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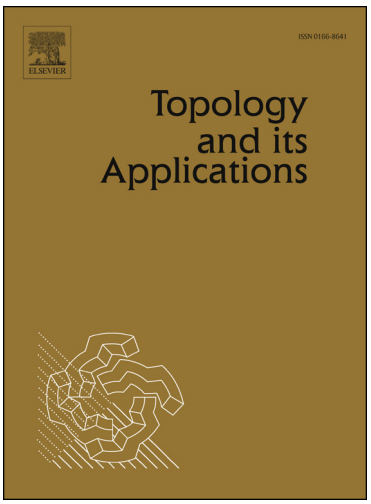

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The lexicographically ordered square is not monotonically star-finite

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Abstract

Monotone star-finiteness defined by Popvassilev and Porter is a stronger property than countable compactness in Hausdorff spaces. A space X is monotonically star-finite if for any open cover $\mathscr{U}$ of X there exists a finite subset $F(\mathscr{U})$ of X such that $X = \mathrm{st}(F(\mathscr{U}), \mathscr{U})$ and if $\mathscr{V}$ and $\mathscr{U}$ are open covers of X with $\mathscr{V}$ refining $\mathscr{U}$, then $F(\mathscr{U}) \subset F(\mathscr{V})$, where $\mathrm{st}(F(\mathscr{U}), \mathscr{U}) = \cup\{U \in \mathscr{U} : U \cap F(\mathscr{U}) \neq \emptyset\}$.

We show that the lexicographically ordered square is not monotonically star-finite. This answers several questions posed in [S. G. Popvassilev, J. E. Porter, Monotone properties defined from stars of open coverings, Topol. Appl. 169(2014), 87–98].

Keywords: monotonically star-finite, compact, countably compact, LOTS, lexicographically ordered square.
2010 MSC: 54F05, 54D20

1. Introduction

A Hausdorff space X is countably compact if and only if for any open cover $\mathscr{U}$ of X there exists a finite subset F of X such that $X = \mathrm{st}(F, \mathscr{U})$, where $\mathrm{st}(F, \mathscr{U}) = \cup\{U \in \mathscr{U} : U \cap F \neq \emptyset\}$. In [4], Fleischman showed this characterization of countable compactness. van Mill, Tkachuk and Wilson [7] call the latter property star-finite.

Popvassilev and Porter introduce concepts of monotonically star-finite spaces and monotonically star closed-and-discrete spaces in [8] and obtain some results and interesting properties on these spaces. A space X is monotonically star-finite (respectively, monotonically star closed-and-discrete) if for any open cover $\mathscr{U}$ of X there exists a finite subset (respectively, a closed-and-discrete subset) $F(\mathscr{U})$ of X such that $X = \mathrm{st}(F(\mathscr{U}), \mathscr{U})$ and if $\mathscr{V}$ and $\mathscr{U}$ are open covers of X with $\mathscr{V}$ refining $\mathscr{U}$, then $F(\mathscr{U}) \subset F(\mathscr{V})$. The F is called a monotone star-finite (respectively, monotone star closed-and-discrete) operator for X.

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