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A unified Eshelbian-like determination of defect driving forces

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Within the framework of Continuum Mechanics, we present a unified theoretical approach to describe the onset and propagation of defects in solid materials. In this context, the term defect encompasses both changes in the material’s topology—such as fracture propagation, rotation, and volumetric expansion of inclusions or voids [1]—and material inhomogeneities, referring to spatial variations in the material properties of the body [2, 3].

We characterize the kinematics of a defect by defining its mode of propagation (see Figure 1, adapted from [4]). Following the principles of Eshelbian Mechanics [2, 3], we compute the associated energy release rate or driving force. Furthermore, we distinguish the contributions of this driving force by identifying their specific roles in defect propagation—whether purely mechanical, topological, or arising from inhomogeneities in constitutive parameters [2, 3].

To illustrate the proposed procedure more clearly, we analyze several prototypical examples from the literature, contextualized within our framework [4]. Finally, we compare the obtained results with those derived from variational approaches based on conservation laws [1, 5].

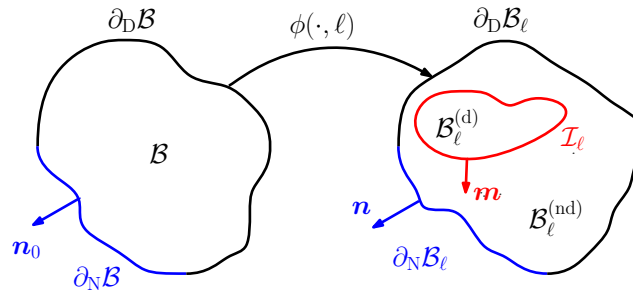


Figure 1: Intact configuration of a continuum body \mathcal{B} transformed into the defected configuration \mathcal{B}_ℓ through the defect map ϕ . Picture taken from [4].

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