### How to visualize particle data with ParaView

Aug. 31, 2015

### Introduction

- This document briefly explains how to visualize particle motions with the ParaView.
  - This explanation includes a transformation of an aspect ratio of a system. You can skip it if an aspect ratio of your data is close to 1.
- The ParaView is an open source application for 3D visualization.

See http://www.paraview.org/ for more details.

# Preparation (1)

- Prepare data.
  - Each file includes 3D position of all particles at a time step in VTK format.
  - Number of files is number of output time step.
  - Sample Fortran program which produces data files is attached at the end of this slide.

# Preparation (2)

- In order to show spherical particles, a following setting is required.
  - Start ParaView
  - [Tools] -> [Manage Plugins] -> [PointSprite\_Plugin]
  - Check [Auto Load]
  - Restart ParaView
- This is required only once.

### Notice

• Click [Apply] when changes are not reflected.

M ParaView 4.3.1 64-bit			and Associate States of States	Name and Address of the owner, which the		_	_		- 0 ×
<u>File Edit View Sources Filters Tools</u>	<u>C</u> atalyst <u>M</u> acros <u>H</u> elp								
📂 🤔 🐺 🐺 🔊 🔍 🛃 🥐		Time: 0	0 .						
	• Representation	🖂 🐹 🔣 🙃 📫	1 📫 14 🐴 🐴	13 🖉 🖉 🛞 (	G				
	8 🔞 🕼 📲 😳 🛞 🕅								
Pipeline Browser & ×	Layout #1 × +						Collaboration Panel		ē ×
builtin:	J 🖏 3D 🐻 🖳 🖳 🖤 🕸 🔣 🔣				RenderVi			Darticipant	
							-	Participant	æ
							I'm alone		
Properties Information									
Properties 8 ×									
. Wobiy									
c to clear text)									
Properties									
📼 Display								Share n	nouse pointer 📃
							Chat room		
- View (Render View)									
Center Axes Visibility									
Orientation Axes									
Orientation Axes visibility									
Stereo Render									
Background									
Single color									
Color									
	μΥ								
	7 1/						Color M··· Time I···	Comparative View I***	Collaborati
	é∕—≱						Selection Display Inspector	-	₽×
								Cell Labels	Ψ.
								♦ Point Labels	-
							Selection Color		A 1
				4					

### Setting a domain (1)

#### • [Sources] -> [Box]



# Setting a domain (2)

• Change the box size and center coordinate



XLength = 360, YLength = 180, ZLength = 100

Center = (180, 0, 50) ("Center" values are coordinate values at the box center.)

### Setting a domain (3)

• Reset the box position

III ParaView 4.3.1 64-bit	And and a second second	CALIFORNIA COMPANY			- 0 ×
<u>File Edit View Sources Filters Tools</u>	<u>Catalyst</u> <u>Macros</u> <u>H</u> elp				
🖻 🤌 🛱 🛱 🍋 🏹 🥐					
📱 🎴 🚔 🛱 🍋 Solid Color	🔹 👻 Surface 🚺 🔣 🔀 🖽 📫 😫	ti t			
🗐 🕥 🗭 🕸 🗐 🖗 🕃 🧉	1 😒 🕼 🖳 🐏 🎬 🛞 💦 💦 👘				
Pipeline Browser Information	□ Layout #1 × +			Color Map Editor	8>
Pipeline Browser 6 ×	<b>身 乳 図 国 国 団 地 総 総 国</b>	Reno	derView1	Search (use Esc to clear text)	
builtin:					
					🚰 Render Views) 📑
Properties 🗗 🛪					
Apply @ Reset X Delete ?					
Search (use Esc to clear text)					
Properties (Box1)					
X Length 360					
Y Length 180					
Z Length 100					
Center 180 0 50					
📼 Display (GeometryRepresentation)					
Representation Surface					
Coloring					
Solid Color -					
Show Show					
Styling	Υ				
Opacity1					
Lighting	<b>4∕</b> ¥				
opecular 0					
Gube Axes					
4 m					
Reset Camera		¥			

