HPC and Making Scientific Animations in ParaView

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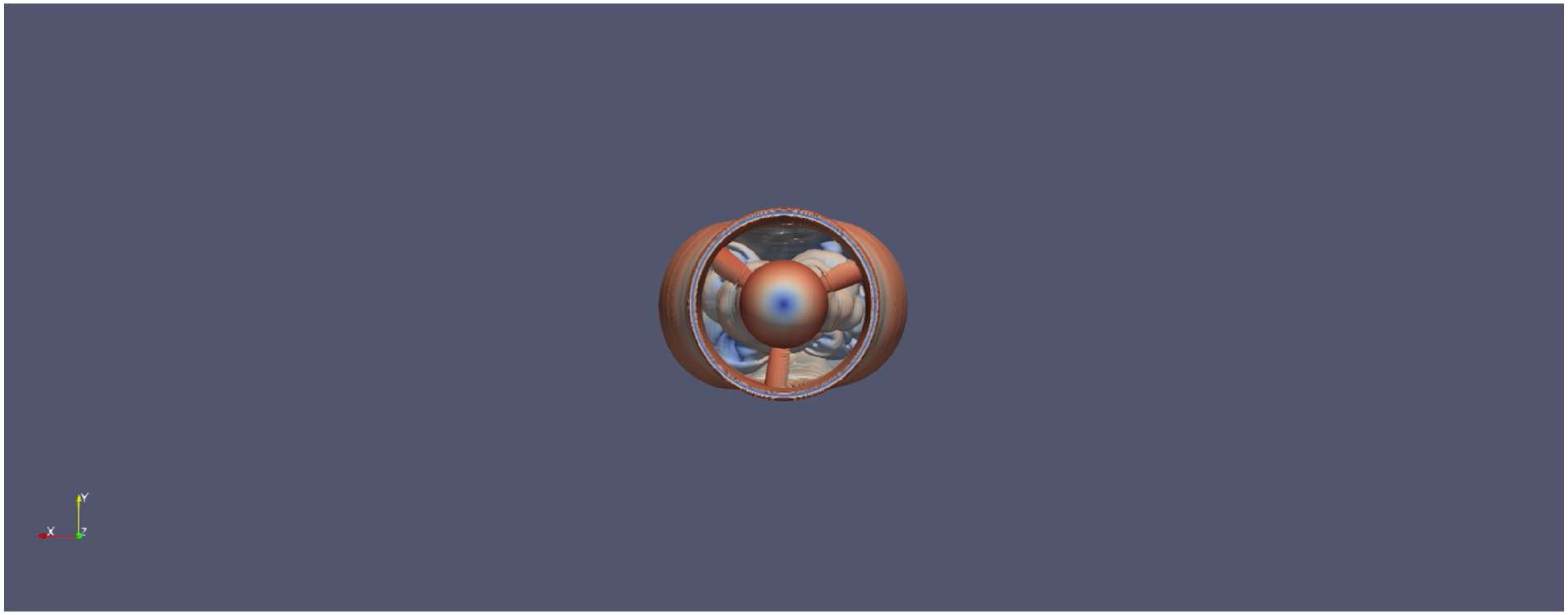
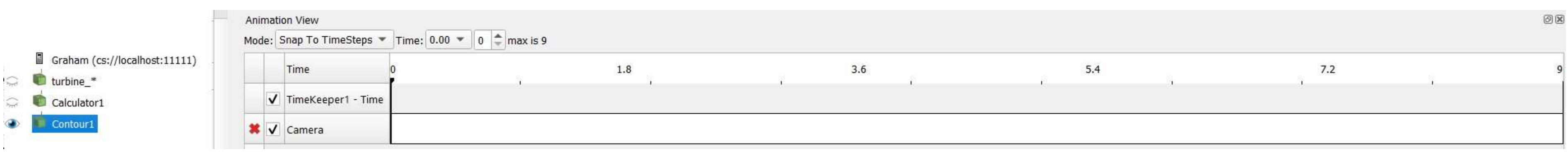
computecanada
regional partner

You’ll be able to …





Steps for Visualization Using Client-Server

Server Side:

