JÜLICH
FORSCHUNGSZENTRUM

Introduction to ParaView

Plugins

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ParaView Plugins - Introduction

- ParaView comes with a large range of readers, filters and views providing a large range of functionality

- ParaView provides an extensive plugin mechanism which enables the user to
  - add new **readers**, writers and **filters**
  - add custom GUI components such as toolbar buttons to perform common tasks
  - add new views for displaying data

- The following slides cover
  - how to use existing plugins
  - how to write new plugins for ParaView.

Using ParaView Plugins

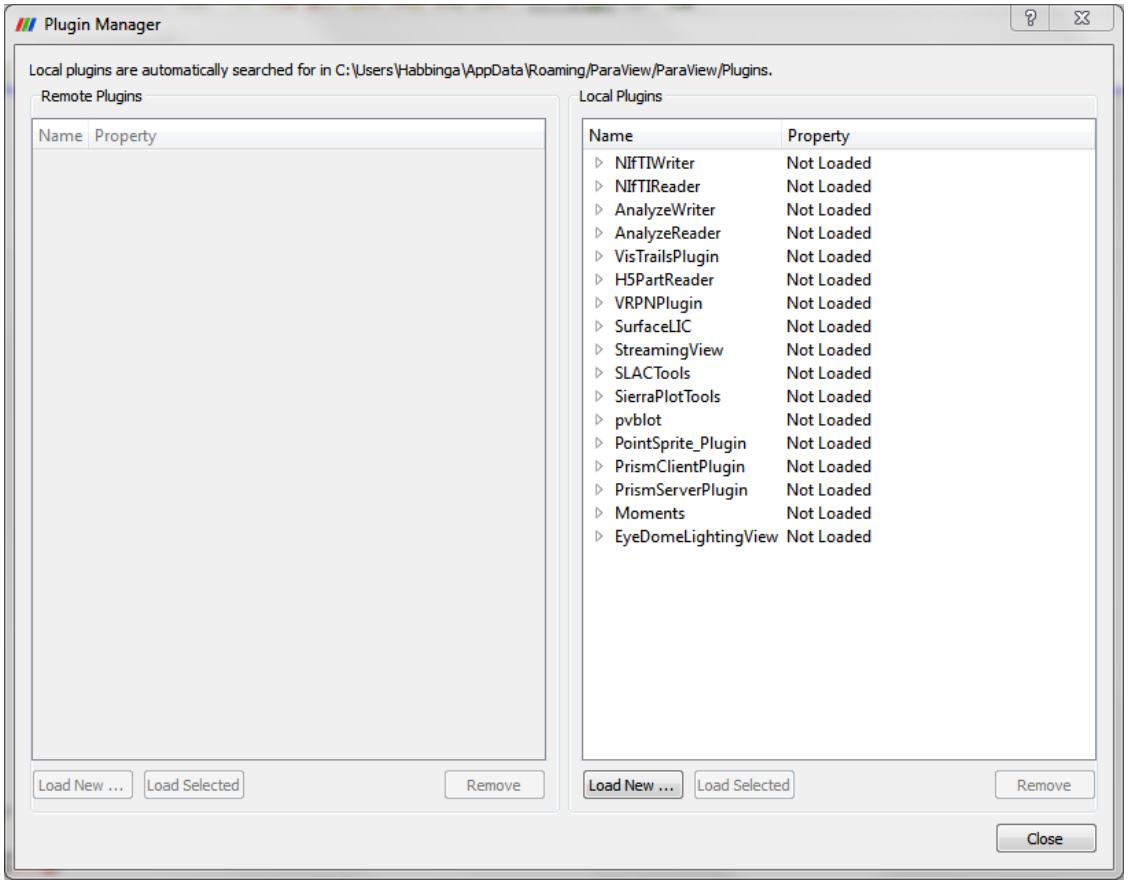
- plugins are distributed as shared libraries (*.so on Unix, *.dylib on Mac, *.dll on Windows)
- plugin must be built with the same version of ParaView
- ParaView has to be built with shared libs enabled
- three ways for loading plugins:
  - using environment variable PV_PLUGIN_PATH (Auto-loading plugins)
  - placing the plugins in a recognized location:
    - “plugins” subdirectory beneath the directory containing the paraview client or server executables
    - “plugins” subdirectory in the user's home area.

