

ANIMATION IN PARAVIEW

Animation methods

1. **Keyframe animation: animate any property of any pipeline object**
 - easily create snazzy animations, somewhat limited in what you can do
 - in Time Manager: select object, select property, create a new track with "+", double-click the track to edit it, press "▶"
 - can combine multiple tracks / timelines
 - examples: load the file `data/sineEnvelope.nc`
 - 1.1 animate a slice
 - 1.2 animate a contour

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3. **Script your animation in Python (covered in the Scripting section)**
 - steep learning curve, very powerful, can do anything you can do in the GUI
 - typical uses: generating one frame per input file, animating the camera
 - a simpler exercise without input files: see next slide

Exercise: animating function growth

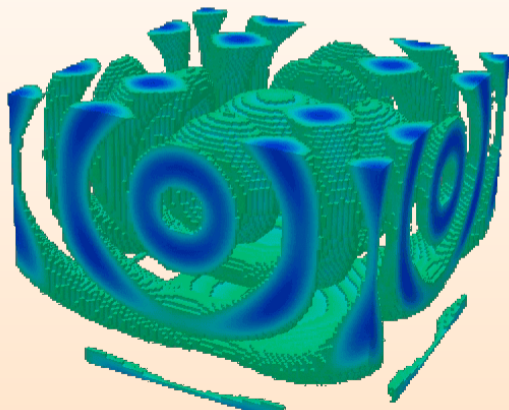
- ➡ 3D sine envelope wave function defined inside a unit cube ($x_i \in [0, 1]$)

$$f(x_1, x_2, x_3) = \sum_{i=1}^2 \left[\frac{\sin^2 \left(\sqrt{\xi_{i+1}^2 + \xi_i^2} \right) - 0.5}{\left[0.001(\xi_{i+1}^2 + \xi_i^2) + 1 \right]^2} + 0.5 \right], \text{ where } \xi_i \equiv 15(x_i - 0.5)$$

- ➡ Reproduce the movie on the screen

<https://youtu.be/Oc3DAJvArIU>

or [hidden/growth.mp4](#) on presenter's laptop



Exercise: animating function growth (cont.)

To visualize a single frame of the movie:

1. load `data/sineEnvelope.nc` (discretized on a 100^3 grid)
2. apply `Threshold` keeping only data from 1.2 to 2
3. apply `Clip`: origin $O = (49.5, 15, 49.5)$, normal $N = (0, -1, 0)$
4. colour by the right quantity

Two possible solutions:


1. bring up **Time Manager** to animate `Clip's O2` from 0 to 99, for best results save animation as a sequence of PNG files
2. covered in `Scripting: Start/Stop Trace` to record the workflow, save the corresponding **Python script**, enclose **parts of it** into a loop changing `O2` from 0 to 99 and writing a series of PNG screenshots, run it inside `ParaView` to produce 100 frames

in either case, merge PNGs using a 3rd-party tool, e.g.

```
ffmpeg -r 30 -i frame%04d.png -c:v libx264 -pix_fmt yuv420p \  
-vf "scale=trunc(iw/2)*2:trunc(ih/2)*2" movie.mp4
```

Camera animation in the GUI

Good introductory resource <https://docs.paraview.org/en/latest/UsersGuide/animation.html>

1. Start with any static visualization and adjust the view to your liking
2. Click 'Adjust Camera' icon  (one of the left-side icons on top of the vis window)
 - check that Center of Rotation = Camera Focal Point and use these in (3a) below
☞ that's why with interactive rotation your visualization stays perfectly centred
3. Bring up Time Manager (or erase all previous timelines) and then do the following:

3a. Circular orbit

- select Camera | Follow Path
- click "+" to create a new timeline
- double-click on the white (or black) timeline
- click Create Orbit (which is not a setting but a macro!), edit **Center**, click Ok
- double-click on Path... in the right column, edit **Camera Focus**, click Ok
- click Apply or Ok to close the Animation Keyframes dialogue
- adjust the number of frames

3b. Custom path

- select Camera | Follow Path
- click "+" to create a new timeline
- double-click on the white (or black) timeline
- double-click on Path... in the right column
- click on Camera Position
 - a white path with spheres will appear
 - drag the spheres around
- also can change Camera Focus and Up Direction
- click Apply in the Animation Keyframes window

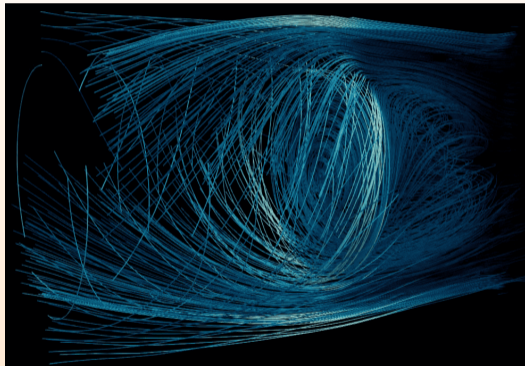
4. Click "▶"

Exercise: create a camera fly-in towards the focal point

- Similar to the scripting exercise, but now using keyframe animation, fly 2/3 of the way towards the focal point
- Use Camera | Interpolate cameras, double-click on the white (or black) timeline
- At $t = 0$:
 - use the current camera position $\mathbf{r}_{\text{initial}}$
 - use the current camera focus $\mathbf{r}_{\text{focal}}$
- At $t = 1$:
 - set Position to $\frac{\mathbf{r}_{\text{initial}}}{3} + \frac{2\mathbf{r}_{\text{focal}}}{3}$
 - will the focus change?

