Linear momentum principle

* {time rate of change of momentum of the body} = {force acting on the body}
  + “Body” consists of some fixed quantity of material
  + Material within systems remains the same; called “material volumes”
  + From principle of conservation of mass: mass of material volume is constant
  + Material volume may be continuously changing size and shape but exchanging no mass with surroundings
  + Material volume = Vm(t)
  + Surface of material volume = Am(t)
* Differential volume: dV
  + Mass, dM = ρ dV
  + Momentum, dM **v =** ρ **v** dV = = force acting on the material volume
  + D/Dt: material derivative
  + Body force exerted on material volume =
* Stress vector: **t(n)** =
  + ΔF is force exerted by surroundings on area ΔA
  + Stress vector at point a for a surface having a normal +/- **j**
    - **t(+/-j)** = +/-**j**(F/A)
  + In the absence of ambient pressure, **t** = 0
* Net surface force acting on material volume
  + Surface force exerted *by* the surroundings *on* the material volume =
  + Time rate of change of momentum = body forces + surface force