      $HOME/.config/ParaView/ParaView<version>/Plugins on Unix/Linux/Mac

      %APPDATA%\ParaView\ParaView<version>\Plugins on Windows
  - using the GUI

Loading ParaView Plugins Using the GUI

- Plugin manager accessible from Tools | Manage Plugins menu:



Writing ParaView Plugins – Server Manager Configuration

- ParaView uses the VTK Server Manager for building distributed client-server applications by means of the Proxy design pattern
- Proxies are defined in the **Server Manager Configuration XML**
- Proxies are organized in **ProxyGroups**
  - Examples: sources, filters, views, …
- Each **Proxy** stores a reference to the corresponding VTK object located on the server
  - Examples: SourceProxy, ViewProxy, …
- The Proxy contains **Properties** to describe the part of the interface which is exposed to the client (function name and arguments)
  - Examples: IntVectorProperty, StringVectorProperty, InputProperty, …
- The range of values of a property can be restricted by **Domains**
  - Examples: IntRangeDomain, FileListDomain, DataTypeDomain, ProxyGroupDomain,…

Enabling existing VTK-Classes as Plugins

- To enable an existing VTK-class, write a Server Manager configuration xml-file and load it into the ParaView GUI
- example: enable the VTK-filter **vtkCellDerivatives**, write CellDerivatives.xml as follows

```
<?xml version="1.0"?>
<ServerManagerConfiguration>
  <ProxyGroup name="filters">
    <SourceProxy name="MyCellDerivatives" class="vtkCellDerivatives" label="My Cell Derivatives">
      <Documentation
        long_help="Create point attribute array by projecting points onto an elevation vector."
        short_help="Create a point array representing elevation.">
      </Documentation>
      <InputProperty
        name="Input"
        command="SetInputConnection">
          <ProxyGroupDomain name="groups">
            <Group name="sources"/>
            <Group name="filters"/>
          </ProxyGroupDomain>
          <DataTypeDomain name="input_type">
            <DataType value="vtkDataSet"/>
          </DataTypeDomain>
      </InputProperty>
    </SourceProxy>
  </ProxyGroup>
</ServerManagerConfiguration>
```

Writing New ParaView Plugins – Source Code

- compiling plugins requires own build of ParaView3 since binaries downloaded from www.paraview.org do not include necessary header files
- Example: simple reader called **vtkCSVImageReader** (example taken from
- http://www.kitware.com/media/html/WritingAParaViewReaderPlug-in.html)
  - read a 2D image from a text file with simple delimited format
  - allow someone to export simple matrices of data from Excel and visualize them as heat maps or height fields in ParaView
  - assume the files consist of strictly numeric values separated by commas or some other delimiter
  - use a vtkDelimitedTextReader instance which will read delimited text into a vtkTable
  - methods to set and get the file name and field delimiter characters, which are delegated to the vtkDelimitedTextReader instance variable

Writing New ParaView Plugins

- Writing a new plugin requires generating the following files:
  - .cxx and .h files (the actual plugin source code)
  - Server manager configuration (xml-file)
  - configuration xml for the GUI (optional for filters)
  - CMakeLists.txt for compiling your source code into a shared library
- Recommended Tool: plugin Wizard
  - developed by MIRARCO
  - free and open source application which helps you to create a framework of the above mentioned files.
  - download at http://pluginwizard.mirarco.org/

Writing New ParaView Plugins – Source Code

- Step 1: create a framework for your plugin using the Plugin Wizard
- Step 2: override the following methods of the chosen vtk superclass to make it operate properly in a standard vtk pipeline:
  - tell the VTK pipeline information about the data before creating the output, e.g. extent, spacing and origin in case of vtkImageData

```
int vtkCSVImageReader::RequestInformation( vtkInformation *request,
                                           vtkInformationVector **inputVector,
                                           vtkInformationVector *outputVector)
```

  - read data from the file and store it in the corresponding data object in the output port

```
int vtkCSVImageReader::RequestData(   vtkInformation *request,
                                      vtkInformationVector **inputVector,
                                      vtkInformationVector *outputVector );
```

- Step 3: override other methods, e.g. **SetFileName**(const char* fname), **SetFieldDelimiterCharacters**(const char* delim), …

Class vtkCSVImageReader

```
class vtkCSVImageReader : public vtkImageAlgorithm
    {
    public:
       static vtkCSVImageReader* New();
       vtkTypeRevisionMacro(vtkCSVImageReader,vtkImageAlgorithm);
       void PrintSelf(ostream& os, vtkIndent indent);
       virtual void SetFileName(const char* fname);
       virtual const char* GetFileName();
       virtual void SetFieldDelimiterCharacters(const char* delim);
       virtual const char* GetFieldDelimiterCharacters();
    protected:
      vtkCSVImageReader();
      ~vtkCSVImageReader();

      int RequestInformation(vtkInformation*, vtkInformationVector**,
    vtkInformationVector*);
      int RequestData(vtkInformation*, vtkInformationVector**, vtkInformationVector*);
      vtkDelimitedTextReader* Reader;

    private:
      vtkCSVImageReader(const vtkCSVImageReader&);
      void operator=(const vtkCSVImageReader&);
    };
```