A. Open a terminal and type:

```
1. cd /home/<username>/projects/def-SomePI
2. salloc --time=3:00:0 --ntasks=16 --mem-per-cpu=4000 --
   account=def-SomePI
3. cd /home/razoumov/paraviewcpu591/bin/
4. mpirun -np 16 pvserver      or            srun pvserver

Waiting for client...
Connection URL: cs://cdr#.int.cedar.computecanada.ca:11111
Accepting connection(s):
cdr#.int.cedar.computecanada.ca:11111
```

B. Open a second terminal and type:

```
1. ssh <username>@cedar.computecanada.ca -L
   11111:cdr#:11111
```

Client Side:

1. **Open ParaView 5.9.1 client on your desktop/laptop**
2. Under **File** > **Connect:** Click on **Add Server.** For **Name** put Cedar and accept the default settings.
3. Click **Open** and navigate to **/home/fbaratchi/paraview_training/**
4. Choose **turbine_*.vtu** and click **OK**
5. Click **Apply**

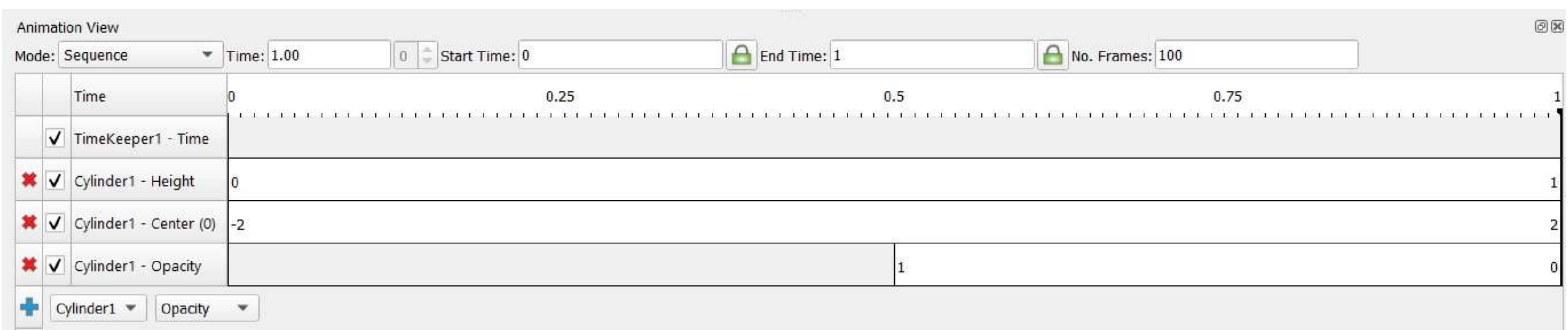
To Make Videos:

For generating videos:

1. Use *.avi format for generated video
2. Generate PNG images and merge them to an *.mp4 video using ffmpeg package

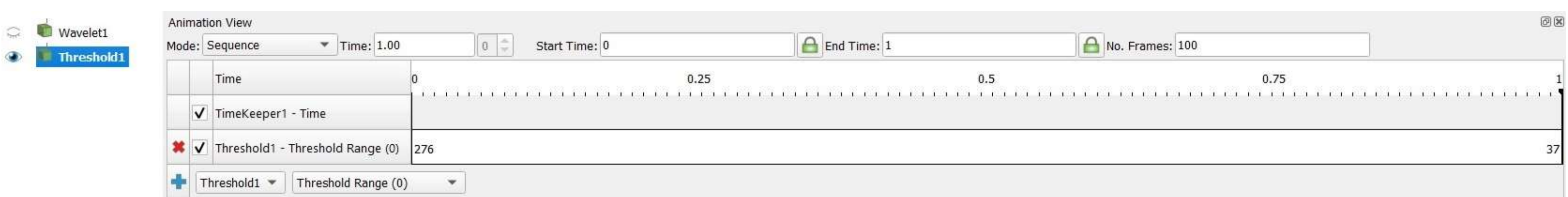
```
ffmpeg -r frame_per_sec -i PNG_file_name%04d.png -c:v libx264 -pix_fmt yuv420p -vf "scale=trunc(iw/2)*2:trunc(ih/2)*2" VIDEO_file_name.mp4
```