Animating stationary flow: streamlines through a slice

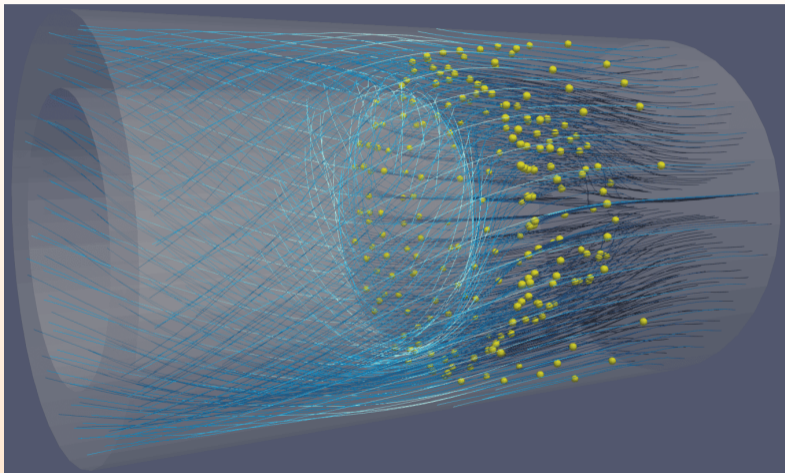
- There is no temporal dimension in this dataset, yet we want to produce an animation with streamlines
- This is one possible direction – what other creative ideas can we explore?
- <https://youtu.be/67qTsW8-kKk> or [hidden/radialSlice.mp4](#) on presenter's laptop
- <https://youtu.be/2uSRrZ6oW0o> or [hidden/xySlice.mp4](#) on presenter's laptop



Animating stationary flow: streamlines through a slice (cont.)

1. Load `disk_out_ref.ex2` making sure to load velocity
2. Draw a radius-z plane slice through the center
 - origin $O = (0, 0, 0)$
 - normal $N = (1, 0, 0)$
3. Stream Tracer With Custom Source
 - `input = disk_out_ref.ex2`
 - `seedSource = Slice1`
4. Tube filter with $r = 0.015$
5. Time Manager: animate Slice's O_0 from -1 to 1 (full range [-5.75,5.75])
6. Use 100 frames, black background, blue2cyan colourmap, colour with vorticity
7. Unselect "Show Plane"
8. Save animation as PNGs, encode at 10 fps

Animating a stationary flow: time contours



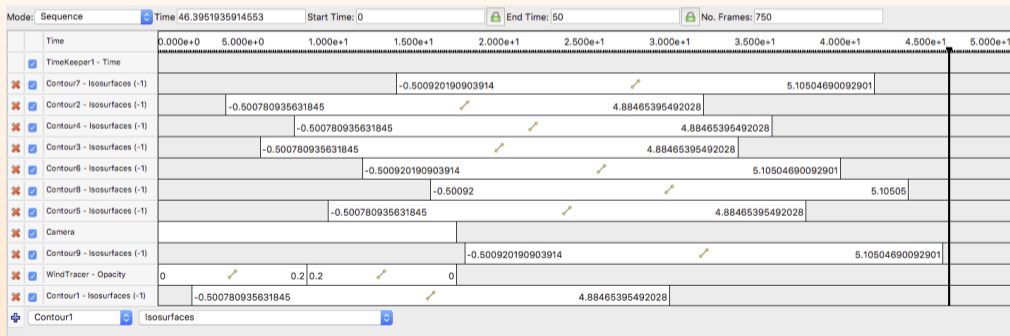
<https://youtu.be/cTBKeybfFyk> or [hidden/timeContours.mp4](#) on presenter's laptop

Animating a stationary flow: time contours (cont.)

1. Start with the streamtracer lines, however drawn
2. Apply a Countour filter to the output of Streamtracer
 - contour by Integration Time
 - probe the range of values that works best
3. Apply Glyph filter to the output of Countour
4. Time Manager: animate Contour | Isosurfaces
5. This video was recorded with 2000 frames at 60 fps
 - such high resolution only for the final production video
 - debugging animation with 100 frames is perfectly Ok

Combining many timelines in one animation (cont.)

- In principle, you can add as many timelines to the animation as you like, each with its own time interval and variables
- Here is an example from WestGrid's 2017 *Visualize This* competition submission by Nadya Moisseeva (UBC)



<https://youtu.be/eT8tj8BoYfg> or [hidden/complexAnimation.mp4](#) on presenter's laptop