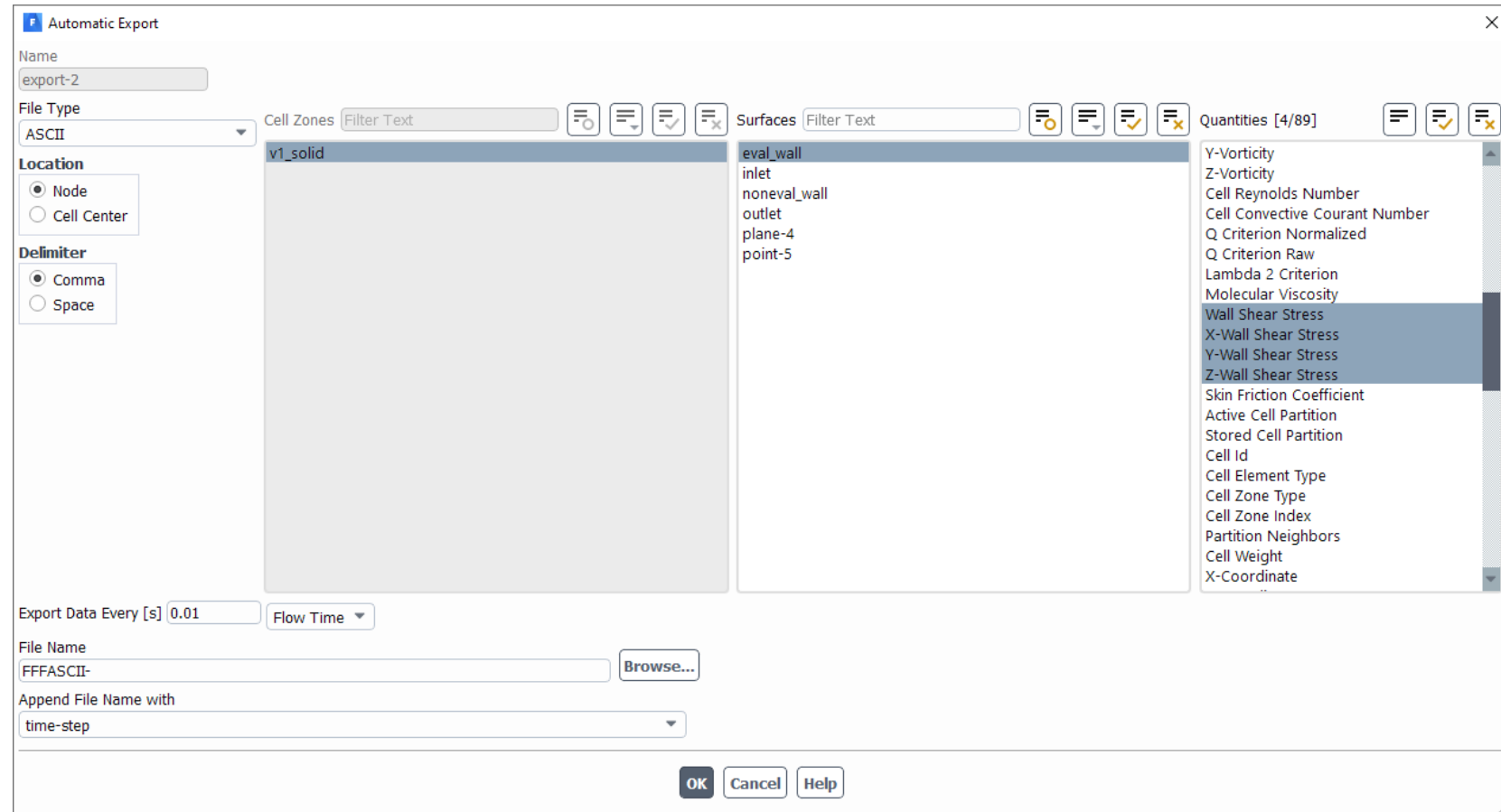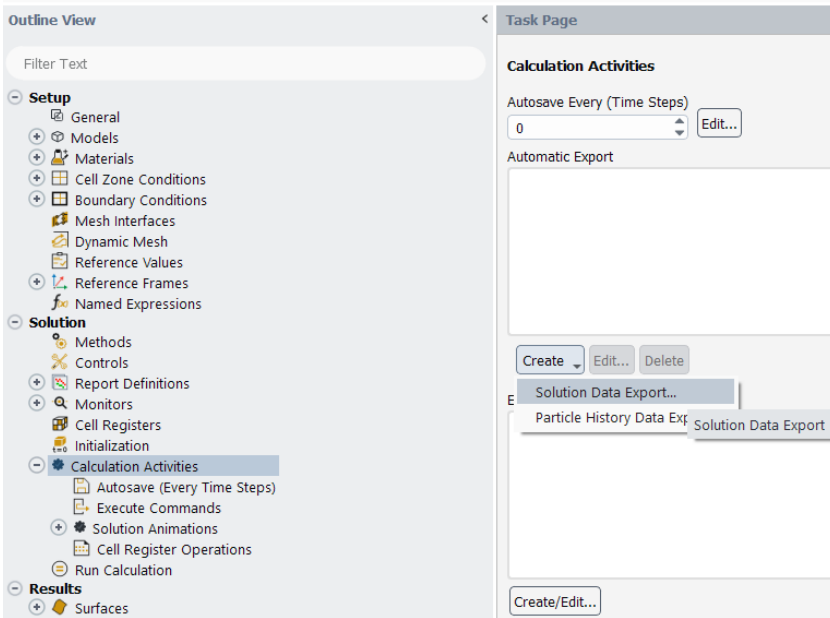# Hemodynamic Fluent Calculation Guide

