ME 6125
Mechanics of Viscous Fluid

Lecture 1

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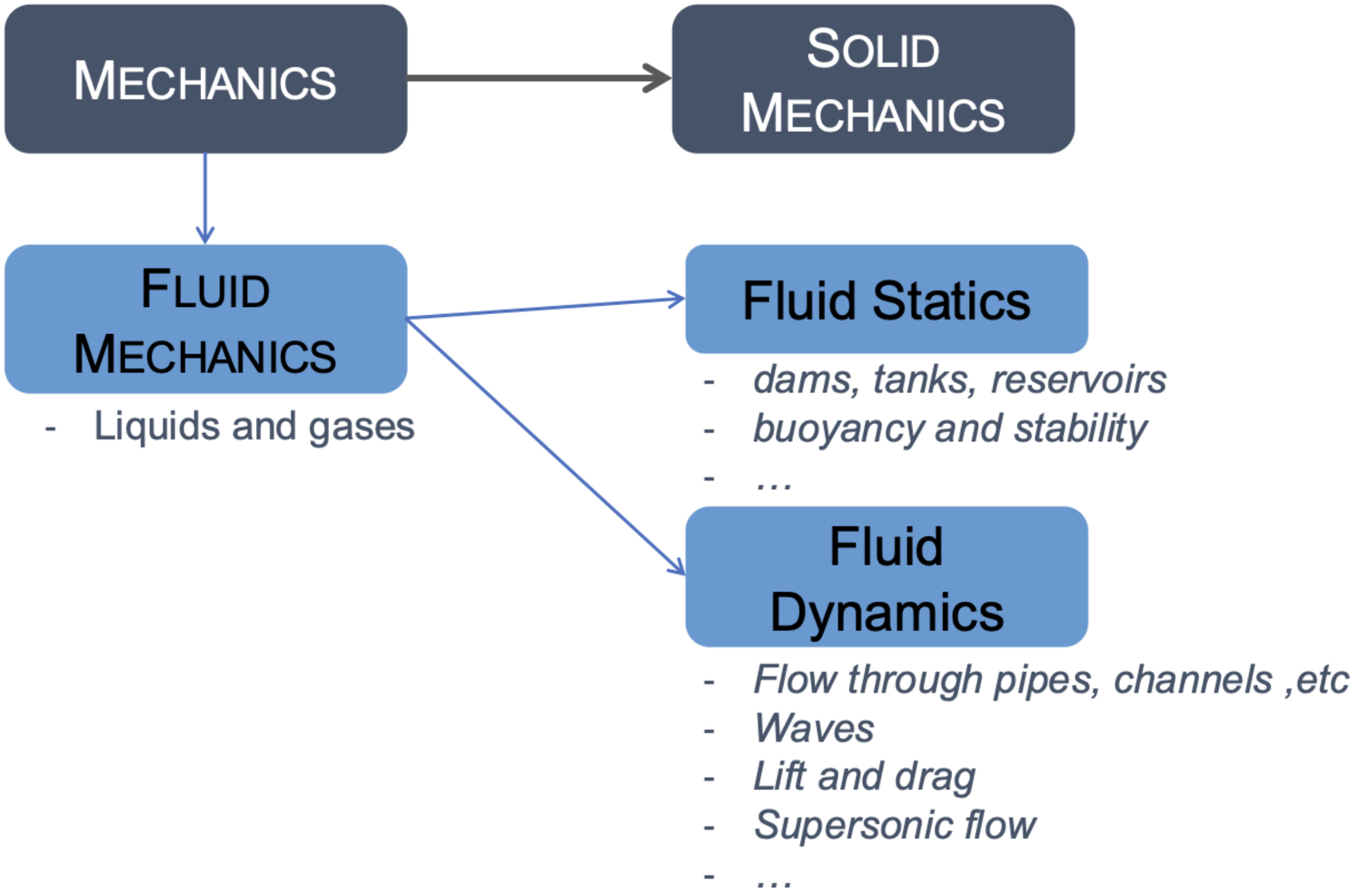
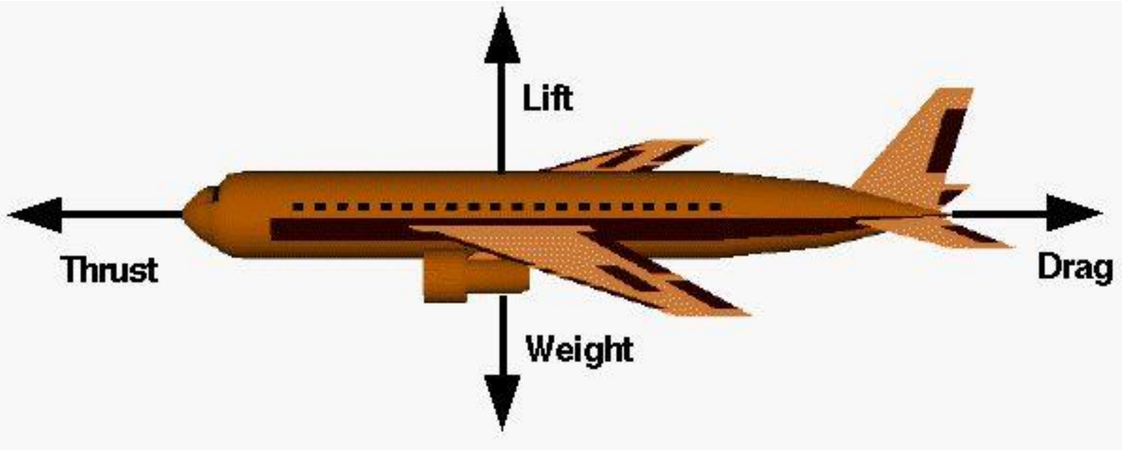
IMPACT Lab
Interfacial Multiscale Physics and Transport

