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Shrinking Targets for Countable Markov Maps

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Let T be an expanding Markov map with a countable number of inverse branches and a repeller Λ contained within the unit interval. Given $\alpha \in \R_+$ we consider the set of points $x \in \Lambda$ for which $T^n (x)$ hits a shrinking ball of radius $e^{-n\alpha}$ around y for infinitely many iterates n. Let $s(\alpha)$ denote the infimal value of s for which the pressure of the potential $-s\log|T'|$ is below $s \alpha$. Building on previous work of Hill, Velani and Urba\'{n}ski we show that for all points y contained within the limit set of the associated iterated function system the Hausdorff dimension of the shrinking target set is given by $s(\alpha)$. Moreover, when $\bar{\Lambda}=[0,1]$ the same holds true for all $y \in [0,1]$. However, given $\beta \in (0,1)$ we provide an example of an expanding Markov map T with a repeller Λ of Hausdorff dimension β with a point $y\in \bar{\Lambda}$ such that for all $\alpha \in \R_+$ the dimension of the shrinking target set is zero.

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