# Assume that matter moves with velocity $v^e + v^m$.

# Assume body moves with velocity $v^e$.

# The balance laws are valid for all sub-parts of the body.

# Density corresponds to density of matter in body.

# Kinetic energy & internal energy, linear angular momentum are attributes of matter.

**Balance of Mass:**

$$\frac{d}{dt} \int_{\Omega(t)} \rho \, dv = - \int_{\partial \Omega(t)} \rho v^m \cdot n \, da,$$

$$\Rightarrow \rho + \rho \, \text{div} \, v^e = - \text{div} \left( \rho v^m \right).$$

**Balance of Linear Momentum:**

$$\frac{d}{dt} \int_{\Omega(t)} \rho \left( v^e + v^m \right) \, dv = \int_{\partial \Omega(t)} -\rho \left( v^e + v^m \right) \times v^m \cdot n \, da,$$

$$\Rightarrow (\rho + \rho \, \text{div} \, v^e) \left( v^e + v^m \right) + \rho \left( v^e + v^m \right) = \text{div} \left( \text{I} + \text{J} \right)$$

$$- \text{div} \left( \left( v^e + v^m \right) \times \rho v^m \right).$$
\[
\begin{align*}
P^* &= \frac{I \cdot \text{grad} (e^{i \theta V_m})}{\text{grad} (e^{i \theta V_m})} \quad \text{grad} (e^{i \theta V_m}) + P^* \cdot \text{grad} (e^{i \theta V_m}) \\
\text{So, individually asymmetric (envelope momentum)} \quad I \cdot \text{grad} (e^{i \theta V_m}) + P^* \cdot \text{grad} (e^{i \theta V_m}) \\
\text{let no assume I* and I are} \\
\text{Act two axes in do and seen} \\
\text{to help.} \\
\end{align*}
\]
Remark 1: How to this analysis different mechanisms of control volumes with arbitrary velocities? In the case mentioned above, it is possible to write the balance laws in at least one way, viz. in the case with material moving with a constant velocity of reference. Not so in the case of the body, where the reference frame is arbitrary.

Remark 2: How can characteristic patterns evolve. Consider a characteristic law. It seems to make a qualitative difference to talk about movement in which physical forces act on the body, and the forces on material matter less. On surfaces, it will end up being a strange and interesting idea.