Animating Properties of an Object

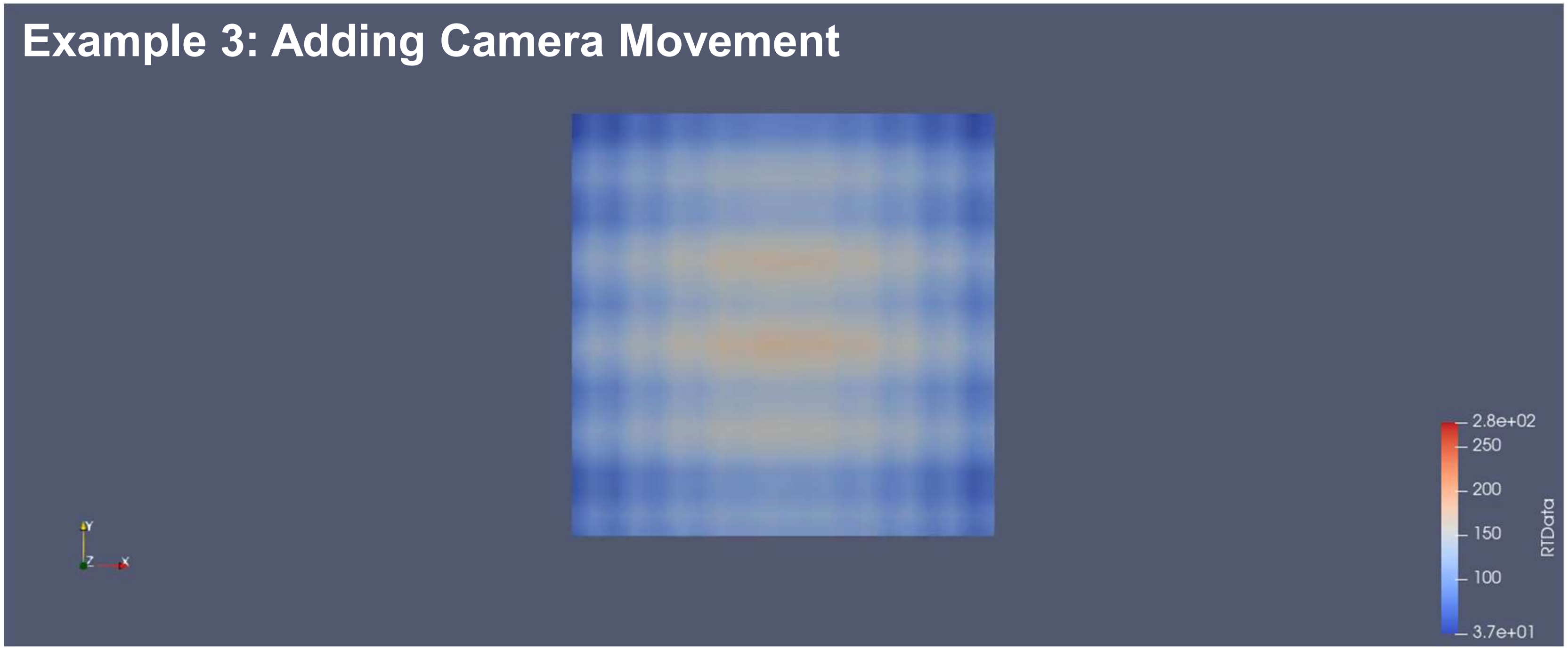


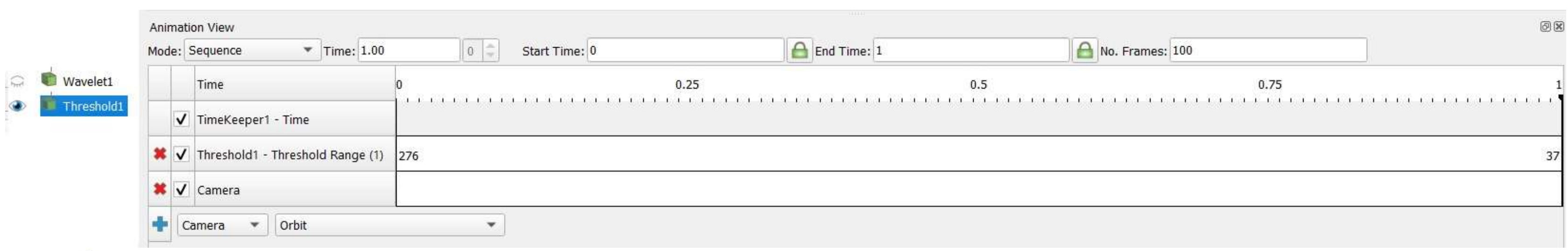
Animating Properties of an Object

Example 2: Animating Properties of a Filter



Animating Properties of an Object





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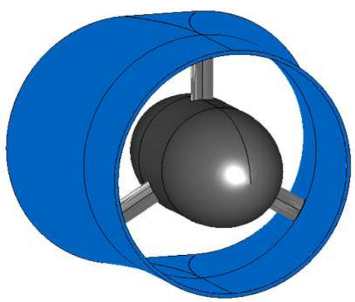
Animating a Sequence of Files:

