# Scientific Visualization with ParaView

#### Geilo Winter School 2016

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# Outline

- Part 1 (Monday)
  - Fundamentals
  - Data Filtering
- Part 2 (Tuesday)
  - Time Dependent Data
  - Selection & Linked Views
- Part 3 (Thursday)
  - Python scripting

# Time & Animations

#### Animation Toolbar



# Loading Data with Time

- 1. Open the file can.ex2
- 2. Select all variables





## Animation Pitfall

- Go to first time step 1.
- 2. Color by EQPS variable
- 3. Play

or skip to last time step 🛛 🔊





### Data Range Workarounds

- Go to representative time and hit

- In Settings change On File Open to Goto last timestep
  - May not work!



### Data Range Workarounds

- Open color scale editor dialog
- Set a custom range
- Or re-scale over time
  - Can be slow!





#### Reset ParaView

#### Edit $\rightarrow$ Reset Session



#### Animation View

#### View $\rightarrow$ Animation View

🕼 Animation View 🕞 🗵					
Mode	e: Snap To TimeSteps	✓ Time: ₽885044992	Start Time: 0	End Time: 9885044992 No, Frames: 10	×.
	Time	D.000e+00	1.433e-03	2.867e-03	4.300e-03
	TimeKeeper - Time				
÷	can.ex2 💌 Apply D	visplacements	~		

#### Animation View

#### View $\rightarrow$ Animation View

- Animation Modes
  - Sequence
  - Real Time
  - Snap To TimeSteps



# Changing Animation Timing

- 1. Open can.ex2. Load all variables
- 2. 1+Y
- 3. View  $\rightarrow$  Animation View
- 4. Change Mode to Real Time Default animation duration is 10 sec
- 5. 🕨
- 6. Change Duration to 60 sec
- 7. 🕨

# **Temporal Filters**

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_			ParticleTracer		
			StreakLine		
			Temporal Cache		
			Temporal Interpolator		
			Temporal Shift Scale		
			Temporal Snap-to-Time-Step		
			Temporal Statistics		

# Smoothing the Animation

- 1. Make sure can.ex2 highlighted
- 2. Add a Temporal Interpolator filter
- 3. Split view 🔳
- 4. Show can.ex2 in one and TemporalInterpolator1 in the other
- 5. Link the cameras
- 6.

# Adding Text Annotation

- 1. If needed, reset ParaView and reload can.ex2
- 2. Add a Text source
- 3. Type a message in text edit box



#### Text Position

- Text Position						
-Lower Left Corner						
0.32 0.93						
Use Window Location						

#### Annotate Time

- 1. Add an Annotate Time source OR
- 1. Select can.ex2
- 2. Add an Annotate Time filter

### Save Animation

Chose File  $\rightarrow$  Save Animation •



Animation Settings Dialog						
Animation Duration (sec)	0,00		A V			
Frame Rate (fps)	15,00		-			
No. of Frames / timestep	1					
Number Of Frames	0		A V			
Resolution (pixels)	1055	660				
Timestep range	0	43				
Stereo Mode (if applicable)	No Stereo		-			
Compression						
Disconnect before saving animation						
Save Animation Cancel						

#### Reset ParaView

#### Edit $\rightarrow$ Reset Session



### Make an Animation

- ParaView supports the animation of various properties of sources/filters over time
  - Source/filter settings
  - Visibility and opacity

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×	1	Transform1 - Transform - Scale (2)	1		ß		1
×	<b>v</b>	Transform1 - Opacity	0	S.	1 1	ð	0.5
¢	Can.ex2 Use Meta File						

• Animations are based on key-frames



## Make an Animation

- 1. Add a Sphere source
- 2. Make animation view visible
- 3. Change No. Frames to 50
- 4. Select Sphere1, Start Theta, press 🕂
- 5. Double-click Sphere1 Start Theta
- 6. Make a new keyframe
- 7. First keyframe value  $\rightarrow$  360, second keyframe time  $\rightarrow$  0.5 value  $\rightarrow$  0.
- 8. Click OK and play |>

### Animating Two Properties

- 1. Open Sphere1 Start Theta
- 2. Delete the first keyframe (at time 0)
- 3. Click OK
- 4. Select Sphere1 End Theta, press 🕂
- 5. Open Sphere1 End Theta
- 6. Change second key frame time to 0.5
- 7. Click OK and play ▶

