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Invariant Measures with Bounded Variation Densities for Piecewise Area Preserving Maps

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We investigate the properties of absolutely continuous invariant probability measures (ACIPs), especially those measures with bounded variation densities, for piecewise area preserving maps (PAPs) on $\mathbb{R}^d$. This class of maps unifies piecewise isometries (PWIs) and piecewise hyperbolic maps where Lebesgue measure is locally preserved. Using a functional analytic approach, we first explore the relationship between topological transitivity and uniqueness of ACIPs, and then give an approach to construct invariant measures with bounded variation densities for PWIs. Our results "partially" answer one of the fundamental questions posed in \cite{Goetz03} - to determine all invariant non-atomic probability Borel measures in piecewise rotations. When restricting PAPs to interval exchange transformations (IETs), our results imply that for non-uniquely ergodic IETs with two or more ACIPs, these ACIPs have very irregular densities, i.e., they have unbounded variation.

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