Design and Analysis of Fluid Structure Interaction for Elbow Shaped Micro Piping System

Department of Control Systems,
St. Mary’s Group of Institutions- Hyderabad,
Affiliated to Jawaharlal Nehru Technological University
Kukatpally, Hyderabad-50085, Telangana, India.

Excerpt from the Proceedings of the 2014 COMSOL Conference in Bangalore
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1. FLUID STRUCTURE INTERACTION

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1. FLUID STRUCTURE INTERACTION
Problems of FSI:

- Inelasticity,
- Noise generation,
- Nonlinear response,
- Flow induced vibrations,
- New path for the flowing fluid,
- Change in boundary conditions,
- Expansion or Contraction in pipe line.
2. COMSOL MULTIPHYSICS

COMSOL Multiphysics computes new mesh coordinates on the channel area based on the movement of the structure’s boundaries and mesh smoothing.
3. DESIGN PROCESS
4. SIMULATION

➢ Flow channel is 85 μm high and 200 μm long.

➢ Vertical rectangular obstacle with 5 μm wide, 47.5 μm.

➢ Semicircular top sits 150 μm away from the channel left boundary.
5. RESULTS

Excerpt from the Proceedings of the 2014 COMSOL Conference in Bangalore
Min/ Max surface distribution for single obstacle.

Min/ Max surface distribution for two obstacles.

Excerpt from the Proceedings of the 2014 COMSOL Conference in Bangalore
Global: Inlet mean velocity (m/s)
Point Graph: Mesh velocity, x component (mm/s)  Point Graph: x-X (mm)

Inlet mean velocity
Mesh velocity in the x direction (mm/s)
Mesh displacement in the x direction (mm)

Point graph for single obstacle.
Global: Inlet mean velocity (m/s) Point Graph: Mesh velocity, x component (mm/s) Point Graph: x-X (mm)

- Inlet mean velocity
- Mesh velocity in the x direction (mm/s)
- Mesh displacement in the x direction (mm)

Time (s)
<table>
<thead>
<tr>
<th>No. of Obstacles</th>
<th>Stress (N/m²)</th>
<th>Velocity (m/s)</th>
<th>Displacement (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Obstacle</td>
<td>1.3327</td>
<td>4.1514x10⁴</td>
<td>32.1236</td>
</tr>
<tr>
<td>Two Obstacles</td>
<td>0.1704</td>
<td>1.5316x10⁴</td>
<td>19.9367</td>
</tr>
</tbody>
</table>
6. CONCLUSION

Finite element analysis plays an important role in helping to understand the interactions of the system under conditions that are simulated to replicate nature and provides a tool for visualizing phenomena not possible to be observed using conventional observation equipment.