Dataset:

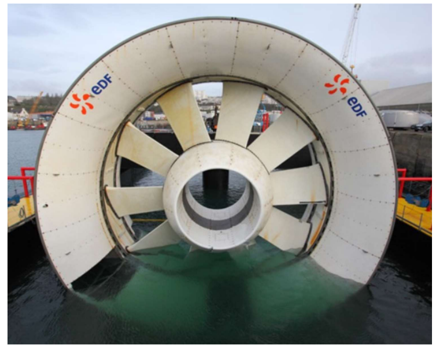
CFD Simulation of a Ducted Tidal Turbine Using Actuator Line Method



Geometry

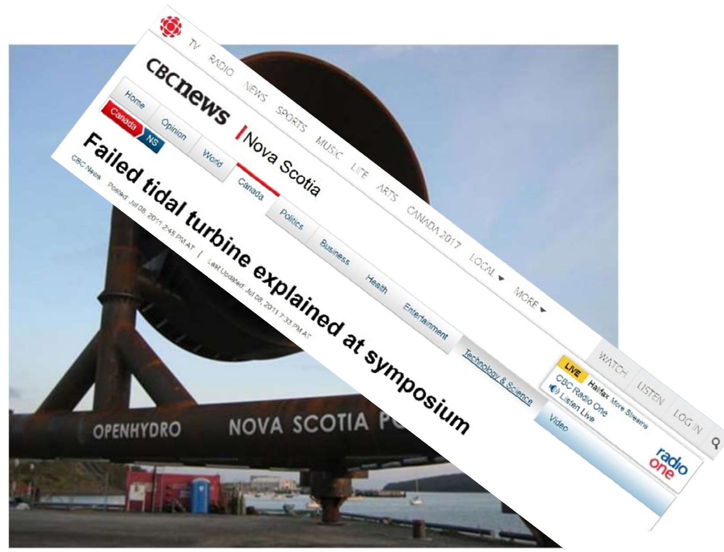
Turbine in Towing Tank

Background: Tidal Turbines Examples



Background: Why Use CFD for Tidal Turbines

- Tidal turbines operate in an extremely harsh environment.



- Pre-deployment studies are necessary to ensure safe and optimum operation of a tidal turbine.

Background: CFD Methods for Simulating Tidal Turbines

1. Full rotor simulation (FRS)
2. Actuator line (AL)
3. Uniform actuator disk (UAD)
4. Blade element actuator disk (BEAD)

Background: Governing Equations

Conservation of mass:

$$\frac{\partial \langle v_i \rangle}{\partial x_i} = 0$$

Conservation of momentum:

$$\rho \frac{\partial \langle v_i \rangle}{\partial t} + \rho \frac{\partial (\langle v_i \rangle \langle v_j \rangle)}{\partial x_j} = -\frac{\partial \langle p \rangle}{\partial x_i} + \frac{\partial}{\partial x_j}\left((\mu + \mu_T) \left(\frac{\partial \langle v_i \rangle}{\partial x_j} + \frac{\partial \langle v_j \rangle}{\partial x_i} \right) \right) + \boxed{S_i}$$

From AL methods

Background: Blade Element Theory

$$W = \sqrt{V_z^2 + (\Omega r - V_\theta)^2} \qquad \alpha = \varphi - \beta$$

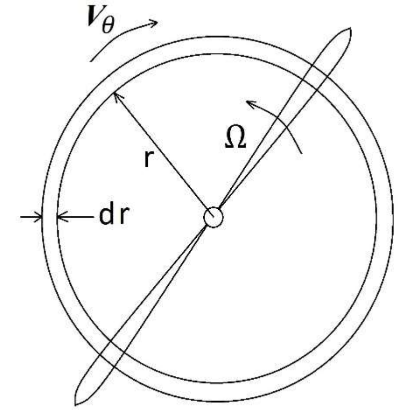
$$\varphi = arctan \frac{V_z}{\Omega r - V_\theta}$$

