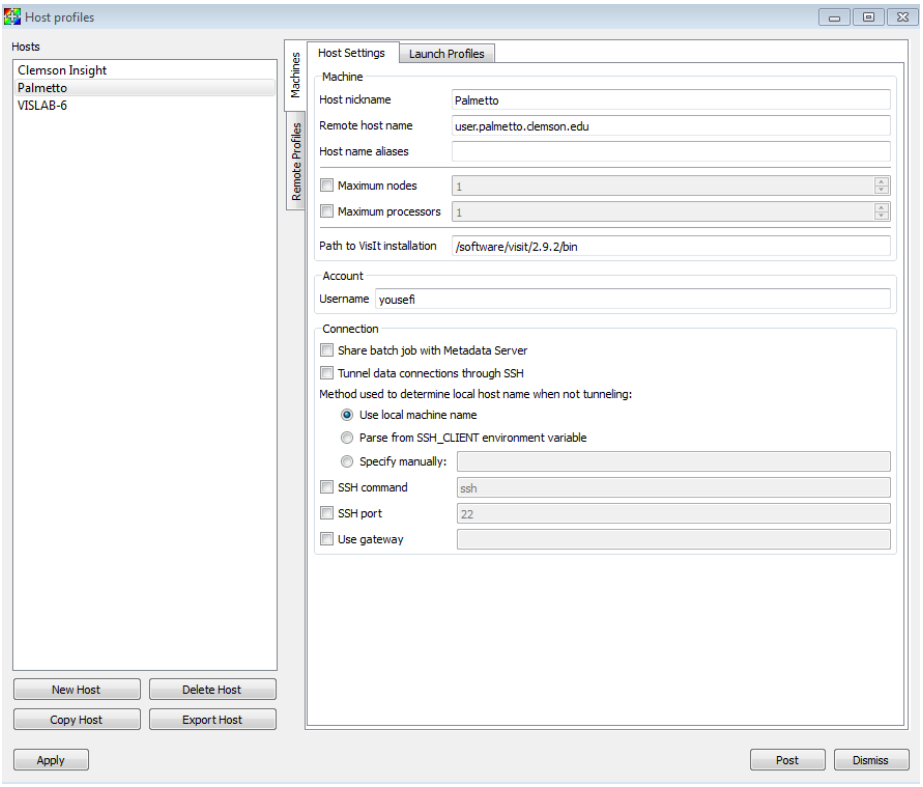

Figure 8: Host profiles settings in VisIt main menu.

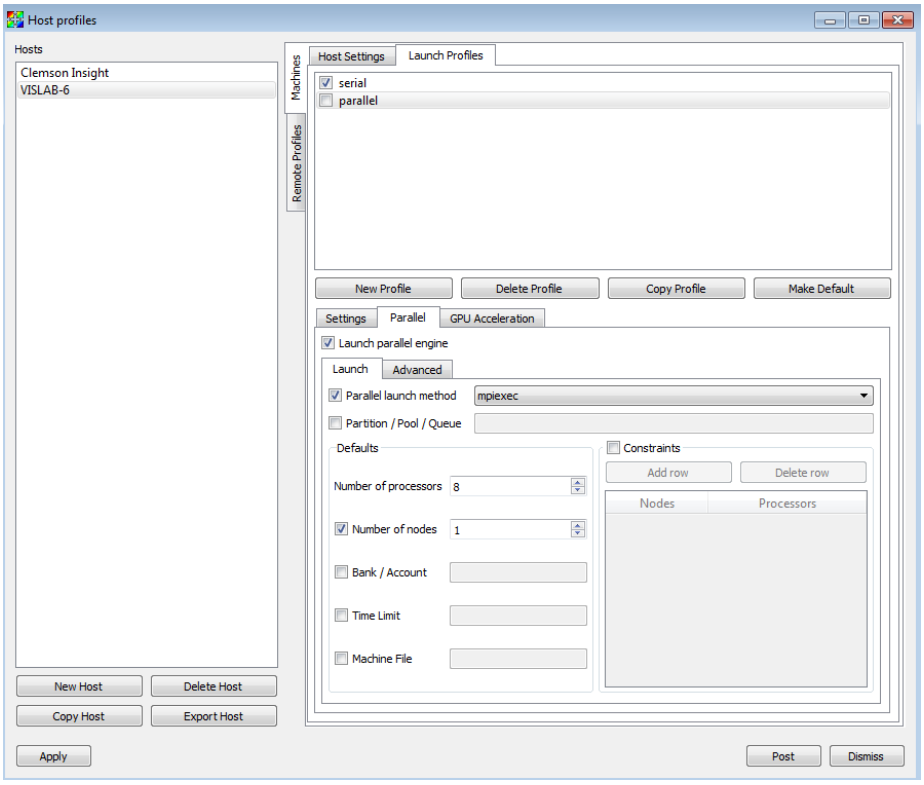

Figure 9: MPI parallel visualization settings in VisIt main menu.

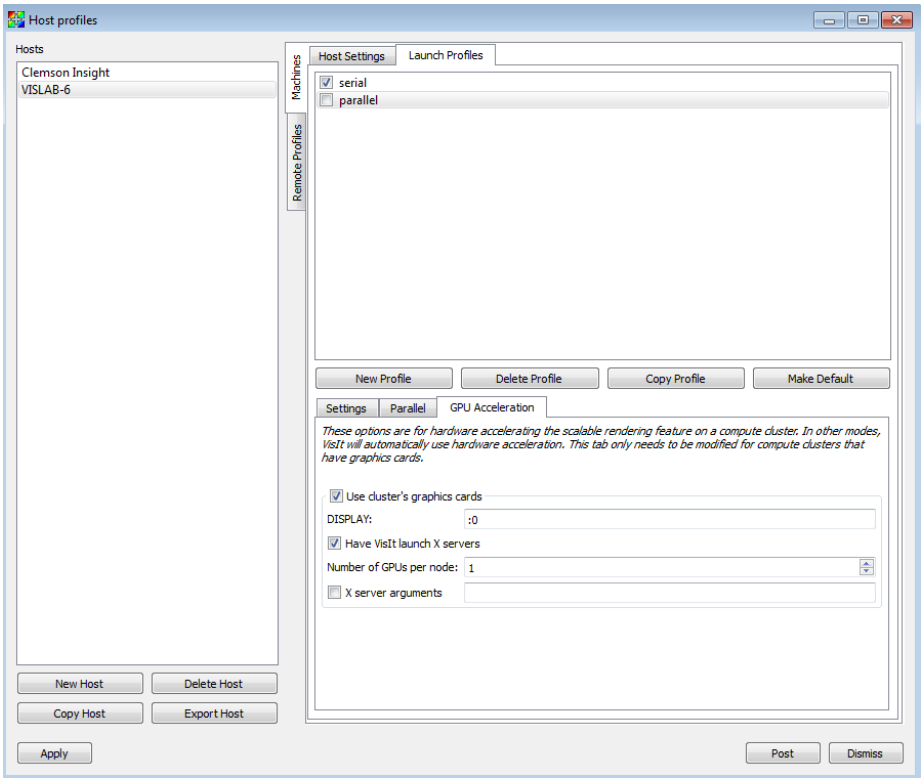

Figure 10: GPU CUDA parallel visualization settings in VisIt main menu.