

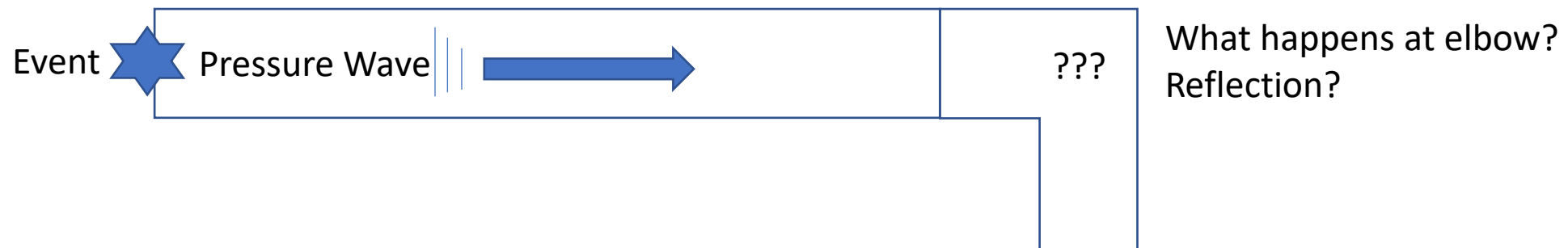
Pressure Wave Transmission Characteristic in Water-Filled Pressurized Pipe