What is fluid mechanics?

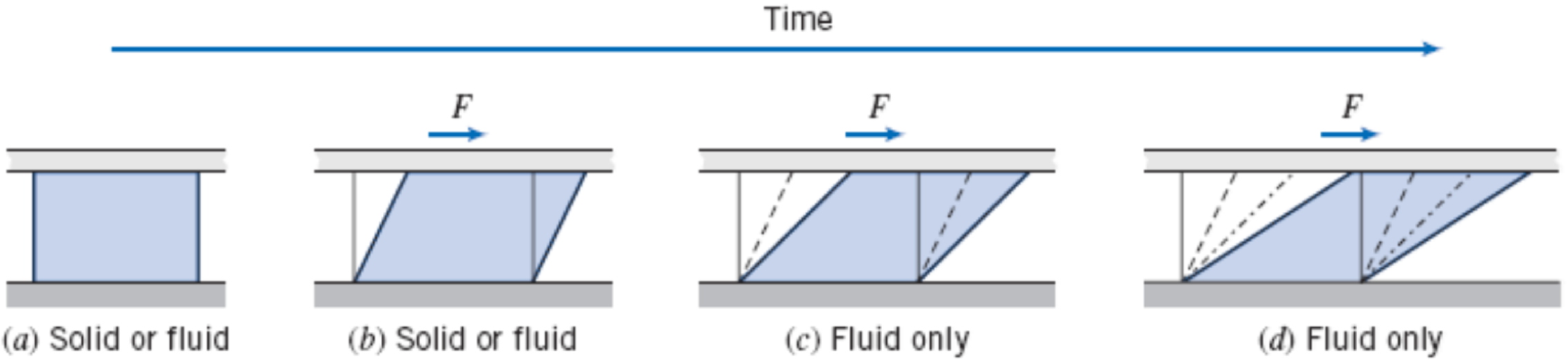


Fluid related engineering problems



Flight Condition	Effect
Lift > Weight	Plane Rises
Weight > Lift	Plane Falls
Drag > Thrust	Plane Slows
Thrust > Drag	Plane Accelerates