RequestInformation(…)

```
int vtkCSVImageReader::RequestInformation (vtkInformation*, vtkInformationVector**,
    vtkInformationVector* outputVector)
    {
      vtkInformation* outInfo =outputVector->GetInformationObject(0);
      this->Reader->Update();
      vtkTable* output = this->Reader->GetOutput();
      vtkIdType rows = output->GetNumberOfRows();
      vtkIdType columns = output->GetNumberOfColumns();

      int ext[6] = {0, rows, 0, columns, 0, 0};
      double spacing[3] = {1, 1, 1};
      double origin[3] = {0, 0, 0};

      outInfo->Set(vtkStreamingDemandDrivenPipeline::WHOLE_EXTENT(), ext, 6);
      outInfo->Set(vtkDataObject::SPACING(), spacing, 3);
      outInfo->Set(vtkDataObject::ORIGIN(), origin, 3);
      vtkDataObject::SetPointDataActiveScalarInfo(outInfo, VTK_FLOAT, 1);
      return 1;
    }
```

RequestData(…)

```
int vtkCSVImageReader::RequestData(vtkInformation*, vtkInformationVector**,
      vtkInformationVector* outputVector)
      {
        vtkImageData* image = vtkImageData::GetData(outputVector);
        vtkTable* output = this->Reader->GetOutput();
        vtkIdType rows = output->GetNumberOfRows();
        vtkIdType columns = output->GetNumberOfColumns();
        image->SetDimensions(rows, columns, 1);
        image->AllocateScalars();
        vtkDataArray* scalars = image->GetPointData()->GetScalars();
        scalars->SetName("Data");
        for (vtkIdType r = 0; r < rows; ++r)
          {
          for (vtkIdType c = 0; c < columns; ++c)
            {
            vtkVariant val = output->GetValue(r, c);
            float f = val.ToFloat();
            scalars->SetTuple1(c*rows + r, f);
            }
          }
        return 1;
      }
```

Writing New ParaView Plugins – Server Manager Configuration

- Server Manager Configuration for the example CSVImageReader:

```
<?xml version=”1.0”?>
    <ServerManagerConfiguration>
        <!– Begin CSVImageReader –->
        <ProxyGroup name=„sources“>
            <SourceProxy name=„CSVImageReader“
                         class=„vtkCSVImageReader“>
                <StringVectorProperty name=„FileName“
                                      number_of_elements=„1“
                                      command=„SetFileName“>
                    <FileListDomain name=„files“/>
                </StringVectorProperty>
                    <StringVectorProperty
                    name=“FieldDelimiterCharacters”
                    command=“SetFieldDelimiterCharacters”
                    number_of_elements=”1”
                    default_values=”,”/>
            </SourceProxy>
        </ProxyGroup>
        <!– End CSVImageReader –->
</ServerManagerConfiguration>
```

Writing New ParaView Plugins – Configuration XML for the GUI

- Provides the higher-level information about where new elements will be placed in the user interface.
- Example: CSVImageReaderGUI.xml

```
<?xml version="1.0"?>
<ParaViewReaders>
      <Reader
            name="CSVImageReader"
            extensions="csvimg"
            file_description="csv Image data">
      </Reader>
</ParaViewReaders>
```

  - tells ParaView to create GUI elements for “CSVImageReader”
  - creates a new entry in the File Open dialog for CSV image data files
  - associates files ending in “.csvimg” with the new reader

Writing ParaView plugins – CMakeLists.txt

- Use cmake to build the ParaView plugin
- CMakeLists.txt file ties sources and xml files together

```
CMAKE_MINIMUM_REQUIRED(VERSION 2.6)
PROJECT(CSVImageReader)

FIND_PACKAGE(ParaView REQUIRED)
INCLUDE(${PARAVIEW_USE_FILE})

ADD_PARAVIEW_PLUGIN(CSVImageReader "1.0"
                    SERVER_MANAGER_XML CSVImageReader.xml
                    SERVER_MANAGER_SOURCES vtkCSVImageReader.cxx
                    GUI_RESOURCE_FILES CSVImageReaderGUI.xml)
```

- locate ParaView with FIND_PACKAGE
- import the CMake configuration parameters from ParaView by including PARAVIEW_USE_FILE.
- ADD_PARAVIEW_PLUGIN specify all the information needed to build the plugin.