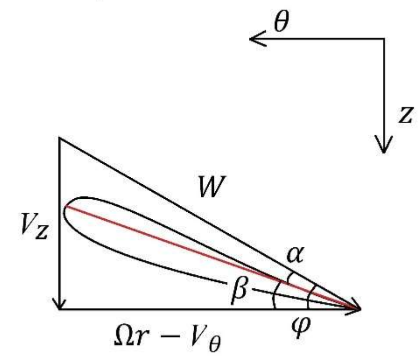
$$dF_z = dL \cos\varphi + dD \sin\varphi$$

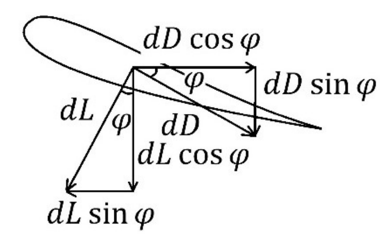
$$dF_\theta = dL \sin\varphi - dD \cos\varphi$$

$$dF_z = \frac{1}{2}\rho W^2 c\, dr(C_L \cos\varphi + C_D \sin\varphi)$$

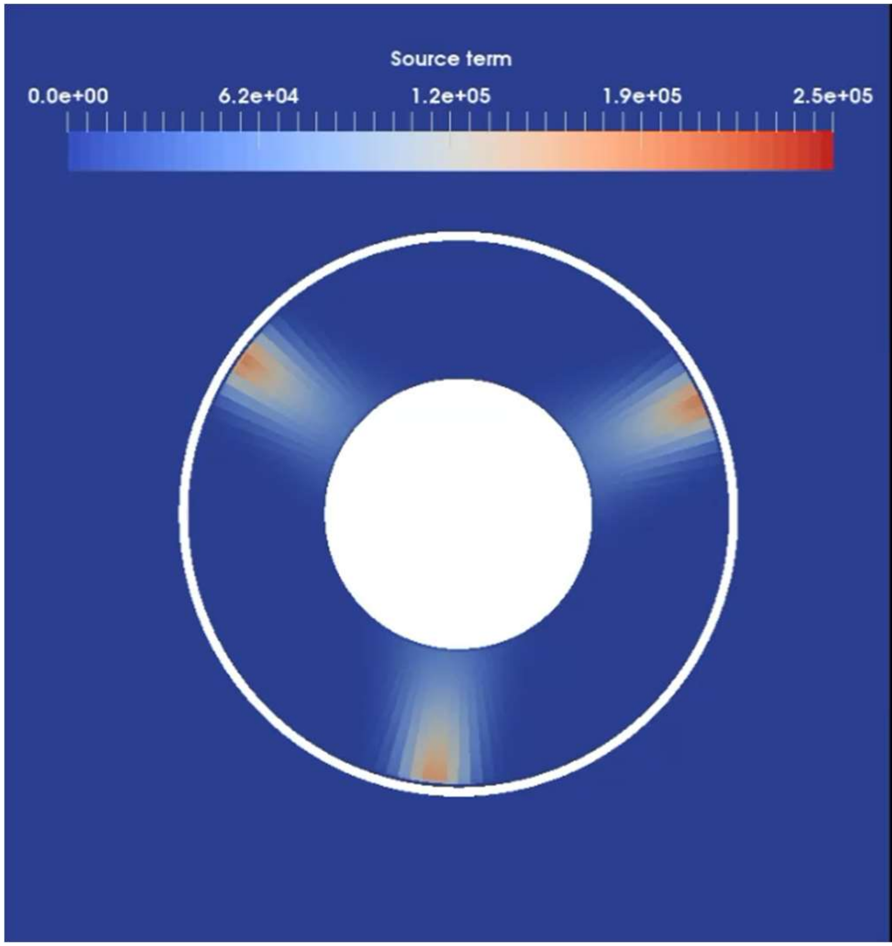
$$dF_\theta = \frac{1}{2}\rho W^2 c\, dr(C_L \sin\varphi - C_D \cos\varphi)$$