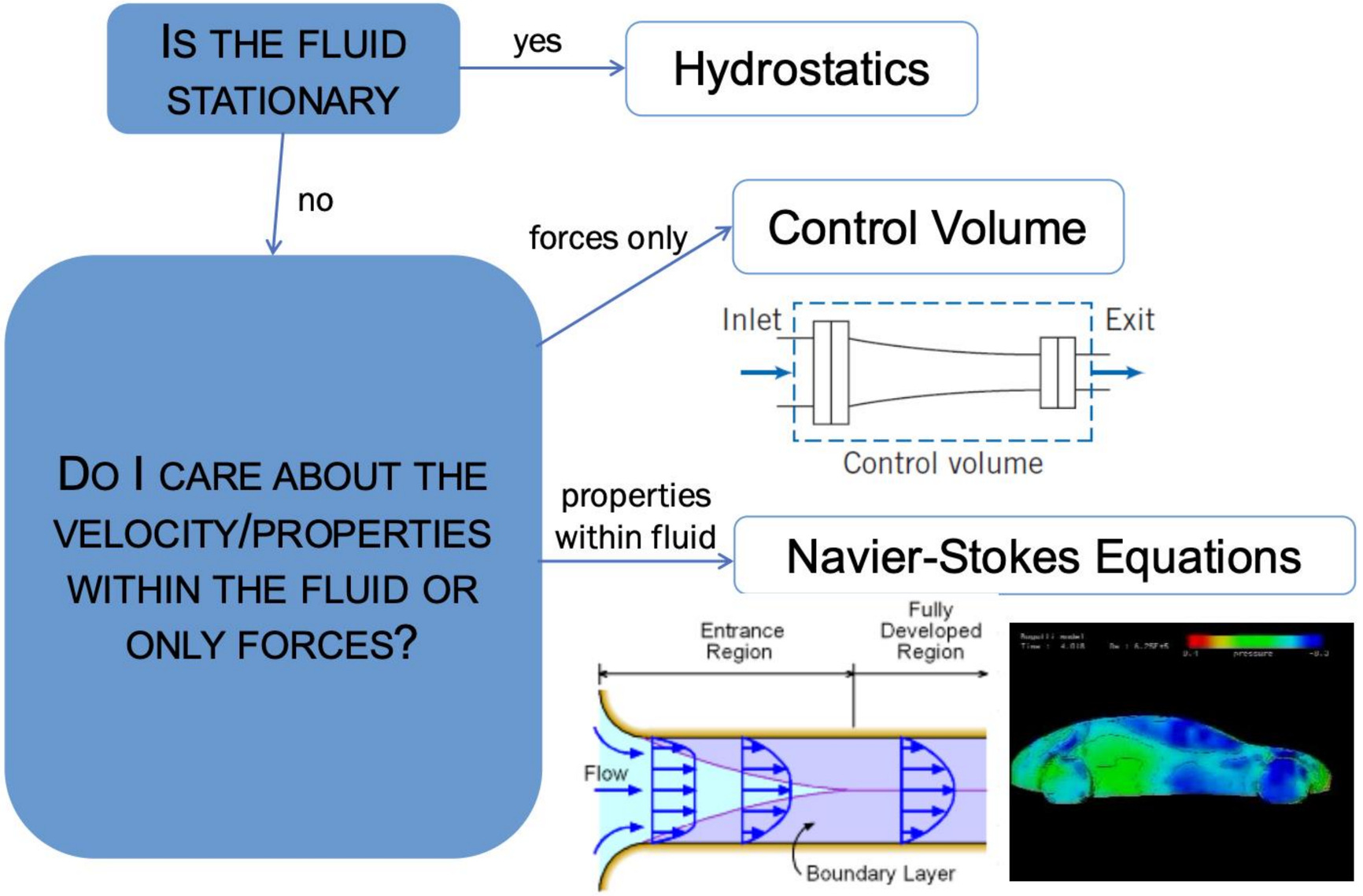
What is Fluid?