2.29 Numerical Fluid Mechanics Project

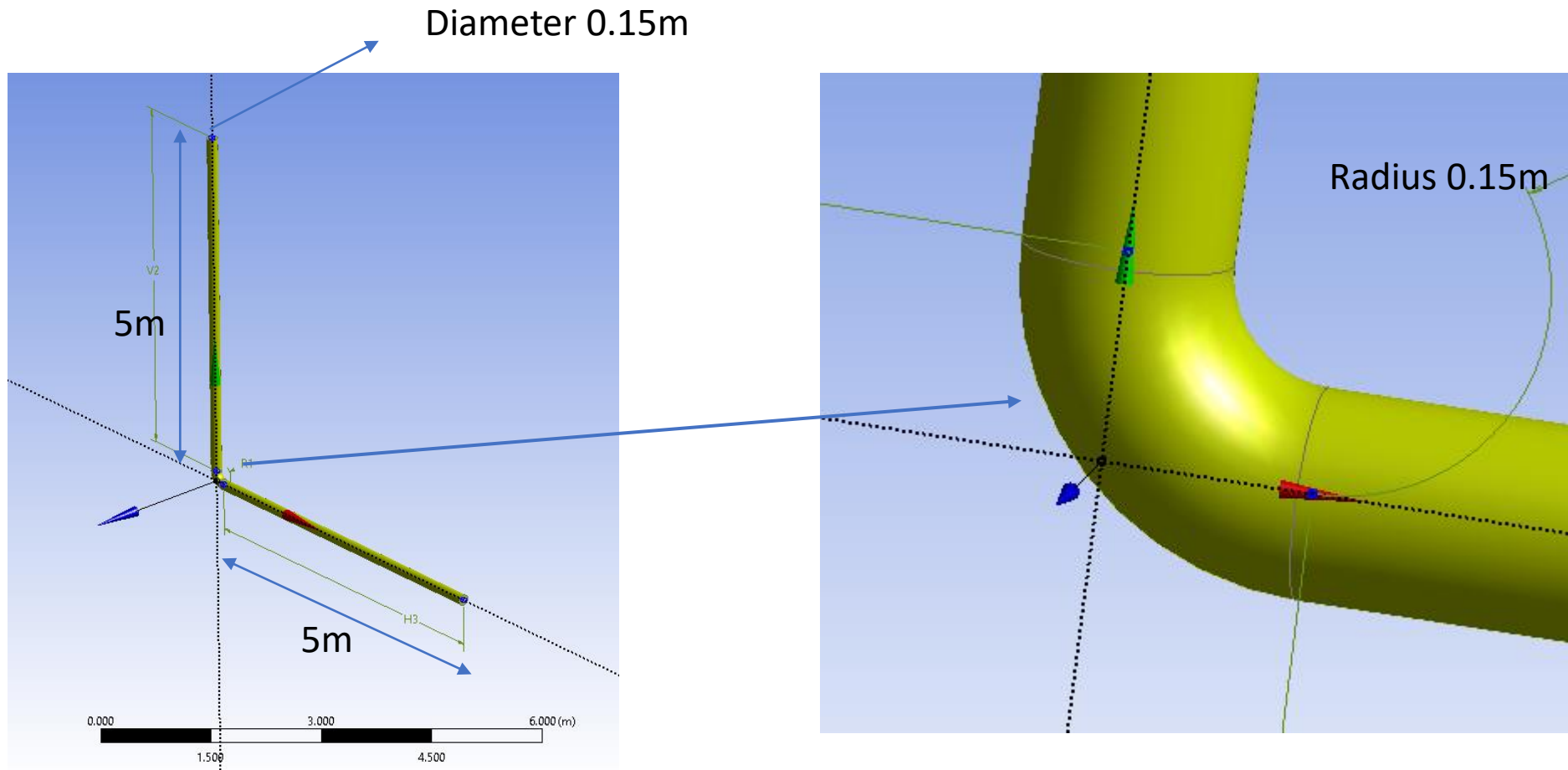
Shiqing Liu

Introduction

- Pressure wave is generated by abrupt changes in water-filled pipes (valve open/closure, pipe break, etc.)
- High-frequency pressure monitoring system is applied in water supply pipe network to detect such events
- Research on pressure wave transmission in pipe is necessary

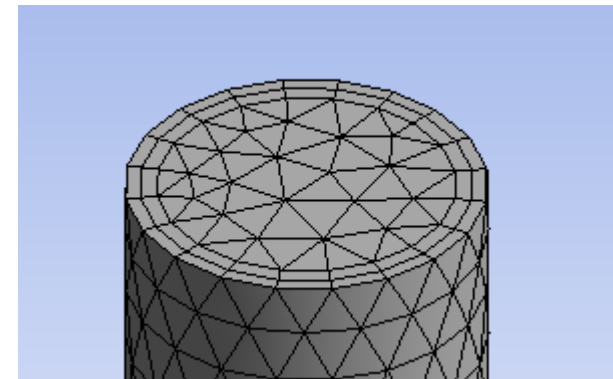
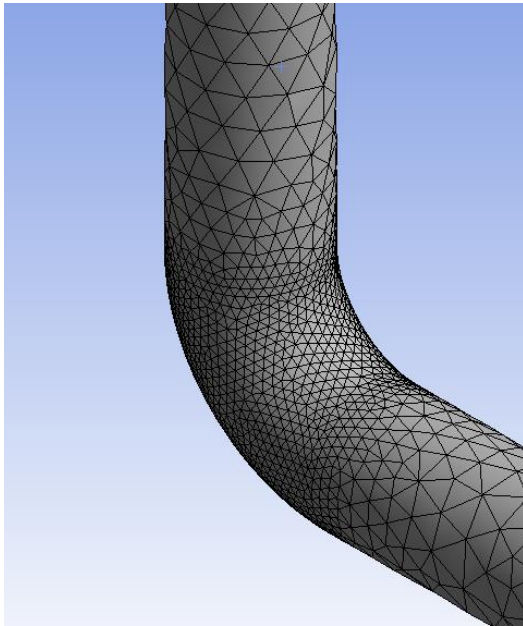


