

ME280B - Finite Element Methods in Non-linear Continua

Notation and list of symbols

General scheme of notation

<i>Roman and italic letters</i>	Scalars (or scalar fields)
<i>Lower-case bold letters</i>	Vectors and tensors (or associated fields)
<i>Upper-case bold letters</i>	Tensors (or tensor fields)
<i>Calligraphic upper-case letters</i>	Sets

Please note that some exceptions apply.

List of frequently used symbols

$[L]$	Physical dimension of length
$[M]$	Physical dimension of mass
$[T]$	Physical dimension of time
\tilde{f}	Spatial (Eulerian) form of function f
\bar{f}	Material form of function f
\hat{f}	Referential (Lagrangian) form of function f
$\dot{\bar{f}}$	Material time derivative of function f
e_{ijk}	Permutation symbol
h	Heat flux per unit area
m	Mass
p	Pressure
r	Heat supply per unit mass
t	Time
E	Young's modulus of elasticity
E^3	Three-dimensional Euclidean vector space
H	Rate of heating
I_1, I_2, I_3	Principal invariants of a tensor
J	Jacobian of the motion
K	Kinetic energy
R	Rate of externally applied forces
S	Stress power
W	Strain energy per unit volume
P	Particle label

\mathbb{N}	The set of natural numbers
\mathbb{R}	The set of real numbers

δ_{ij}	Kronecker symbol
ε	Internal energy per unit mass
λ	Stretch
μ	Shear modulus of elasticity
ν	Poisson's ratio
ρ	Mass density in the current configuration
ρ_0	Mass density in the reference configuration
Ψ	Strain energy function per unit mass

da	Differential area element in the current configuration
ds	Differential line element in the current configuration
dv	Differential volume element in the current configuration
$d\mathbf{f}$	Differential force applied on area da
dA	Differential area element in the reference configuration
dS	Differential line element in the reference configuration
dV	Differential volume element in the reference configuration

\mathcal{B}	Body
\mathcal{E}^3	Three-dimensional Euclidean point space
\mathcal{P}	Subset of a region occupied by a body
$\partial\mathcal{P}$	Boundary of a closed region \mathcal{P}
\mathcal{R}_0	Region occupied by a body in the reference configuration
\mathcal{R}	Region occupied by a body in the current configuration
$\partial\mathcal{R}$	Boundary of a closed region \mathcal{R}
\mathcal{S}	Subset of a body

\mathbf{a}	Acceleration vector
\mathbf{b}	Body force vector
\mathbf{e}	Relative Eulerian (Almansi) strain tensor
\mathbf{e}_i	Cartesian basis vectors in current configuration
\mathbf{g}	Gravitational force vector
\mathbf{n}	Outward unit normal in the current configuration
\mathbf{m}	Unit vector in the direction $d\mathbf{x}$
\mathbf{p}	Stress vector measured in the reference area
\mathbf{q}	Heat flux vector per unit area
\mathbf{t}	Stress vector
\mathbf{u}	Displacement vector
\mathbf{v}	Velocity vector
\mathbf{w}	Vorticity vector
\mathbf{x}	Position vector in the current configuration

B	Left Cauchy-Green deformation tensor
C	Right Cauchy-Green deformation tensor
D	Rate-of-deformation tensor
E	Relative Green-Lagrange strain tensor
E_A	Cartesian basis vectors in reference configuration
F	Deformation gradient tensor
H	Displacement gradient tensor
I	Identity tensor
L	Velocity gradient tensor
M	Unit vector in the direction $d\mathbf{X}$
N	Outward unit normal in the reference configuration
P	First Piola-Kirchhoff stress tensor
R	Rotation tensor
S	Second Piola-Kirchhoff stress tensor
T	Cauchy stress tensor
U	Right stretch tensor
V	Left stretch tensor
W	Vorticity (or spin) tensor
X	Position vector in the reference configuration
<hr/>	
ε	Infinitesimal strain tensor
κ_0	Initial configuration
κ_R	Reference configuration
κ	Current configuration
σ	Infinitesimal stress tensor
τ	Kirchhoff stress tensor
χ	Motion
ω	Angular velocity vector
Ω	Angular velocity tensor
<hr/>	
curl	Curl of a vector
det	Determinant of a tensor
div	Divergence (or spatial divergence) of a vector or tensor
Div	Material divergence of a vector or tensor
grad	Gradient (or spatial gradient) of a scalar or vector
Grad	Material gradient of a scalar or vector
tr	Trace of a tensor
<hr/>	
\cdot	Inner product of two vectors or tensors
\times	Cartesian product of sets, cross product of two vectors
\otimes	Tensor product in E^3

\mathbf{T}^{-1}	Inverse of a tensor \mathbf{T}
$\mathbf{T}^{\mathbf{T}}$	Transpose of a tensor \mathbf{T}
\mathbf{T}^*	Adjugate of a tensor \mathbf{T}
$\text{sym}\mathbf{T}$	Symmetric part of a tensor \mathbf{T}
$\text{skw}\mathbf{T}$	Skew-symmetric part of a tensor \mathbf{T}
<hr/>	
$\mathcal{A} \cup \mathcal{B}$	Union of sets \mathcal{A} and \mathcal{B}
$\mathcal{A} \cap \mathcal{B}$	Intersection of sets \mathcal{A} and \mathcal{B}
$\mathcal{A} - \mathcal{B}$	Difference of sets \mathcal{A} and \mathcal{B}
$\mathcal{A} \subset \mathcal{B}$	Set \mathcal{A} is a proper subset of set \mathcal{B}
$\mathcal{A} \subseteq \mathcal{B}$	Set \mathcal{A} is a subset of set \mathcal{B}
$\mathcal{A} \times \mathcal{B}$	Cartesian product of sets \mathcal{A} and \mathcal{B}
$x \in \mathcal{A}$	Element x belongs to set \mathcal{A}
$x \notin \mathcal{A}$	Element x does not belong to set \mathcal{A}
\emptyset	Empty set