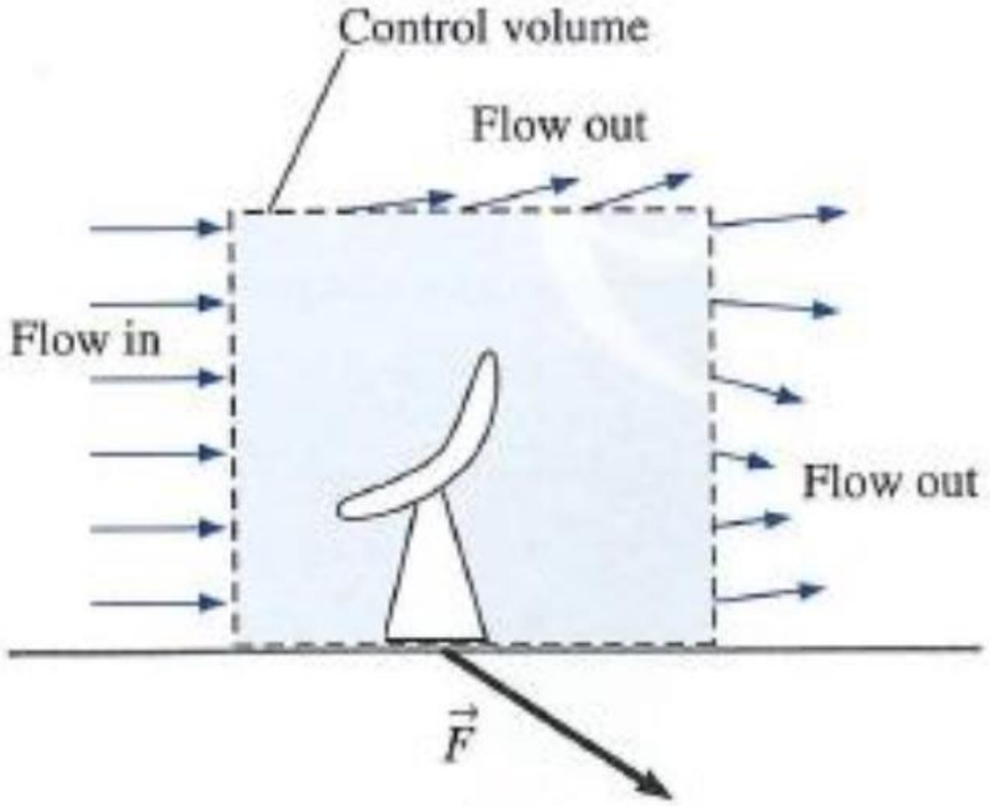
Solid: Deforms until reaction force balances the applied force

(the *amount of deformation* depends on the *G* modulus)

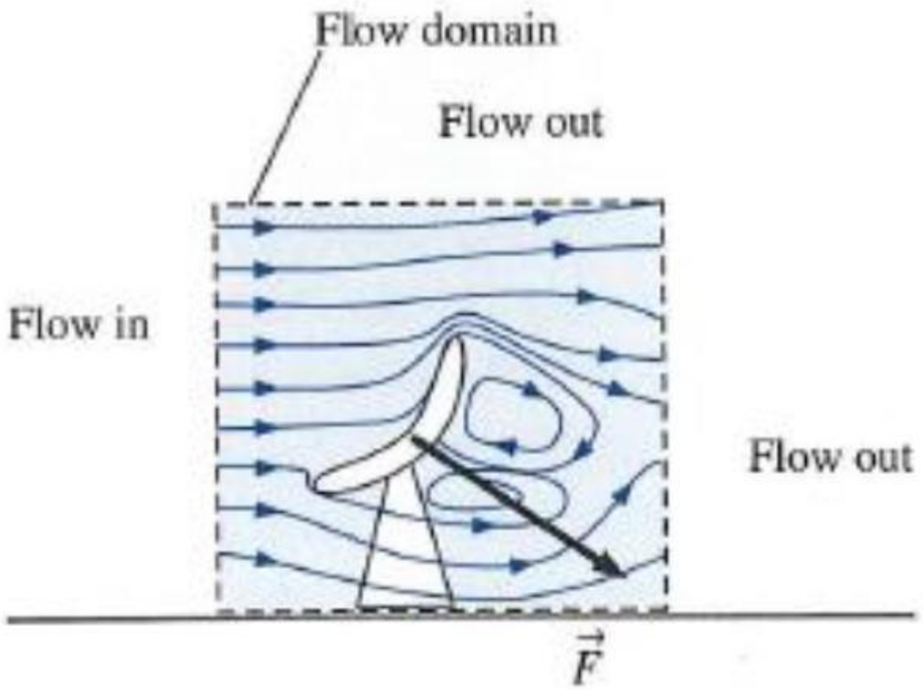
How do we study fluid mechanics?