Fluent Software Step 1 Geometry



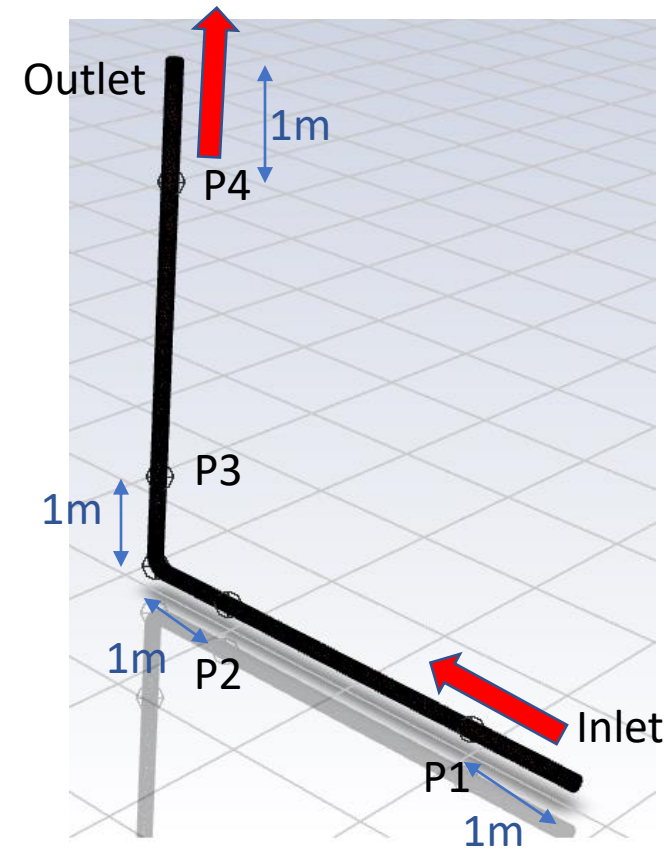
Fluent Software Step 2 Generating Mesh

- Local refined mesh at bend area
