

Title: Interiors of continuous images of self-similar sets with overlaps

Author(s): Lifeng Xi, Kan Jiang, Jiali Zhu and Qiyang Pei

Let K be the attractor of the following iterated function system

$$\{S_1(x) = \lambda x, S_2(x) = \lambda x + c - \lambda, S_3(x) = \lambda x + 1 - \lambda\},$$

where $S_1(I) \cap S_2(I) \neq \emptyset$, $(S_1(I) \cup S_2(I)) \cap S_3(I) = \emptyset$, and $I = [0, 1]$ is the convex hull of K . Let $d_1 = \frac{1-c-\lambda}{\lambda} < \frac{1}{1-c-\lambda} = d_2$. Suppose that f is a continuous function defined on an open set $U \subset \mathbb{R}^2$. Denote the image

$$f_U(K, K) = \{f(x, y) : (x, y) \in (K \times K) \cap U\}.$$

If $\partial_x f, \partial_y f$ are continuous on U , and there is a point $(x_0, y_0) \in (K \times K) \cap U$ such that

$$\left| \frac{\partial_y f|_{(x_0, y_0)}}{\partial_x f|_{(x_0, y_0)}} \right| \in (d_1, d_2) \quad \text{or} \quad \left| \frac{\partial_x f|_{(x_0, y_0)}}{\partial_y f|_{(x_0, y_0)}} \right| \in (d_1, d_2),$$

then $f_U(K, K)$ contains an interval. As a result, we let $c = \lambda = \frac{1}{3}$, and if

$$f(x, y) = x^\alpha y^\beta (\alpha\beta \neq 0), \quad x^\alpha \pm y^\alpha (\alpha \neq 0), \quad \sin(x) \cos(y), \quad \text{or } x \sin(xy),$$

then $f_U(C, C)$ contains an interval, where C is the middle-third Cantor set.

Address:

Lifeng Xi
Department of Mathematics
Ningbo University
Ningbo 315211
P. R. China

Address:

Kan Jiang
Department of Mathematics
Ningbo University
Ningbo 315211
P. R. China

Address:

Jiali Zhu
Department of Mathematics
Ningbo University
Ningbo 315211
P. R. China

Address:

Qiyang Pei
Department of Mathematics
Ningbo University
Ningbo 315211
P. R. China