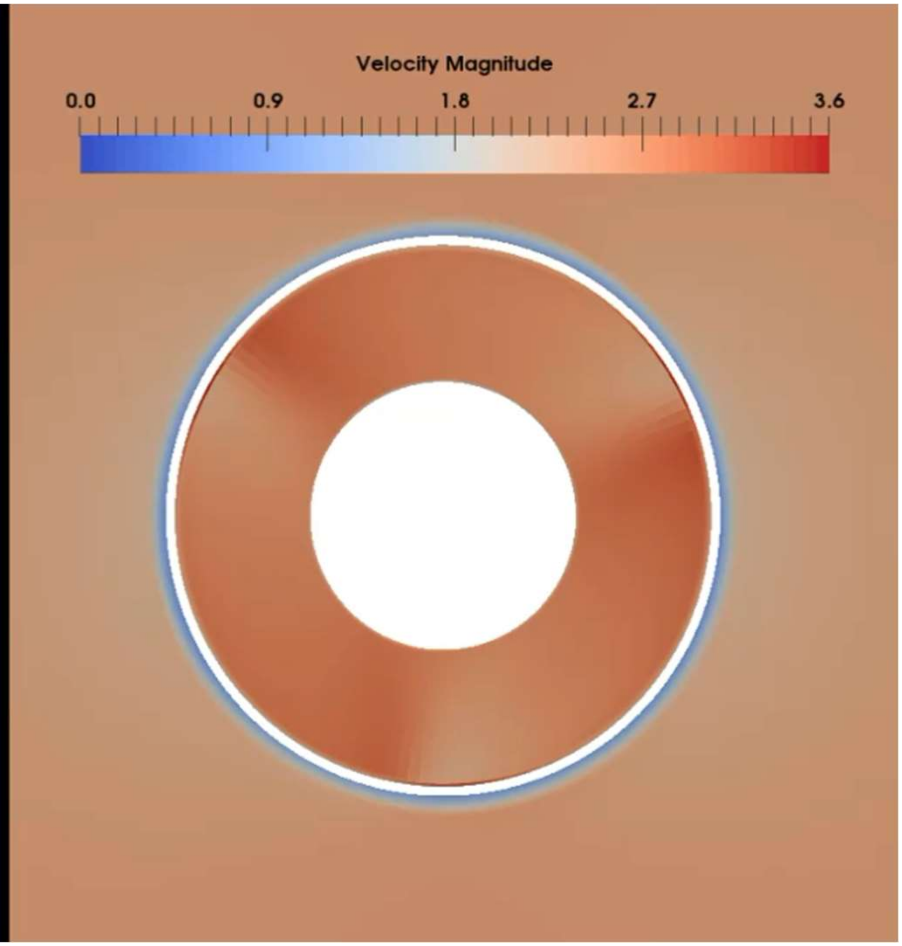




Animating a Sequence of Files (Example 1):