By: Asad Mirza

For: CV-PEUTICS

Setting Up Fluent Export

Calculation Activities → Create → Solution Data Export

File Type: ASCII

Location: Node

Delimiter: Comma

Surface: Surface whose OSI/TAWSS you're interested in

Quantities: Wall Shear Stress and XYZ Wall Shear Stress

Exported Data

Post-Processing: Setting Parameters

- The MATLAB script titled "Fluent_Post_Processing.m" must be run to process the exported data.

- It will ask you for the following:
  - Simulation Start Time
  - Simulation End Time
  - Time Step Size
  - Cycle Period

- You will then be asked which results you wish to plot: TAWSS, OSI, RRT, or transWSS
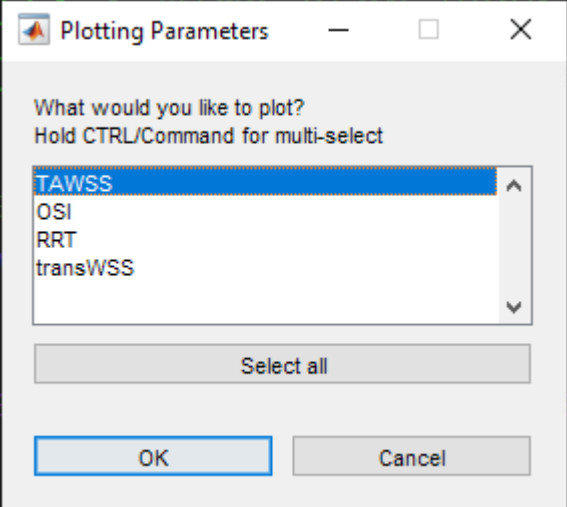
Post-Processing: TAWSS/OSI/RRT/transWSS

$$TAWSS = \frac{1}{T} \int_0^T |\overrightarrow{\tau_w}| dt$$

$$OSI = \frac{1}{2}\left(1 - \frac{\left|\int_0^T \overrightarrow{\tau_w}\, dt\right|}{TAWSS}\right)$$

Measures average WSS on a surface over time.

Measures average of the degree of forward/backward fluid movement on a surface over time.

$$RRT \sim \frac{1}{TAWSS(1 - 2OSI)}$$

$$transWSS = \frac{1}{T} \int_0^T \left|\overrightarrow{\tau_w} \cdot \left(\vec{n} \times \frac{\int_0^T \overrightarrow{\tau_w}\, dt}{\left|\int_0^T \overrightarrow{\tau_w}\, dt\right|}\right)\right| dt$$

Measures a fluid particle's relative time spent in a particular location on a surface over time.

Measures multidirectional WSS on a surface over time.

