Bernoulli's Theorem Overview

Here is an overview of Bernoulli's theorem based on the uploaded lecture material.

Bernoulli's Theorem

Bernoulli's theorem is based on the principle of conservation of energy for fluid flow. It states that for an incompressible, non-viscous fluid in steady flow, the total mechanical energy along a streamline remains constant. This mechanical energy comprises three terms: pressure energy, kinetic energy, and potential energy. The theorem can be mathematically expressed as:

$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$$

where:

- P is the static pressure exerted by the fluid,
- ρ is the fluid density,
- v is the velocity of the fluid flow,
- g is the gravitational acceleration, and
- h is the height above a reference level.

Assumptions of Bernoulli's Theorem

1. The fluid is incompressible.
2. The flow is steady, with no variation in flow speed or direction.
3. The fluid has no viscosity, implying no internal friction.
4. The flow is along a streamline without turbulence.

Applications

1. **Venturi Meter**: Bernoulli's principle is applied in a Venturi meter to measure the flow speed of a fluid in pipes.
2. **Dynamic Lift**: In aerodynamics, Bernoulli's theorem explains the lift force on airplane wings due to pressure differences caused by airflow velocities.
3. **Blood Flow and Arterial Health**: The principle helps explain blood flow dynamics, particularly in constricted arteries where faster blood flow lowers pressure, potentially leading to artery collapse.