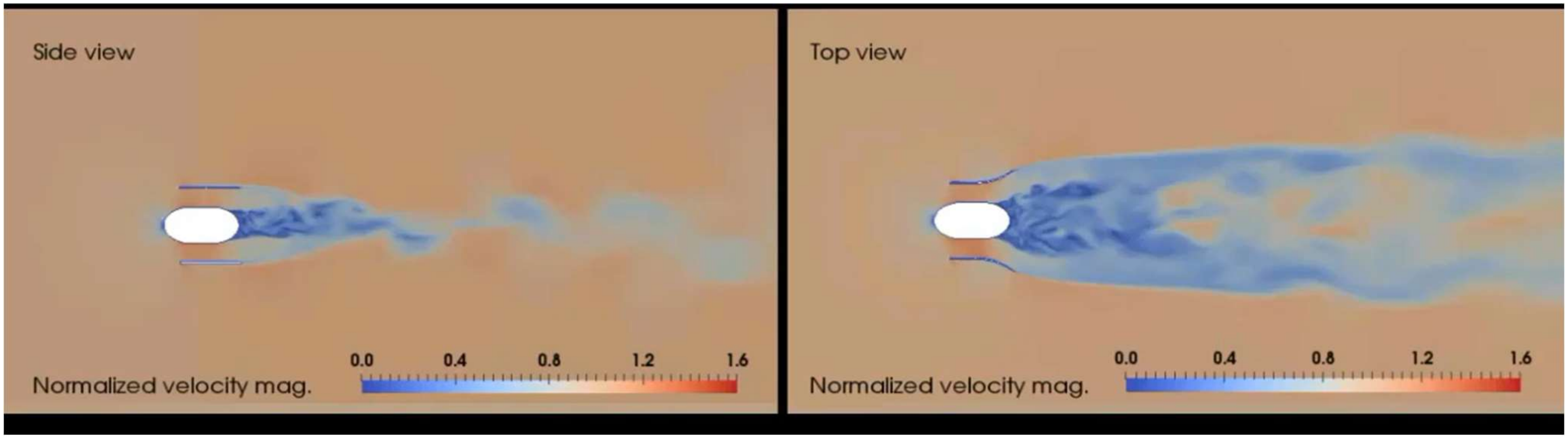


Source term distribution

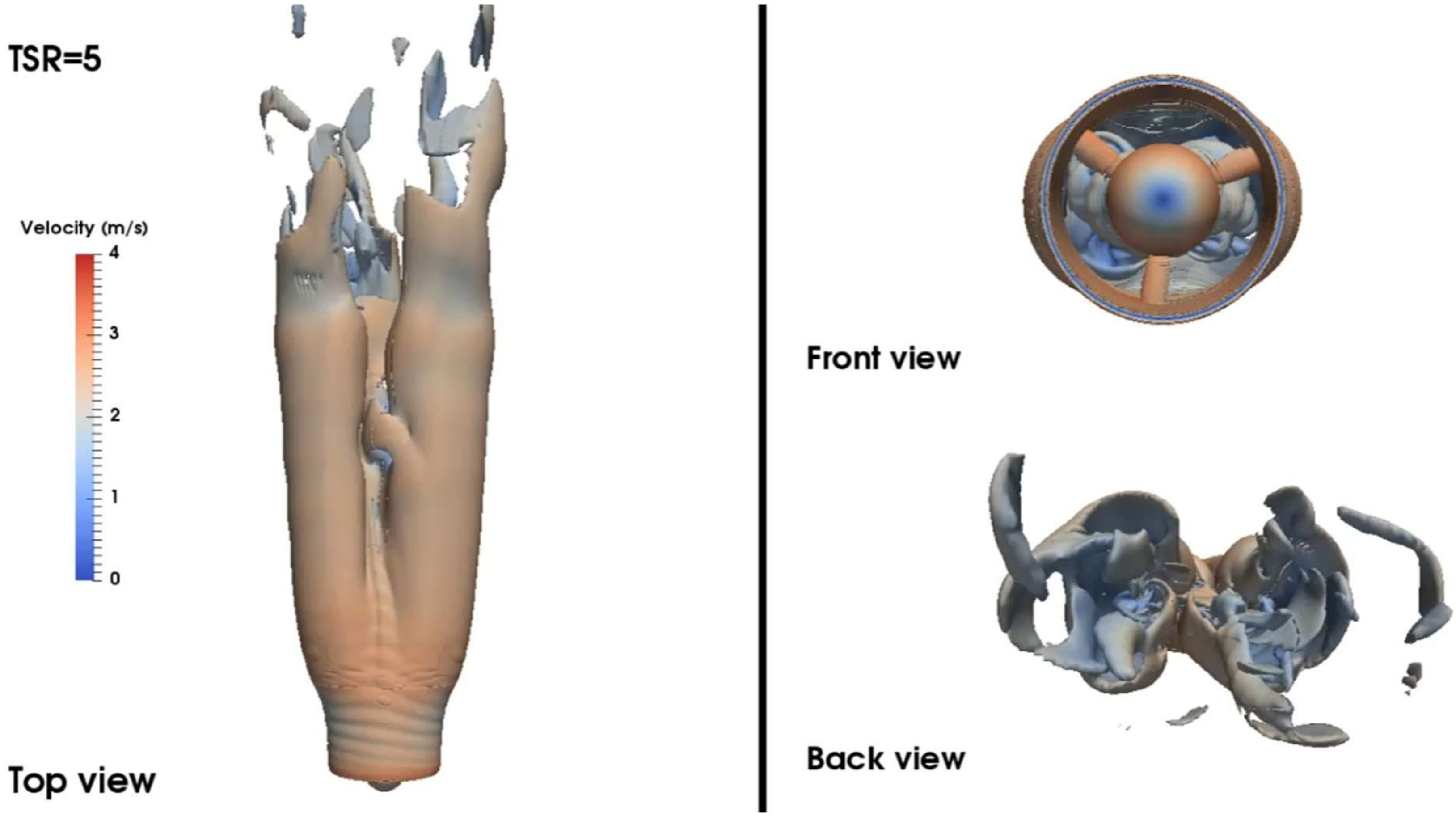


Velocity contours at rotor plane

Animating a Sequence of Files (Example 2):