## Setting a domain (4)

• Select [Outline] to look inside the domain

III ParaView 4.3.1 64-bit	states Man 21 + 22	North Treatment	1.00				
Eile Edit View Sources Eilters Tools	<u>C</u> atalyst <u>M</u> acros <u>H</u> elp						
😥 🤔 🞇 🖉 🔊 🖓 🚰 🤶		Time: 0					
📱 🎴 🛱 🛱 🎜 📾 Osolid Color	- Outline			19 🗞 🖓 🕰			
🗐 🕥 🗘 🗘 🧐 🖗 🕃 🥖	1 🎯 词 🗖 🖬 🐖 🐖	75					
Pipeline Browser Information	□ Layout #1 × +					Color Map Editor	8 >
Pipeline Browser 5 ×	🥬 🍕 3D 🕅 🖳 🔄 🕸 🕸 🗟				RenderView1 🔲 🗉 🗙	Search (use Esc to clear text)	
builtin:							
							🥐 Render Views
Properties & X					7		
Apoly @ Reset & Delete ? Search - (use Eac to clear text)      Properties (Boxt)      X Leneth 360      Y Length 180      Z Length 180      Center 180     0 50      Display (GeometryRepresentation) Representation Outline      Color ine      Sold Color      Show    Edit      Show      Syline	Y						
Opacity 1 Lighting Specular 0	z_x						
Cube Axes							

### Open series of files



### Scaling input values (1)

#### • [Filters] -> [Alphabetical] -> [Transform]



# Scaling input values (2)

Set values for scaling

M ParaView 4.3.1 64-bit	_		×
Elle Edit View Sources Ellters Tools Catalyst Macros Help			
😰 🔊 🐯 🐺 🍂 🔍 💽 ? 🚉 🕅 📣 🕨 🕅 🛱 Time 🔍 0 🖶 of 100			
📱 🎴 🛱 🛱 🍋 Solid Color 🔹 🐨 Surface 🔤 🔣 🔣 🖏 🗱 🗱 🗱 🗱 🗱 🗱 🕼			
Pipeline Browser Information		Color Map Editor	8>
Pipeline Browser	RenderView1	Search (use Esc to clear text)	
in builtin:       image: stability       image: s	7	Coarch - (Lide Eac to clear text)	िंगे 🔲 🖷 🗨
Image: Specify in the second secon			

Translate = (0, 0, 100), Rotate = (0, 0, 0), Scale = (1, 1, -100)Vertical position is reversed and multiplied by 100.

## Scaling input values (3)

• Uncheck [Show Box]

M ParaView 4.3.1 64-bit		×
Elle Edit View Sources Ellters Tools Catalyst Macros Help		
😰 ở 🐯 🙀 \land 🖓 🛃 👔 🖉 4 🖬 🕨 🗤 🖾 Time 0 🛛 0 🗄 of 100		
📱 🎴 🛱 🛱 💿 Solid Color 🔹 👻 Surface 💽 🔣 😳 🗱 😳 🗱 💱 🎎 😫 😕 🎯 🚱 🕵		
Pipeline Browser Information	Color Map Editor	8>
Pipeline Browser 8 × 8 1 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Search (use Esc to clear text)	
a builtin:		
● - ● Box1	S 🗐 🖬	
Contractorni		
Properties 5 ×		
Seenh _ (use Esc to clear text)		
Reseit The values in this argumenty		
Display (Unstructured GridRy allow you to specify the		
Representation Surface transform (translation,		
Colorine to the input dataset.		
Lighting		
Specular 0 - 0		

# Change radius of particles (1)

• Select [Point Sprite]

M ParaView 4.3.1 64-bit	An other Constant of States and S	
Eile Edit View Sources Eilters Tools	Catalyst Macros Help	
😥 🔌 🛱 🛱 🔊 🔍 💽 🤶	🔍 🕅 📣 🗈 🛤 🔁 Time: 0 🛛 0 🚍 of 100	
📱 🎴 🚔 🛱 🗟 🔵 Solid Color	🔹 🕞 Point Sprite 🚽 🔀 🔣 😳 🗳 鉢 鉢 🗱 🖽 🖉 🚱 🚱 🔇	
🗐 🕥 🟟 🕸 🏟 🎯 🖉 🖉		
Pipeline Browser Information	Layout #1 × +	Color Map Editor & >
Pipeline Browser & X	<b>卵 乳 3D 間 風 田 時 戦 戦 取</b> Ren	derView1 BBBX Search _ (use Esc to clear text)
builtin:		
		C L
Properties & X		
🕅 Apply 🖉 Reset 🗱 Delete 💡		
Search (use Esc to clear text)		
roperties (Transform I)		
Transform Transform		
Show Box		
Translate 0 0 100		
Rotate 0 0 0		
Scale 1 1 -100		
Rese		
<ul> <li>Display (UnstructuredGridRepresentat</li> </ul>		
Representation Point South		
Coloring		
Solid Color	μY	
	7 V	
Styling		
Opacity 1		
·····		
· · · · · · · · · · · · · · · · · · ·		