Differential analysis of fluid motion



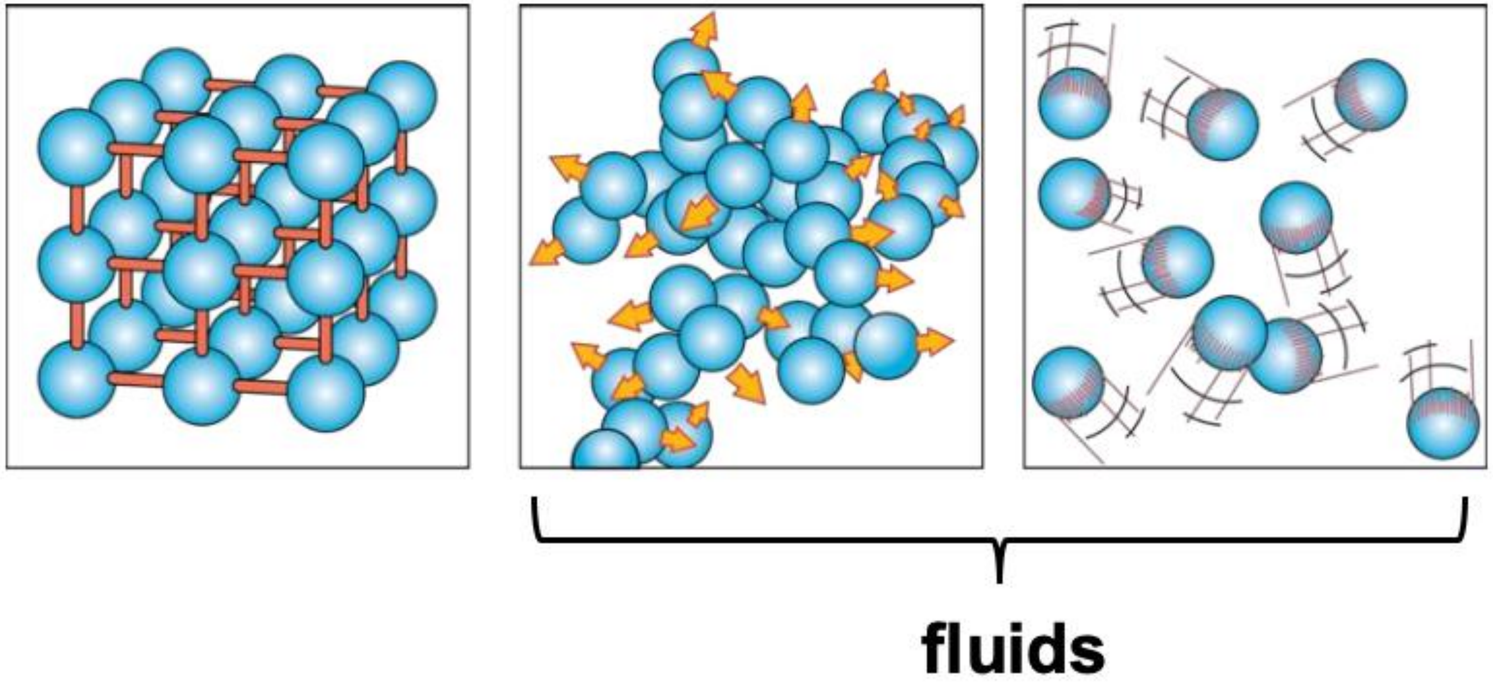
Control volume analysis



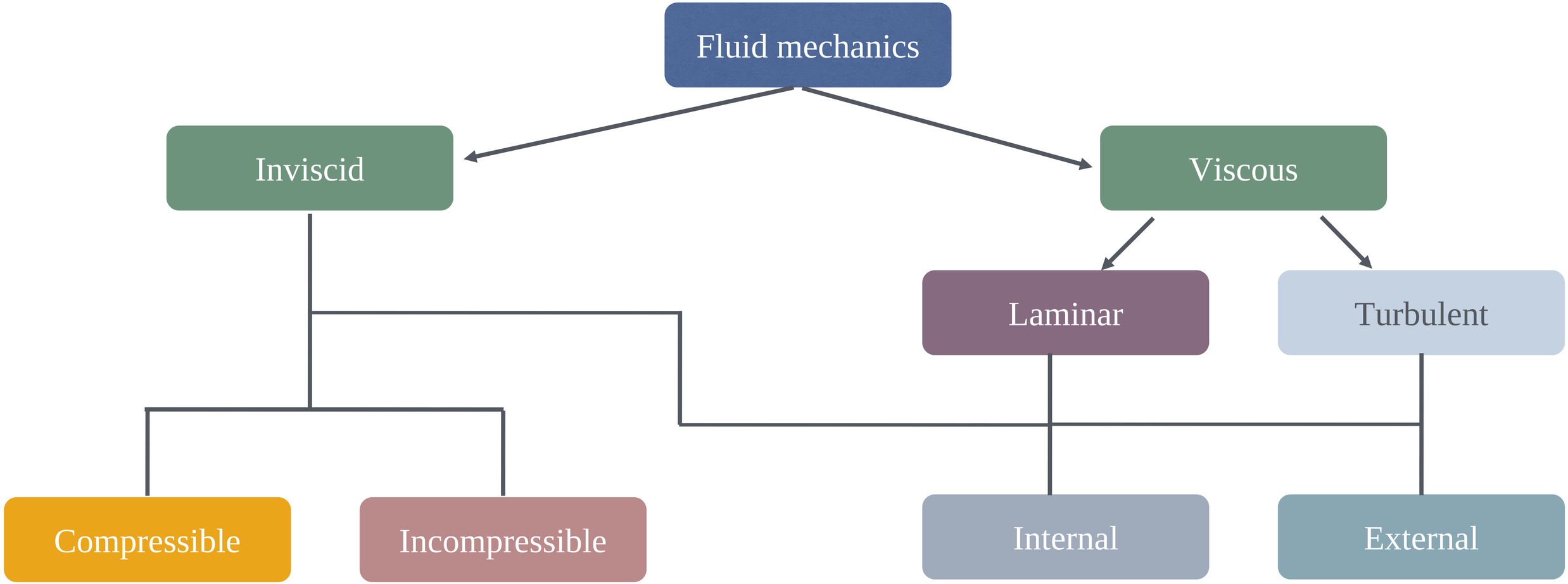
Differential analysis

Fluid from molecular lens

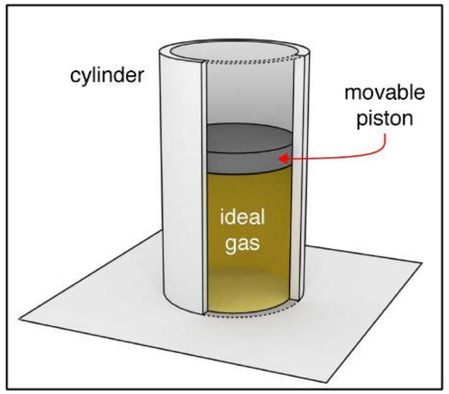
- Molecular (phys-chem) definition:
  - “fluids are disordered collections of molecules”

