Continuum Mechanics - Basics and New Applications

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Continuum mechanics is a branch of mechanics that deals with the analysis of the kinematics, the reasons of motions and deformations, and the mechanical behavior of materials and structures modeled as a continuous mass rather than as discrete particles. In several references the first contributions are related to the French mathematician Augustin-Louis Cauchy the founder of the mathematical theory of elasticity in the 19^{th} century.

The starting point of continuum mechanics is the following definition [1]:

- The continuum is a manifold of points filling the space or a part of the space continuously at each moment t. Material properties (for example, density, temperature, etc.) are prescribed to the points.

The consequances of such definition are:

- The dimension of the space is not limited - one can introduce three-dimensional, two-dimensional, one-dimensional or the Minkowski space;
- One should introduce the time t which is a pseudo-time;
- The body and the mass are some basic elements;
- The accounting of special cases (isotropy, homogeneity) makes the things simpler

Any continuum theory should be valid for

- solids and fluids;
- arbitrary scales (macro, meso, micro, nano, etc.)

Finally, two sets of equations (material independent equations, material dependent equations) should be formulated for getting an Initial-boundary value problem. Examples of various continuum theories will be presented and discussed. A special focus is made on the one-dimensional continuum theory [2].

References

1. Altenbach, H. *Kontinuumsmechanik.* Springer, Cham, 2015.
2. Naumenko, K. & Altenbach, H: *Modeling High Temperature Materials Behavior for Structural Analysis - Part I: Continuum Mechanics Foundations and Constitutive Models.* Springer, Cham, 2016 (Advanced Structured Materials 28)