- Axisymmetric mesh at pipe cross-section
- A total of 20080 nodes
- Minimum dx is 0.01m

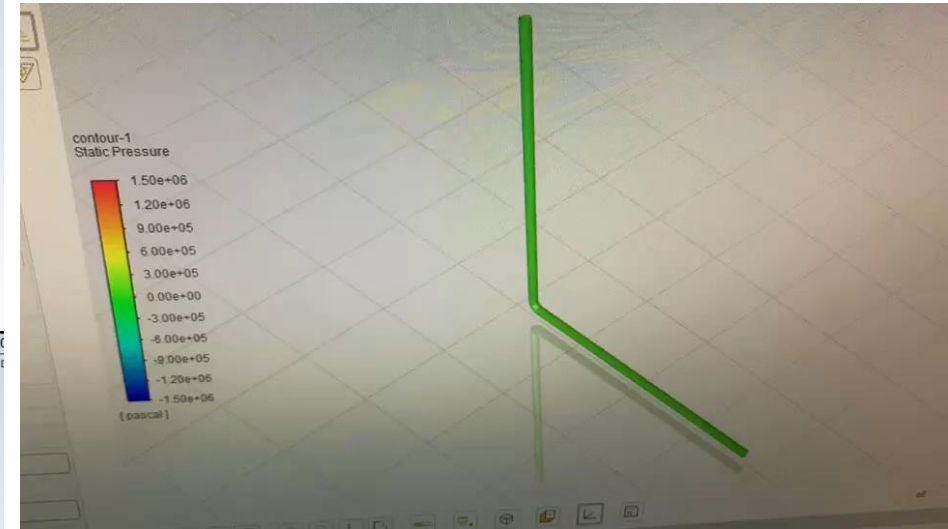
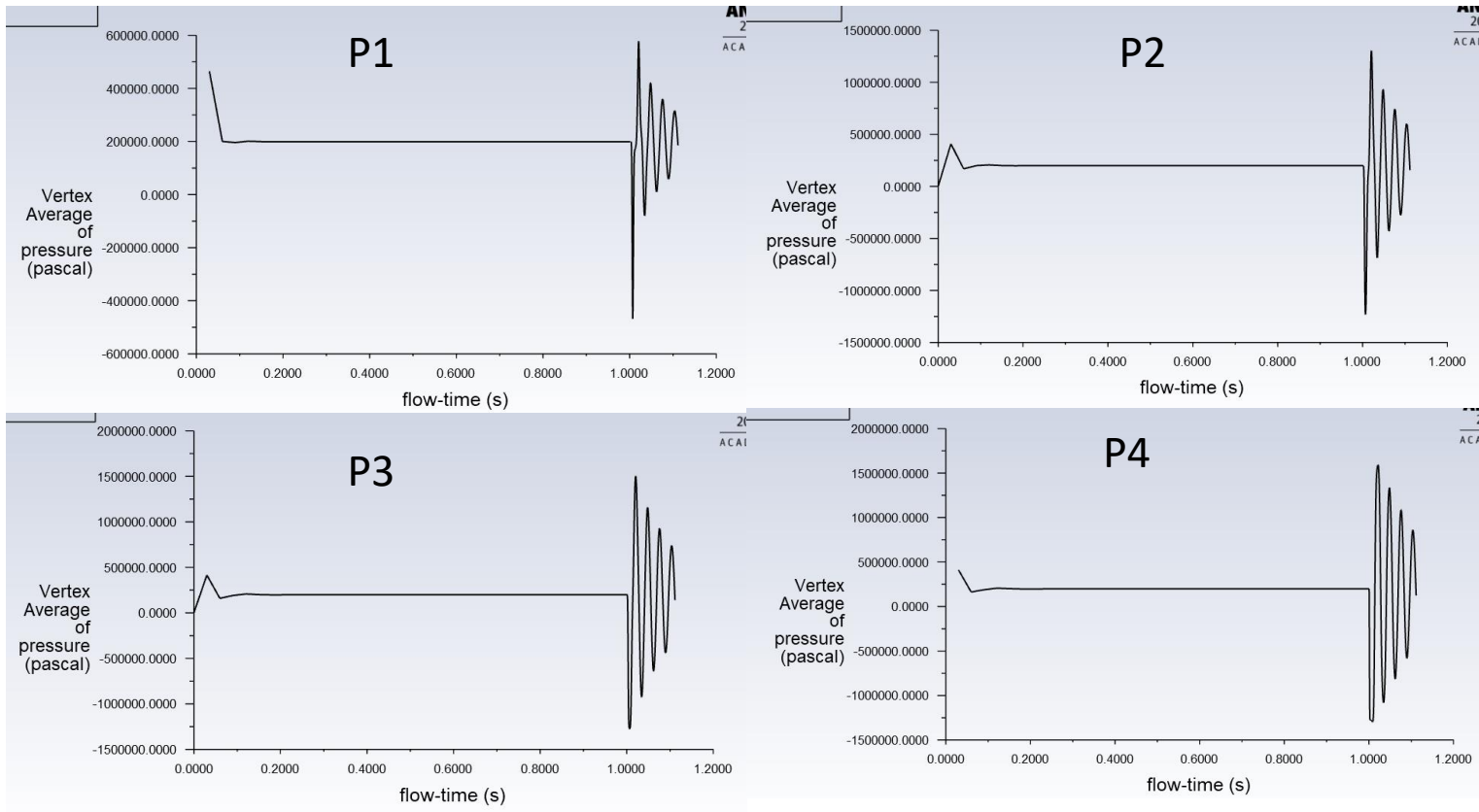