#### Camera Orbit

- 1. Place the camera where the orbit should start.
- 2. Make animation view visible.
- 3. Select Camera Orbit, press
- 4. Accept default values (click OK).
- 5. 🕨

## Following Data

- 1. Open can.ex2. Load all variables.
- 2. 1+Y
- 3. Make animation view visible.
- 4. Select Camera Follow Data, press



5. 🕨

#### Reset ParaView

#### Edit $\rightarrow$ Reset Session



# Data Selection

# Query-Based Selection

- 1. Open can.ex2. All variables
- 2. Go to last time step 🕨
- 3. Edit  $\rightarrow$  Find Data
- 4. Top combo box: find Cells
- 5. Next row: EQPS, is >=, and 1.5
- 6. Click Run Selection Query



# Query-Based Selection

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	Find Cell 🛟 from can.ex2					
	EQPS     ↓     is >=     ↓     1.5					
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Variables	EQPS ObjectId GlobalElementId <sup>2</sup> edigreeEl	lemer	1			
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	2 2.13094 1 76 76					
ACCL	Selection Color Labels None	el Color				
✓         Image: Second s	Extract Selection Plot Selection Over Time Cl	lose				
Apply Displacements 1						
Check Selected Blocks						

# **Brush Selection**



- Surface Cell Selection (shortcut: s)
- **Surface Point Selection**



Through Point Selection



Select Points (polygon)



Select Cells (polygon)



- Block Selection (shortcut: b)
- Interactive Selections



# Selections

- 1. Open Find Data
- 2. Make various brush selections
- 3. Observe results in the Find Data dialog box
- 4. Play with the Invert Selection and Show Frustum options

### Frustum vs. Id Selections

1. Make a Select Cells Through



- 2. Turn on Show Frustum in Find Data
- 3. Play  $\triangleright$
- 4. Hit Freeze Selection in Find Data
- 5. Play 🕨

# Adding Labels

- 1. Go to the last time step
- 2. Open Find Data
- 3. Create query Global ID is min
- 4. Click Run Selection Query
- 5. In the Cell Labels chooser, select EQPS

## Interactive Selections

1. Go to the last time step



- 2. Open Find Data
- 3. In the Cell Labels chooser, select EQPS
- 4. Click Gintractiv Select Cells On
- 5. Move the mouse around

# Plot Selection Over Time

- 1. Open Find Data
- 2. Create query EQPS is max
- 3. Click Run Selection Query
- 4. Click Plot Selection Over Time
- 5. 💽 Apply
- In Display controls, turn off all plot series except for max(EQPS)

### Selection over Scatterplots

- 1. Open can.ex2. Load all variables
- 2. Go to the last time step
- 3. Apply a Scatter plot filter
- 4. Set X Array Name to DISPL\_X
- 5. Enable only DISPL\_Y
- 6. Select Points with large negative displacements in both X and Y
- Click on the 3D view and make Scatterplot1 visible

# Extracting a Selection

- Open can.ex2. Load all variables 1.
- Select the can only 2.
  - Use parallel projection
- Add the extract selection filter 3.



- 4. Apply
- Create a Scatter plot of can.ex2 and a 5. Scatter plot of the extracted selection and compare them (over time)

#### Exercises

- Exercise 3
  - Load can.ex2
  - Find the cell with the highest average EQPS
  - Plot its position over time
  - Make a clip plane along the X-axis so that the cell is always visible
  - Add an arrow that always points at the cell
  - Make the camera follow the cell
  - Save the final animation
- Suggested filters: Arrow, Clip, Calculator, Extract Selection, Temporal Statistics, Transform

#### Exercises

- Exercise 4
  - Load rot\_a and rot\_b
  - Identify the centers of rotation in both datasets
  - Synchronize the motion of the two centers
  - Resample the dataset in time so that they have the same time domain
  - Study the difference between the fields
  - Identify the extra center of rotation in rot\_b, and the related scalar field
- Suggestions: Animation View, Append Attributes, Calculator, Contour, Scatterplot, Temporal Interpolator, Temporal Shift-Scale

#### Exercises

- Exercise 4 Bonus
  - Identify the equations used to generate the datasets
  - Resample the datasets on a plane so that the motion is removed
- Suggestions: Animation view, Plane, Plot over line, Plot selection over time