Computational Fluid Dynamics – Cardiovascular health

OBJECTIVE:
Learn basic principles of fluid mechanics and computational fluid dynamics and how they can be applied in cardiovascular research and medicine.

ACTIVITIES:

START → Introductions (5 min)

10 min → Introduction to fluid mechanics
- What is a fluid? Examples of fluids (air, water, blood)
- Fluids in motion
    - Flow in a pipe: Flow vs. pipe diameter
    - Bernoulli

15 min → Introduction to computational fluid dynamics (CFD)
- What is CFD?
- Examples from aerospace to sports performance, and clinical applications of CFD.

20 min → How are fluid mechanics and CFD used to diagnose and treat cardiovascular disease?
- Examples:
    - Coronary artery disease (CFD, FFR-CT)
    - Aortic valve stenosis (Bernoulli)
    - Predicting clot formation (CFD)

30 min → Setup computers and introduce ParaView

1 hour → Introduction to ParaView: an open-source software to review CFD data

Hands-on tutorial to walk the students through the process of reviewing cardiovascular CFD simulation data.
- *Load the data*
    - Healthy and diseased examples of aorta. Diseased model has coarctation, or a severe narrowing of the descending aorta
- *Review the data*
    - Students will quantitatively compare differences in the healthy and diseased models.
    - Look at pressure values, see differences in the numbers and how they change over the anatomy
- *Visualize the data*
    - Students will visualize the blood flow in the diseased and healthy models
    - Follow instructions to view blood flow in two unique ways (cut view, streamlines)