Post-Processing: TAWSS/OSI Plotting
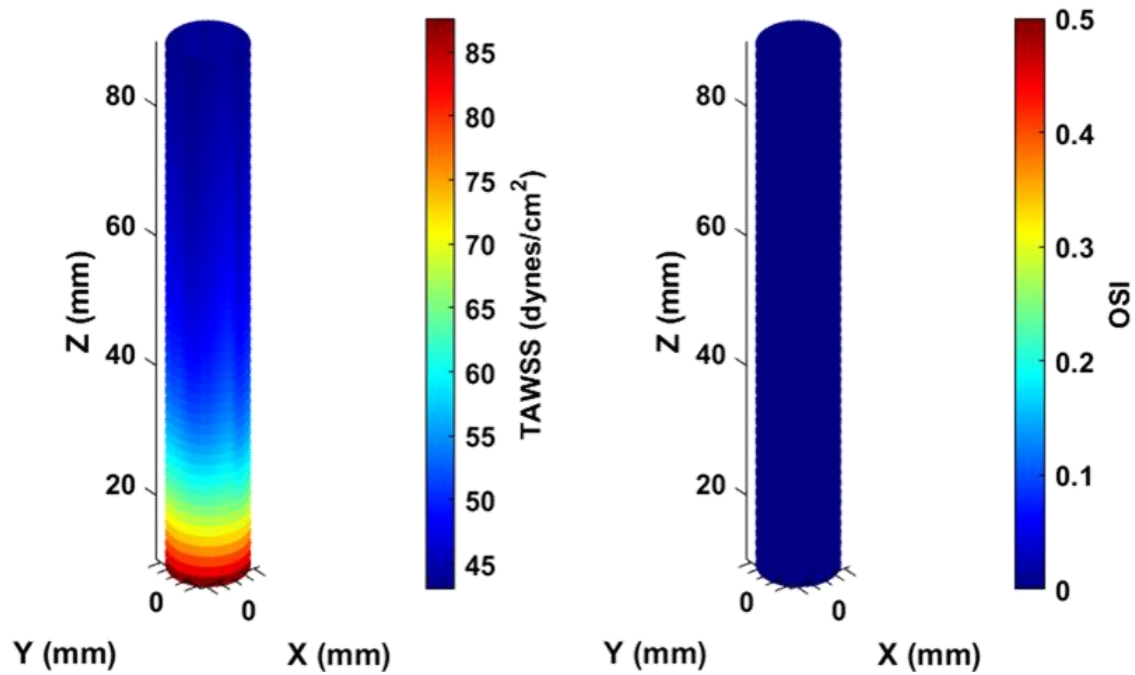
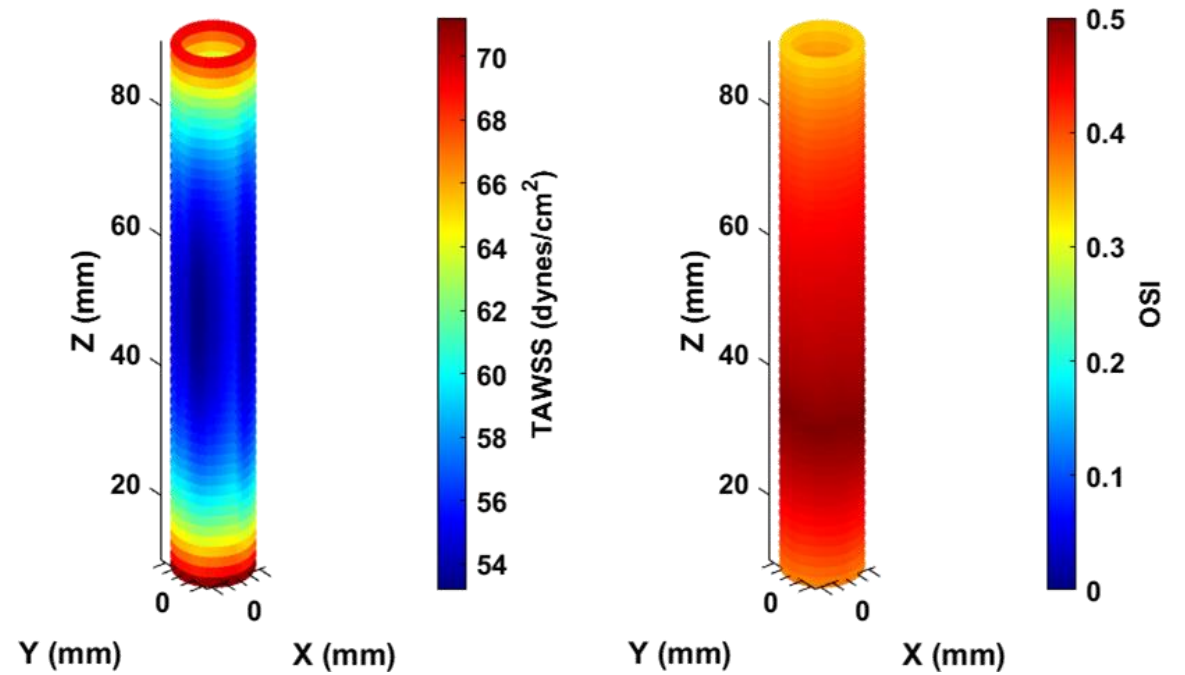