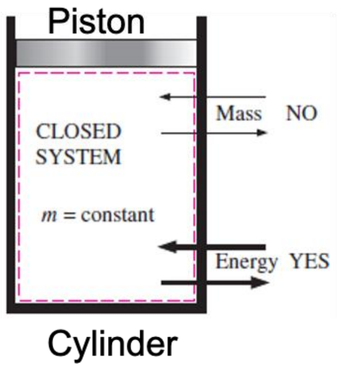


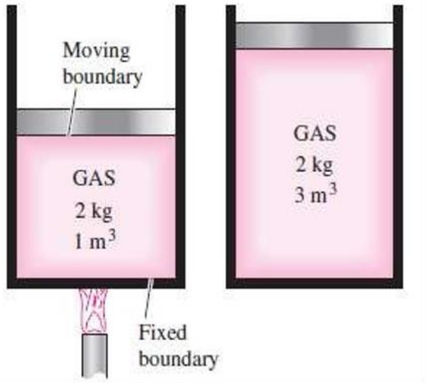
Classification of fluid motion

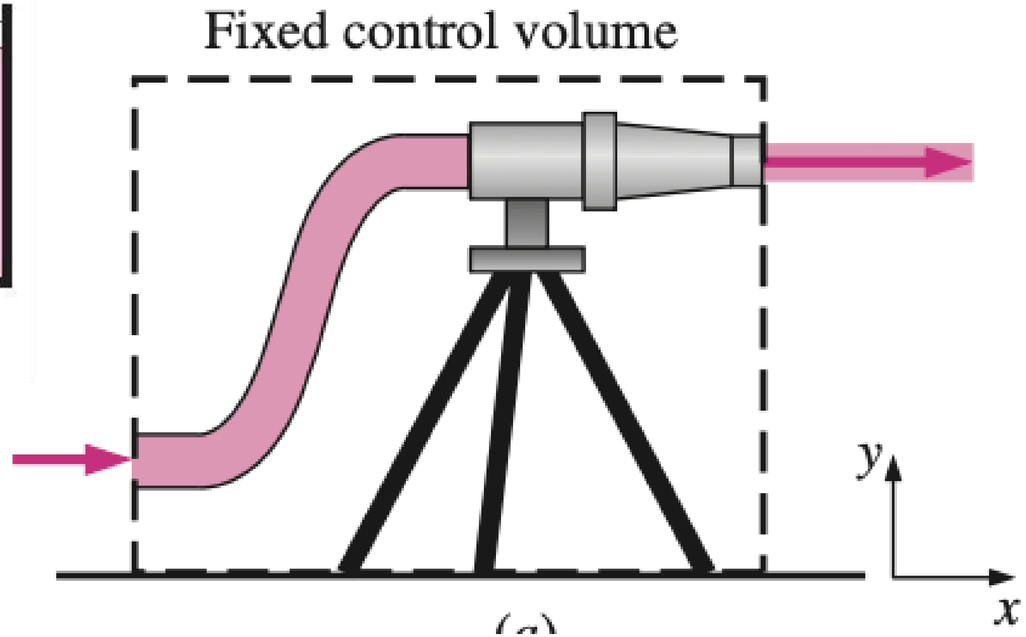


Open system and control volume system









Hot Water Bag

Water Flask

Intensive, extensive properties, non-dimensional number

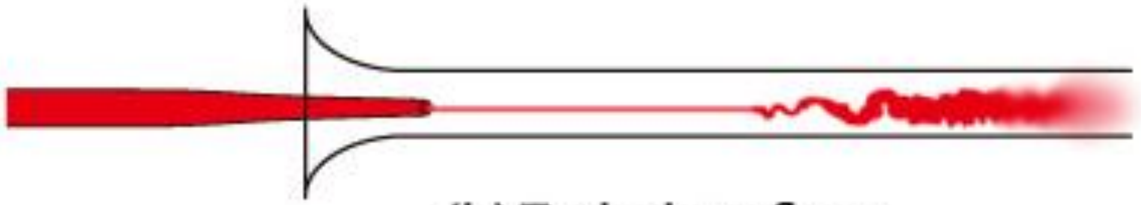
- Intensive properties:
- Expensive properties:
- Non-Dimensional number:

Flow type

- Laminar flow:

(a) Laminar flow

- Turbulent flow:



(b) Turbulent flow

Lagrangian vs Eulerian Descriptions of Fluid flow

- YouTube link: https://www.youtube.com/watch?v=DVB3hwfUr0w

Question

- $\overline{V} = xy^2\mathbf{i} - \frac{1}{3}y^3\mathbf{j} + xy\mathbf{K}$ ——— (i) Flow dimensionality? (ii) Can this be an incompressible flow? (iii) Particle acceleration at (x,yz) =(1,2,3).