Operators of Stochastic Adding Machines and Julia Sets

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Abstract

A *stochastic adding machine*, defined with respect to a given system of numeration, is a Markov chain on the natural numbers that models the process of adding the number 1 but failure is probable whenever a carry is necessary to be performed.

The first model of a stochastic adding machine, defined with respect to the binary base, was introduced by Killeen and Taylor. The real-life motivation of their work was to provide a model for the *theory of biological clocks* and describe phenomena related to time discrimination and psychological judgments. From a mathematical point of view, their result was to describe the spectrum of the transition operator determined by this Markov chain in terms of a filled Julia set. Given a holomorphic map f on $\mathbb{C}$, the *filled Julia set of* f is the set of complex numbers z whose forward iteration, that is, the sequence $(f^n(z))_{n\in\mathbb{N}}$, is bounded.

In this work, we consider a Markov chain associated with the stochastic adding machine based on a generic Cantor system of numeration and prove that the spectrum of the respected transition operator in some classical Banach spaces is related to a fibered Julia set.