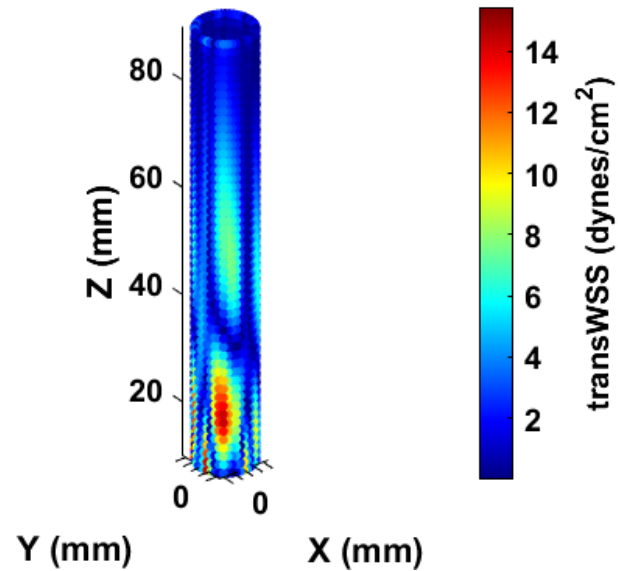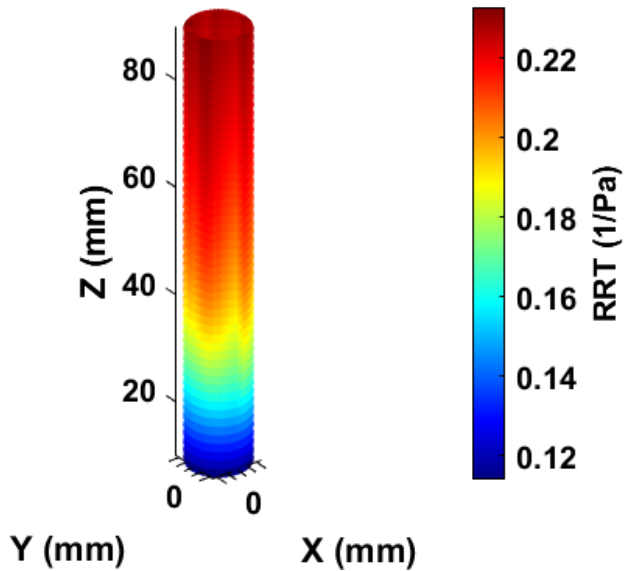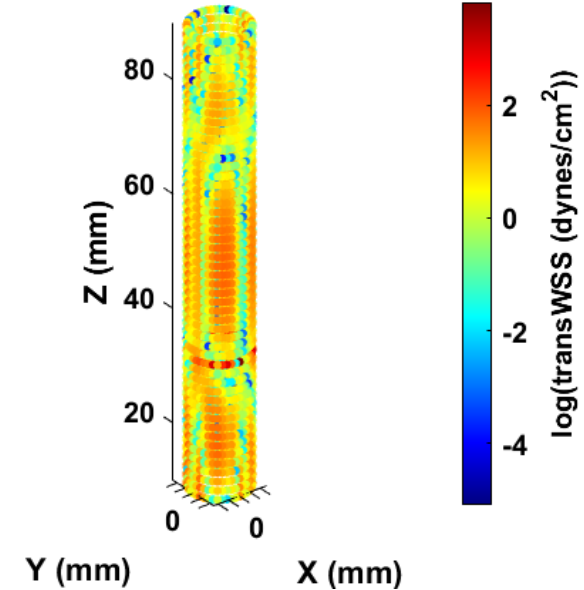Ex: +1 m/s Inlet   Ex: +/- 1 m/s Inlet
