Introduction

Search Continuum Mechanics Website

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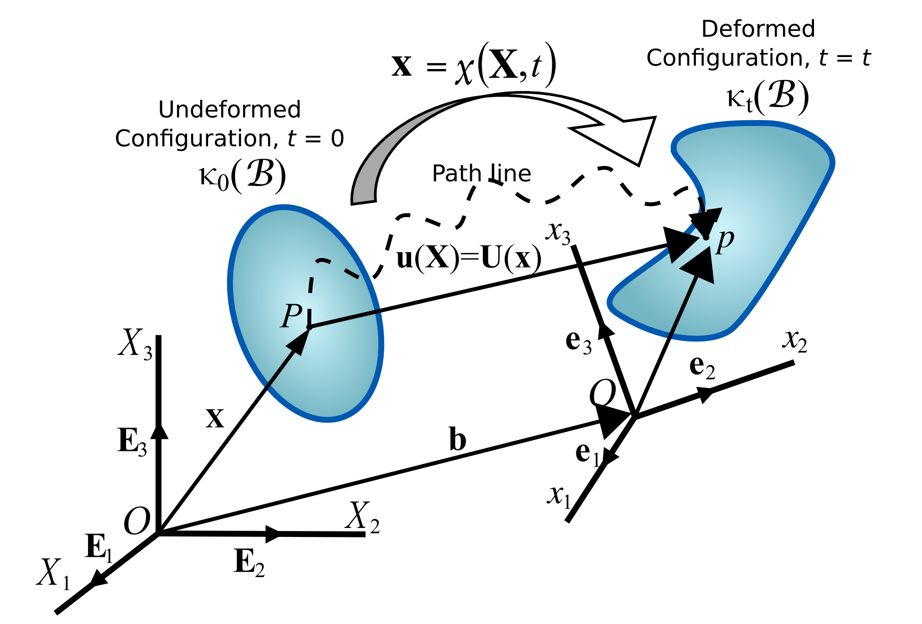
Overview



Ref: http://commons.wikimedia.org/wiki/File:Displacement_of_a_continuum.svg

Continuum Mechanics is all about using linear algebra, with some calculus thrown in, to describe the deformations (strains) in objects and relate them to the resulting stresses. This is represented by the popular figure to the right showing an object in both its undeformed and deformed states. Continuum Mechanics provides the tool box of methods needed to accomplish all the nuts-and-bolts calculations of structural analysis, whether it is performing coordinate transformations, applying material derivatives, or extracting principal stresses.

From this basic foundation, continuum mechanics expands into equilibrium balances, constitutive models that relate material deformations to the stresses generated, and the 1st and 2nd Laws of Thermodynamics, which set limits on the behavior of the constitutive models. Upon completing these advanced topics, the Navier-Stokes equations can actually seem logical. And if it (ever) becomes intuitively obvious why the Second Piola-Kirchhoff stress is the derivative of the Helmholtz free energy with respect to the Green strain tensor, well then, you've graduated.

Notation and Conventions

It is common in continuum mechanics to represent scalars with regular, normal-weight variables. For example, mass and entropy are represented by m and s, respectively (although entropy is sometimes represented by η). Vectors, tensors, matrices, etc are represented by bolded variables such as $\mathbf{v}$ for velocity. Furthermore, vectors are represented by lowercase bold variables as just shown for velocity, while higher-rank quantities, such as strain tensors, are represented by uppercase bold variables, $\mathbf{E}$.

Of course, exceptions exist. Examples include the use of $\boldsymbol{\sigma}$ for stress and $\mathbf{X}$ for the vector of coordinates of a point on an object in the undeformed state.