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Differential Inclusions in $SBV_0(\Omega)$ and Applications to the Calculus of Variations

We study necessary and sufficient conditions for the existence of solutions in $SBV_0(\Omega)$ of a variational problem involving only bulk energy. Related to that we study the problem of finding $u \in SBV_0(\Omega)$ such that

$$\nabla u(x) \in E, \text{ a.e. in } \Omega,$$

subject to the condition

$$\int \nabla u = \zeta_0 |\Omega|,$$

where $E \subseteq \mathbb{R}^N$ is a given set and $\zeta_0 \in \text{int co } E$ is prescribed.