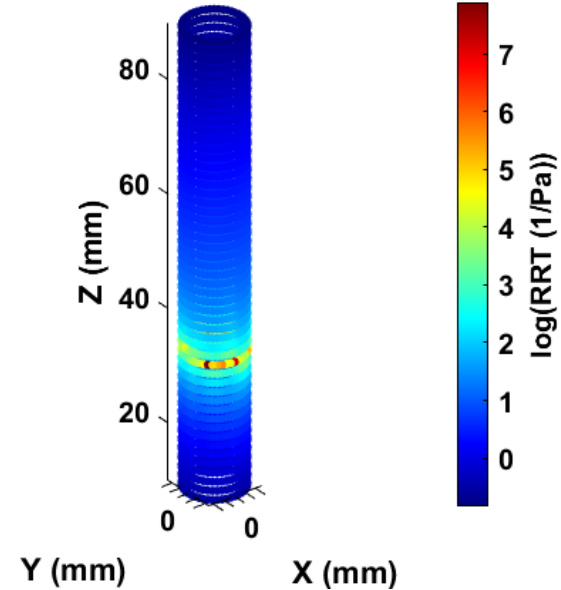
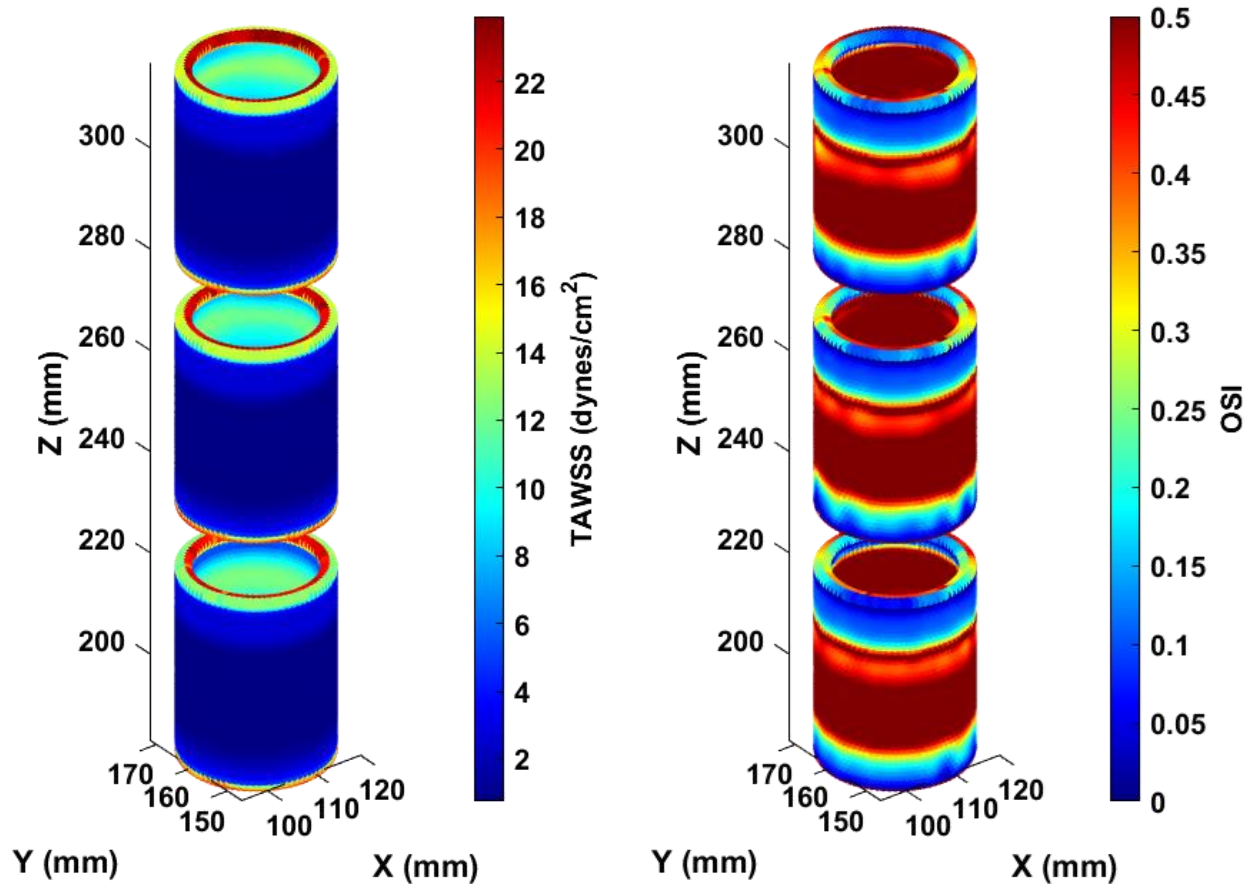# Post-Processing: RRT/transWSS

