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Asymmetric Continuum

Extreme Processes in Solids and Fluids

Springer

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Preface

The complexity of processes in the vortex motions in fluids and in a fracture source in solids has inspired us to reconsider a class of basic motions and deformations in the Asymmetric Continuum Theory. First of all, we consider the basic deformations in solids and molecular deformations in fluids and, moreover, the transport velocity in fluids and molecular transport in solids; we believe that these elements play an important role in the fracture processes. This approach gives grounds for considering the Asymmetric Continuum as a common basis for the continuum media with respective phase transitions. Thus, we consider the molecular deformations and transport velocities in fluids and will supplement the strain deformations in solids by molecular transport, important when the material becomes close to fracture.

In solids, the simple deformations include the axial nuclei, that is, point extension/compression, the shear nuclei and, when considering an asymmetric continuum, the rotation strains. Such rotation strains describe the oscillations of the main shear axes and their amplitudes. All these fields should be related to the independent motion equations. However, a separate problem concerns the displacements and a simple rotation which might be reduced even to a point dimension (Planck length). Recording of displacements, e.g., by means of seismometers, might prove their physical existence; however, we will show that such displacement records prove only the existence of displacement derivatives. The existence of displacement derivatives in solids allows us to define the molecular displacements, which might relate to the space and time derivatives. This approach will lead us to a new fracture criterion and permits to discuss some complex deformation processes. Here, an important role is played by the defect distributions of opposite signs, leading to the induced opposite-sense strains, and fracture processes.

In fluids, the transport displacement velocities describe the motion processes, while the molecular strains are related to the time rates of strains or deformations. Here, a special role is played by vorticity. The vortex motions are usually related to rotation of transport motion; however, our asymmetric approach to the continuum theory allows us to define the vortex motions by means of the rotational transport expressed in a cylindrical system. In some publications we have already shown that this new definition opens a way leading to more complicated problems, like those related to turbulence phenomena, including an influence of the gas–liquid phase transitions at breaks of some molecular bonds inside some part of a continuum.

Further, we show how this new approach to the Asymmetric Continuum, as described by a joint theory, permits also to discuss and introduce new elements into the theory of defects. The defect densities form the induced strains and effectively change the internal stress system; this approach explains many important problems related to the fracture processes. We include also some thermodynamical problems, especially those related to the fracture processes. Some quantum theory analogies help us to better understand the extreme processes in fluids and solids. We also consider and try to explain the extreme processes, like fractures in solids and turbulence motions in fluids.

Further, we explain how this new approach to the Asymmetric Continuum, as described by a joint theory, permits also to discuss the complex interaction processes, especially those related to the electric and magnetic fields including the mutual influences between these fields and the stresses. The interaction processes and some thermodynamical problems and quantum theory analogies help us to understand the extreme processes in fluids and solids. A final problem is the release–rebound theory and the interaction processes and the wave propagations presented in an invariant four-dimensional form.

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