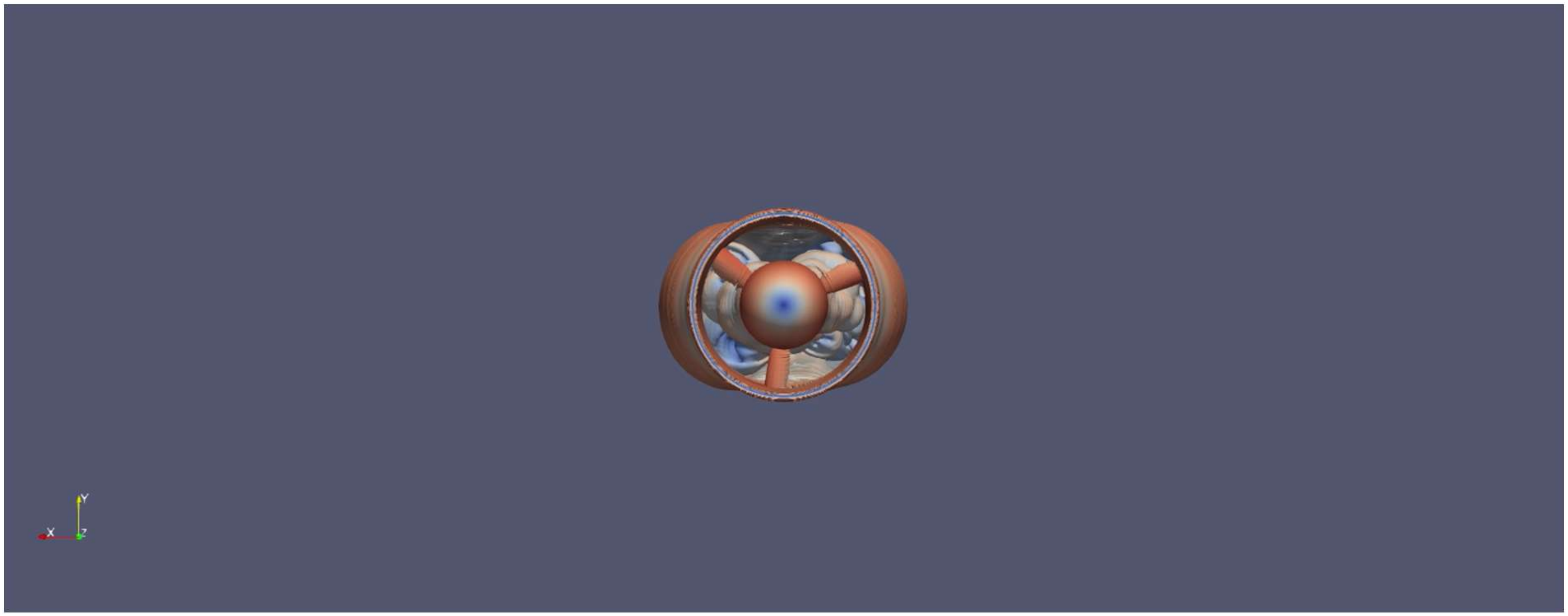


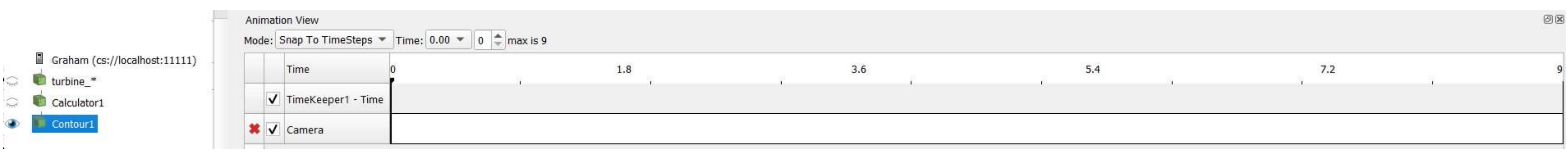
Animating a Sequence of Files (Example 3):




```
Calculator: mag(Vorticity)/16.8691
```

Animating a Sequence of Files (Example 4): Camera Movement





Where To Go For Help

Compute Canada wiki:

http://docs.computecanada.ca/

Email support:

support@computecanada.ca