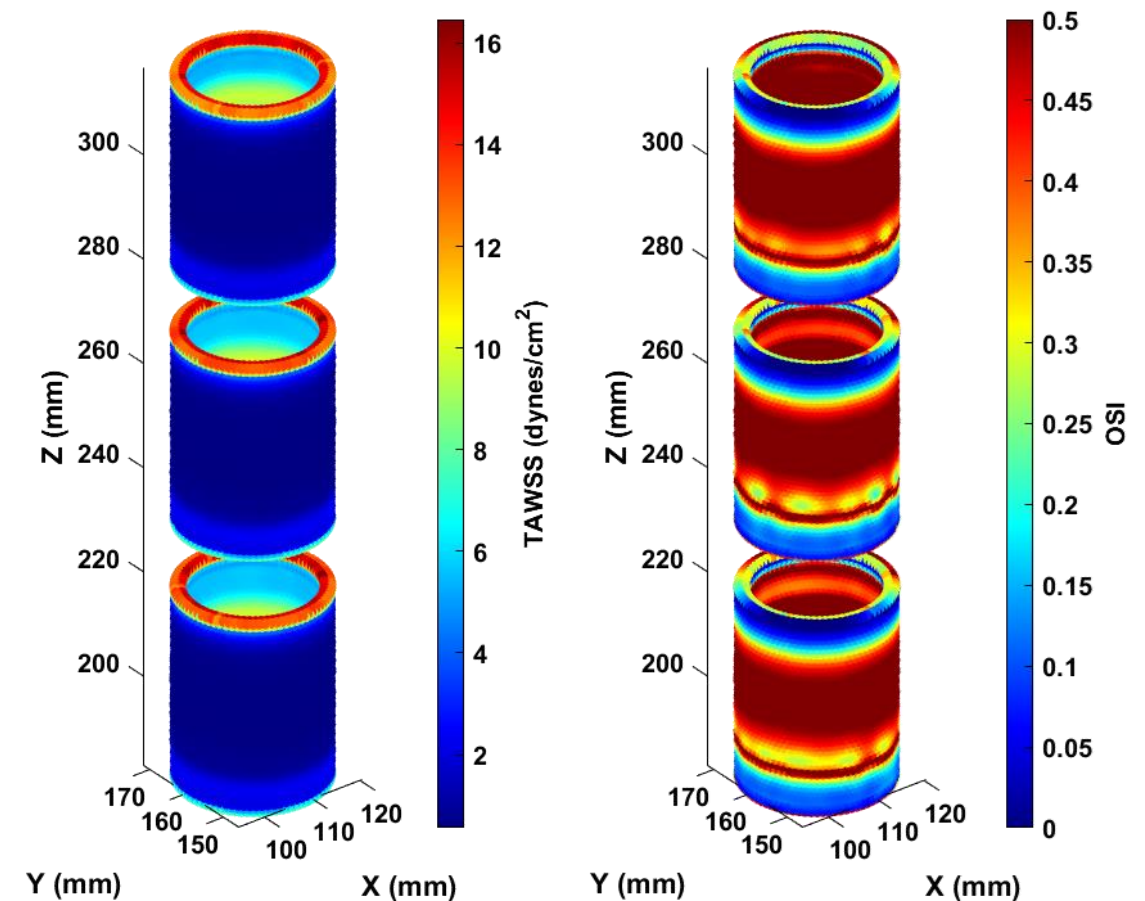## Ex: +1 m/s Inlet

Ex: +/- 1 m/s Inlet

Post-Processing: More Examples (TAWSS/OSI)
