

# Numerical Simulation of Wave Propagation in Multilayered Viscoelastic Tubes

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## ABSTRACT

Numerous examples of the fluid flows in multilayered viscoelastic tubes can be found in biomedical and technological units and processes and in biological organisms. Biological fluids move through the tubes composed of viscoelastic sheets with different rheological properties. Blood vessel wall, airways, oesophagus, ureter, intestine are layered biocomposites with complex viscoelastic behavior. Numerical investigation of the blood flow through the blood vessels as three-layered viscoelastic tubes revealed some possibilities for the flow stabilization by a proper choice of the material parameters of the layers [1]. An effective numerical algorithm has been elaborated and stability of the steady flow in the tube at different boundary conditions at the outer surface of the tube has been in-depth studied. A novel method to eliminate the absolute instability of the system by using a layered viscoelastic coating for the drug reduction, delay of the laminar to turbulent transition, vibration damping and noise absorption has been proposed [2].

Here the wave propagation in the multilayered fluid-filled tube is studied using the method developed in [3]. The incompressible Navier-Stokes equations for the fluid and the momentum equations for the incompressible viscoelastic solid have been solved at the flow and stress continuity conditions at the fluid-solid and solid-solid interfaces. The fluid flow and wall displacement fields have been computed as well as the shear stress at the wall. The dispersion relationship has been obtained and the regularities of the wave dispersion in the multilayered fluid-filled tubes have been studied. The fluid based and wall based modes have been compared for the isotropic and anisotropic single layered and three layered tubes. The limits of the linear viscoelastic model are discussed basing on the results for the nonlinear and weakly nonlinear models of the wave propagation in the thick-walled fluid-filled viscoelastic tubes.

## REFERENCES

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