# Change radius of particles (2)

• Set radius of particles



# Set trajectory pathlines (1)

#### • [Filters] -> [Alphabetical]

-> [Temporal Particles Pathlines]



(Sample data shown above is changed from previous slide.)

# Set trajectory pathlines (2)

• Set parameters for pathlines

M ParaView 4.3.1 64-bit	THE REAL PROPERTY AND ADDRESS OF THE REAL PROPERTY AND ADDRESS OF THE REAL PROPERTY AND ADDRESS OF THE REAL PROPERTY ADDRESS OF THE		- 0 X
<u>Eile Edit View Sources Eilters Tools</u>	Catalyst Macros Help		
🖻 🖄 🞇 🖉 \land 🖓 💡	🚉 🕪 📣 🕨 🛱 Time:0 0 😭 of 100		
📘 🎥 🛱 🛱 📾 🔹 Traild	🔹 🕞 Surface 🔹 🔣 🔣 😳 🗱 👫 🗱 👫 🗱 🕼 🖉		
🖩 🚳 🟟 🏟 🏟 🖗 😂 🚽	🕲 🕼 🖳 👷 🖉 🛞		
Pipeline Browser & X	Layout #1 × +	Comparative View Inspector	₽×
builtin:	# % 30 簡 派 [1] ● 総 総 派 Render View 1 回日口×	Lavout 8 A x 8 A	
		Overlay all comparisons	
		Darameter	
👁 💼 Transform 1		Parameter	
TemporalParticlesToPathlines1			
Pathlines			
Particles			
Properties Information			
Properties B ×			
Search (use Esc to clear text)			
Properties (TemporalParticles TePathlin			
Maalu Daintes (Temporali al ricites for admir			
Mask Fornts 1			
Max Track Length 25	Traille	Time	
Max Step Distance 350 180 =		⊿ [Select Parameter]	
Global or Local IDs		Comma-separated values accepted.	
📼 Display (GeometryRepresentation)			
Coloring			
◆ TrailId ▼			
Show Ge Edit	4		
Styling	Y4		
Opacity 1	2		
Lighting			
Specular 0			
Cube Axes -	==0.000e+00		
4		Memory Insper Comparative View Insper	Collaboration P···
	36		

Mask Points = 1, Max Track Length = ???, Max Step Distance = (350, 180, 100)

### Animation

#### • Click > to play a movie



### Sample program making data

program main

!

write(FileName, '(a,i6.6,a)') 'out/step', t, '.vtk'

```
implicit none
real(8), parameter :: PI = 3.141592d0
integer, parameter :: NParcel = 10
                                       ! Number of particles
real(8)
             :: a ParcelLon(NParcel) ! Parcel position X
             :: a_ParcelLat(NParcel) ! Parcel position Y
real(8)
             :: a_ParcelSig(NParcel) ! Parcel position Z
real(8)
integer
             ::1
integer
              :: t
integer
              :: tmax
character(len=256) :: FileName
integer
              :: FU = 50
tmax = 100
do I = 1, NParcel
a ParcelLon(I) = 0.0d0 + 10.0d0 * (I-1)
a_ParcelLat(I) = 0.0d0
 a_ParcelSig(I) = 0.0d0
end do
do t = 1, tmax
 ! Calculate parcel positions
 !
 do | = 1. NParcel
  a ParcelLon(I) = a ParcelLon(I) + 1.0d0
  a_ParcelLat(I) = a_ParcelLat(I) &
   & + 1.0d0 * sin( 2.0d0 * PI / 360.0d0 * a_ParcelLon(I) + 2.0d0 * PI / dble( tmax ) * (t - 1))
  a ParcelSig(I) = a ParcelSig(I) + 1.0d0 / dble(tmax)
 end do
 ! Output
 ! A new file is created at each time step.
```