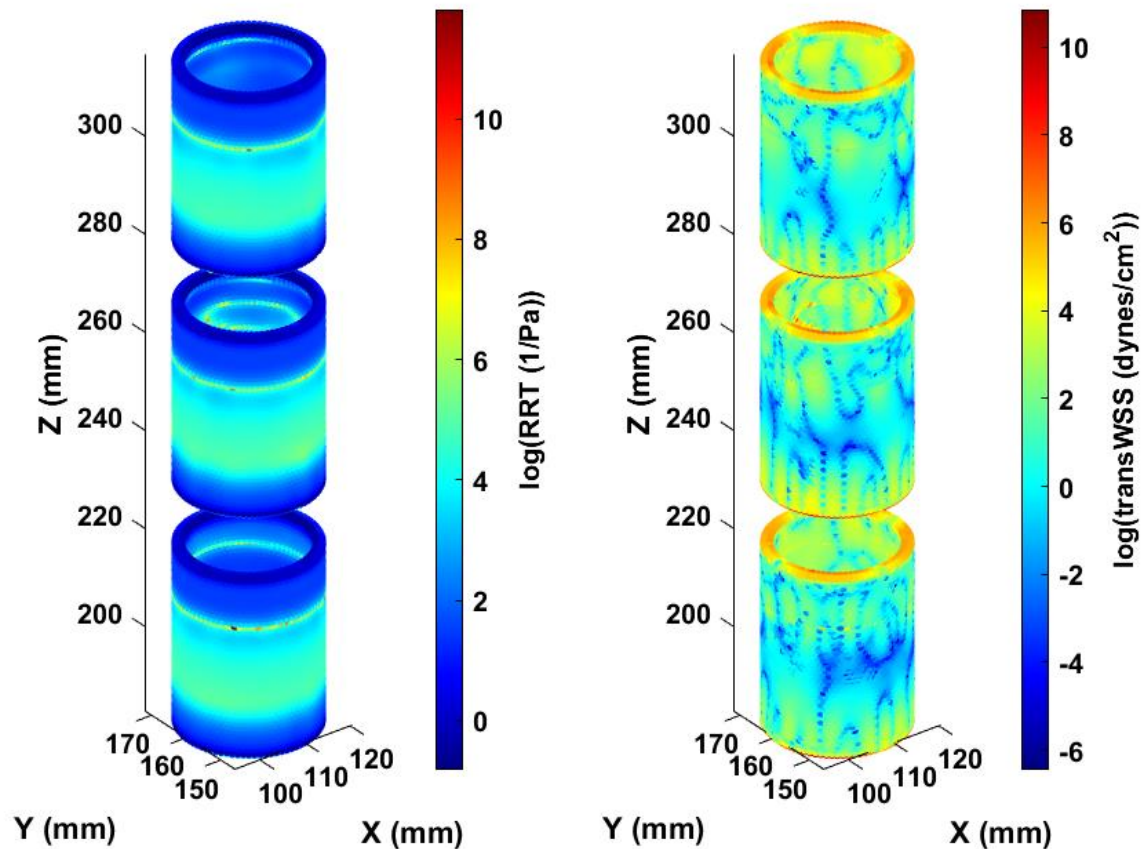
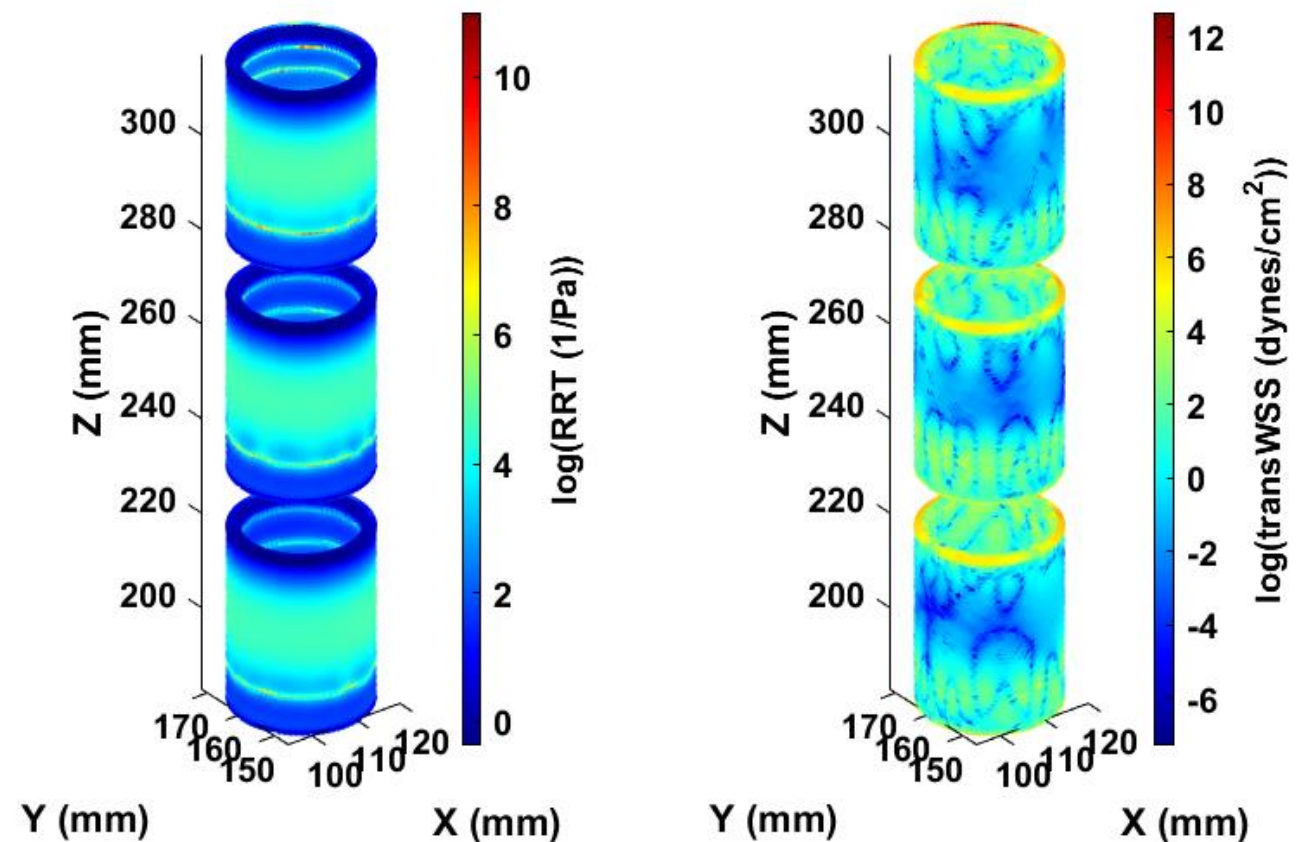## Ex: S35/4 Waveform