Fluent Software Step 3 Simulation

- k-epsilon model
- 2nd order accuracy in pressure
- Water is compressible, density is pressure dependent
- Boundary and Initial Condition
 - pressure in pipe is 200 kPa
 - initial velocity is 1m/s
 - at t=1s, “leak” happens at outlet, outlet velocity increase to 2m/s
- Pressure wave is generated at outlet and propagate towards inlet
- Evaluate pressure profile at p1, p2, p3, p4
- Time step is 2e-4 second, run 500 timesteps
- Total transient duration is 0.1s

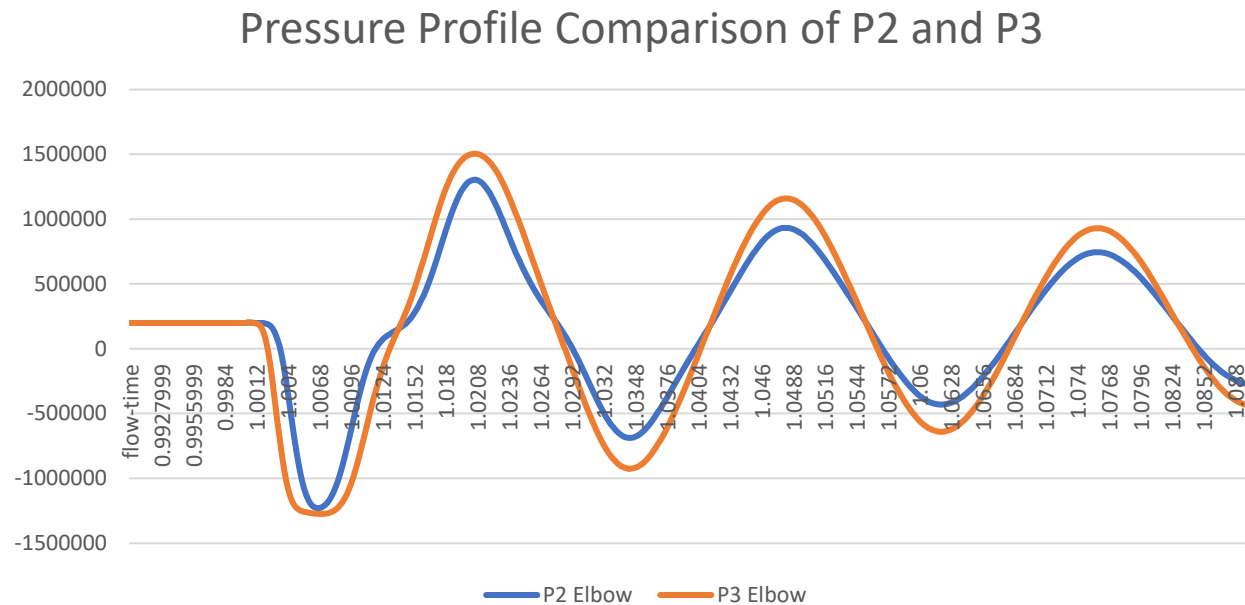


Simulation Results



Simulation Results

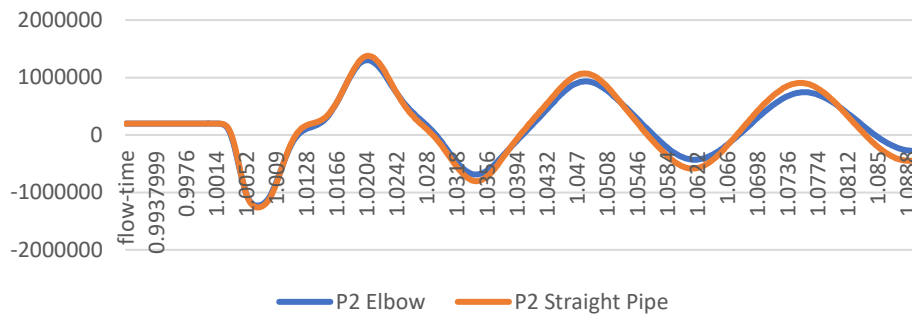
There is no significant wave reflection between P2 and P3



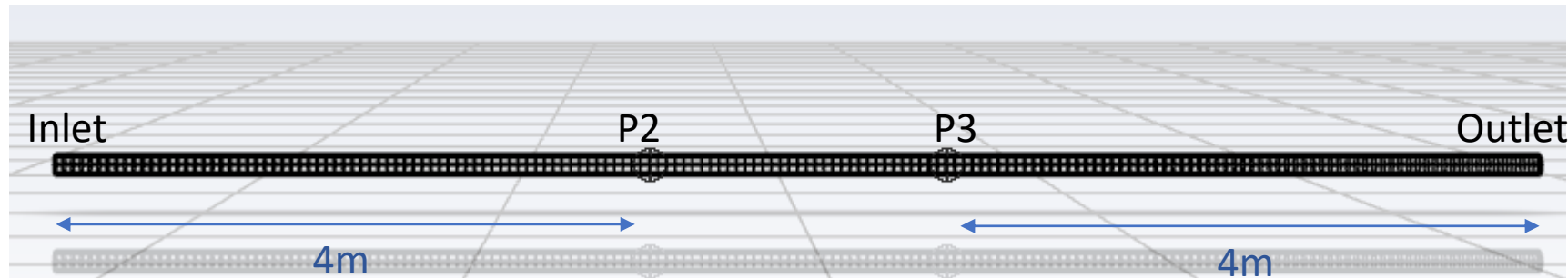
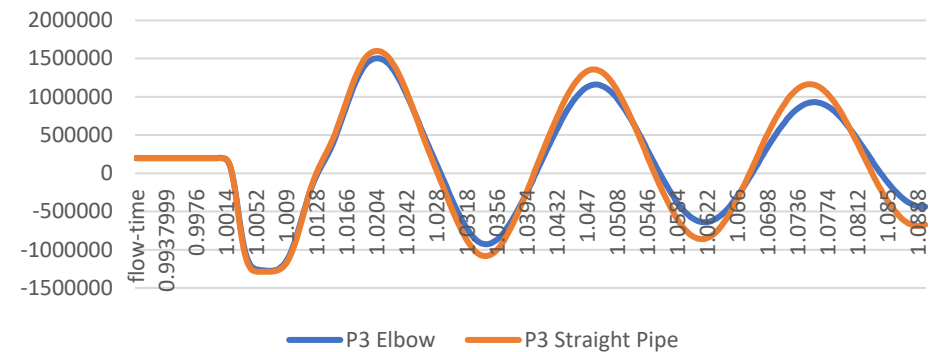
Compare with Straight Pipe

- Everything is the same except pipe shape
- P2 and P3 are at same position of bend and straight pipe

Pressure Profile Comparison of P2 in Different Pipe Shape



Pressure Profile Comparison of P3 in Different Pipe Shape



Future Topics

- Wave transmission in pipe with diameter change
- Wave transmission in T-junction area
- Wave transmission in pipe with different diameter

Thank you!

2.29 Teaching Team

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