Kinematics comes first

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Abstract

Continuum mechanics rests on a conceptual hierarchy: (1) the description of body morphology and its changes, (2) the definition of observers and classes of their changes, (3) the representation of interactions and derivation of the relevant balance equations, (4) the assignment of constitutive structures. The last item specifies classes of materials. The freedom in selecting constitutive structures is constrained by the need to satisfy the second law of thermodynamics, even when we consider it only as a mechanical dissipation inequality.

Even if we limit the description of body morphology to the only region that a body can occupy in classical space-time (Cauchy's scheme), we need to choose a function class as a set of admissible deformations. Every such class is defined by the properties of maps that make up it; they can describe some physical properties but cannot capture others. Thus, selecting a function class for admissible deformations is also in a sense a constitutive choice. Indeed, a given functional class agrees with a given class of phenomena but properly not with another class. Thus, conceptually, the traditional hierarchy admits a sort of weak loop.

In the talk to which this abstract refers, I give full evidence of these aspects, ranging from non-linear elasticity of simple bodies to plasticity and the presence of incoherent interfaces.

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