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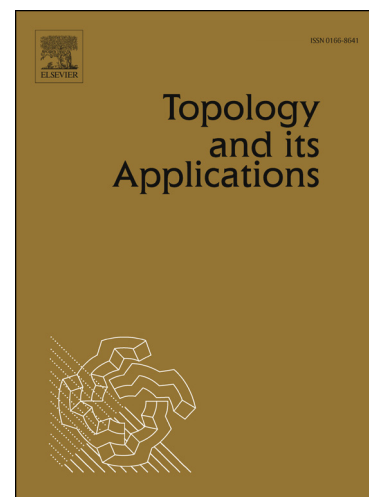
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Warsaw discs and semicomputability

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Abstract

We examine conditions under which a semicomputable set in a computable metric space is computable. Topology plays an important role in the description of such conditions. Motivated by the known result that a semicomputable cell is computable if its boundary sphere is computable, we investigate semicomputable Warsaw discs and their boundary Warsaw circles. We prove that a semicomputable Warsaw disc is computable if its boundary Warsaw circle is semicomputable.

Keywords: computable metric space, computable set, semicomputable set, Warsaw circle, Warsaw disc

2010 MSC: 03F60, 54H99

1. Introduction

A point $x \in \mathbb{R}^n$ is computable if it can be effectively approximated by a rational point $q \in \mathbb{Q}^n$ with arbitrary precision. A nonempty compact subset S of \mathbb{R}^n is computable if it can be effectively approximated by a finite subset A of \mathbb{Q}^n , in the sense of the Hausdorff metric, with arbitrary precision. Each computable set contains computable points, moreover they are dense in it.

On the other hand, a nonempty compact subset S of \mathbb{R}^n is called semicomputable if we can effectively enumerate all rational open sets (i.e. finite unions of open balls whose centers are rational points and radii are rational numbers) which cover S . This is equivalent to saying that $S = f^{-1}(\{0\})$ for some computable function $f : \mathbb{R}^n \rightarrow \mathbb{R}$. Each computable set is semicomputable, but a semicomputable set need not be computable. In fact, there exists a computable function $f : \mathbb{R} \rightarrow \mathbb{R}$ which has zero-points and they are all contained in $[0, 1]$, but none of them is computable, meaning that $f^{-1}(\{0\})$ is a semicomputable set which contains no computable point, hence which is “far away from being computable”.

Nevertheless, under certain conditions a semicomputable set is computable. Some topological properties can force a semicomputable set to be computable

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