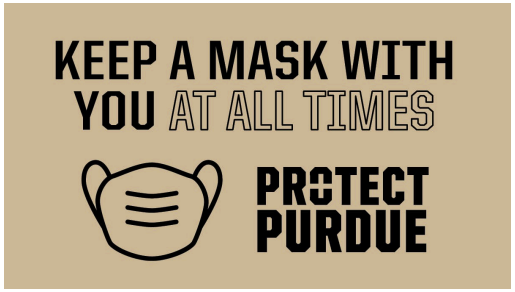
Spring, 2022

ME 597 – Solid Mechanics II

Lecture 1 – Notation and nomenclature



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Notation and nomenclature

Direct notation:

- Examples of physical properties

mass (scalar)	velocity (vector)	stress (tensor)
m	$\boldsymbol{v}$	$\boldsymbol{\sigma}$

- Examples of algebraic operations

$$\boldsymbol{a} \cdot \boldsymbol{b} \qquad \boldsymbol{a} \times \boldsymbol{b}$$

DIY

How are we going to follow this nomenclature during the lecture or in the homework problems?

Notation and nomenclature

Indicial notation:

- Examples of physical properties

mass (scalar) velocity (vector) stress (tensor)

$$m \qquad v_i \qquad \sigma_{ij}$$

$$i \in \{1, 2, ..., n_\mathrm{d}\}$$

- Examples of algebraic operations

$$\boldsymbol{a} \cdot \boldsymbol{b} = \sum_{i=1}^{n_\mathrm{d}} a_i b_i = a_i b_i$$

Einstein's summation convention
or summation convention
(i is *dummy index*)

- Many times, it is convenient to store the components of a vector or a tensor in a column or a matrix.

DIY

$$[\boldsymbol{v}] = \qquad [\boldsymbol{\sigma}] =$$

Notation and nomenclature

Indicial notation:

- Dummy indices and free indices

$$\sigma_{ij} n_j = t_i$$

i free index

j dummy index

DIY

$\boldsymbol{\sigma n} = \boldsymbol{t}$

Notation and nomenclature

Indicial notation:

- Kronecker delta

$$\delta_{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases}$$

DIY

$a_i \delta_{ij} = a_j$ (index substitution)

Notation and nomenclature

Indicial notation:

- Permutation symbol

$$\epsilon_{ijk} = \begin{cases} 1 & \text{if } i,j,k \text{ form an even permulation of 1,2,3} \\ -1 & \text{if } i,j,k \text{ form an odd permulation of 1,2,3} \\ 0 & \text{if } i,j,k \text{ do not form a permulation of 1,2,3} \end{cases}$$

DIY

$\boldsymbol{a} \times \boldsymbol{b} = \boldsymbol{c}$ with $c_k = \epsilon_{ijk} a_i b_j$