Ex: Inlet Squared by 4 Waveform

Post-Processing: More Examples (RRT/transWSS)
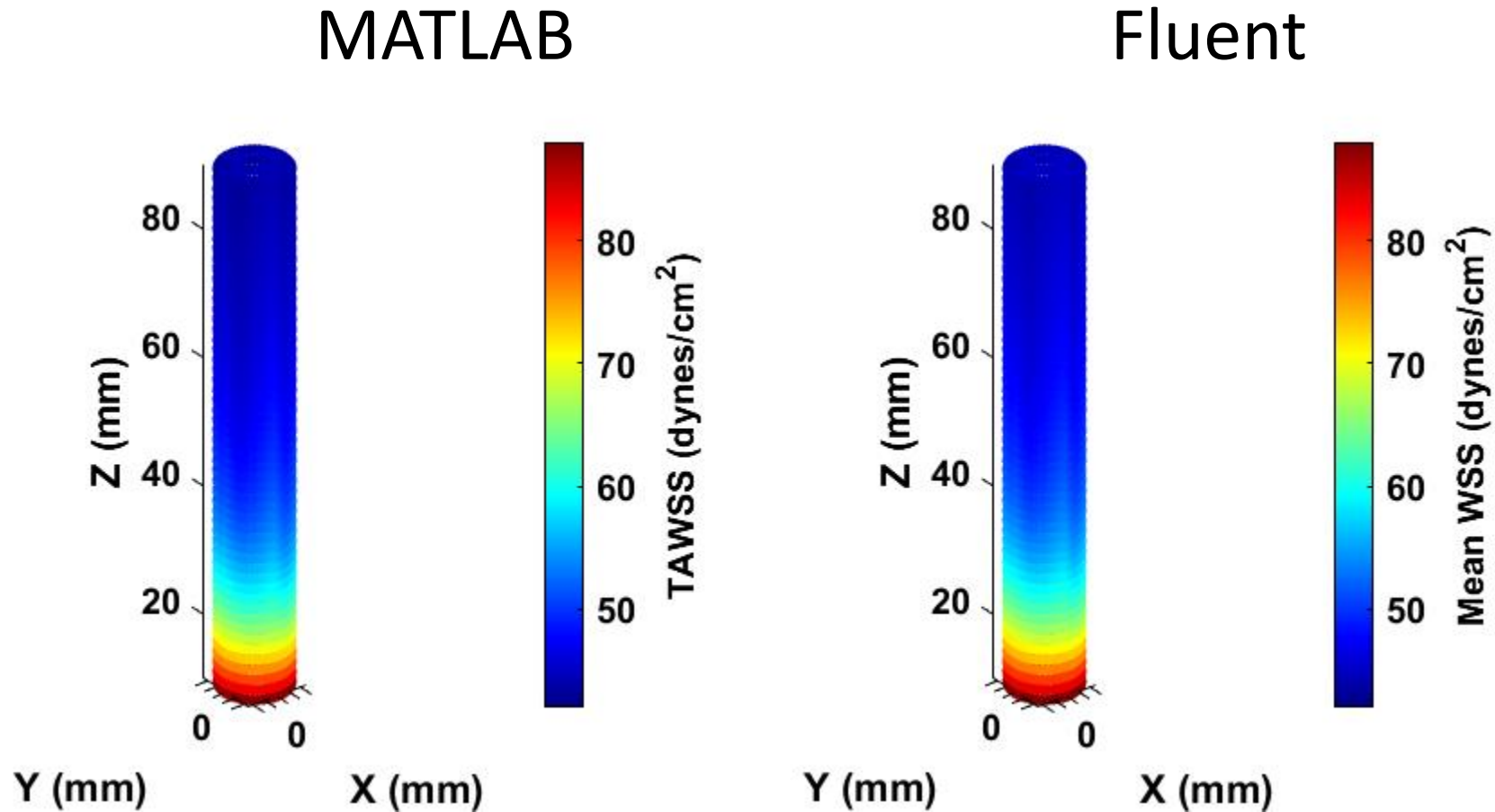
Ex: S35/4 Waveform

Ex: Inlet Squared by 4 Waveform

Future Improvements

- Proper surface/element plotting rather than point cloud
- ~~Faster processing of many points~~
- Reporting of Average +/- Standard Deviation for the exported surface
- ~~Creation of interactive GUI to simplify data processing.~~
- Export GUI as exe to allow function outside of MATLAB

Comparing MATLAB TAWSS with Fluent Mean WSS

Error Between Means = 1.305%