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Jacobians of Sobolev homeomorphisms

Let $\Omega \subset \mathcal{R}^3$ be a domain and let $f : \Omega \rightarrow \mathcal{R}^3$ be a homeomorphism in the Sobolev space $W^{1,1}(\Omega, \mathcal{R}^3)$. We show that the Jacobian satisfies either $J_f \geq 0$ a.e. or $J_f \leq 0$ a.e. We also discuss the higher dimensional setting. This is a joint work with Jan Malý.