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A NOTE ON SPAN UNDER REFINABLE MAPS

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1. Introduction.

All spaces considered in this note are metric, and all maps are continuous functions. A compactum is a compact metric space. A continuum is a connected compactum. In [1], Ford and Rogers defined a map $r: X\rightarrow Y$ from a compactum X onto a compactum Y to be *refinable* if for each $\varepsilon>0$, there is an ε-map $f: X\rightarrow Y$ from X onto Y whose distance from r is less than ε. Refinable maps are useful in continuum theory, and many properties in continuum theory are preserved by refinable maps. For example, decomposability [1], aposyndesis [2], property [k], irreducibility, hereditary indecomposability and being the pseudo-arc [6] (see for other properties [4] and [5]).

Lelek [8] defined the *surjective span* of a continuum X, $\sigma^{*}(X)$, (resp. the *surjective semi-span*, $\sigma_{0}^{*}(X)$) to be the least upper bound of all real numbers α with the following property; there exist a continuum C and maps $f_{1}, f_{2}: C\rightarrow X$ such that $f_{1}(C)=X=f_{2}(C)$ (resp. $f_{1}(C)=X$) and dist $(f_{1}(c), f_{2}(c))\geqq\alpha$ for every $c\in C$. The *span* $\sigma(X)$ and the *semi-span* $\sigma_{0}(X)$ of X are defined by the formulas;

$$\sigma(X)=\sup\{\sigma^{*}(A)\mid A \text{ is a subcontinuum of } X\},$$

$$\sigma_{0}(X)=\sup\{\sigma_{0}^{*}(A)\mid A \text{ is a subcontinuum of } X\}.$$

Recently, many authors have been investigating span theory and finding interesting properties. Concerning span and special classes of maps, the following problems are raised in the University of Houston Problem Book;

Problem 86. *Do confluent maps of continua preserve span zero?*

Problem 92. *If M is a continuum with positive span such that each of its proper subcontinua has span zero, does every nondegenerate monotone continuous image of M have positive span?*

Ingram, [3, Theorem 2], showed that monotone maps of continua preserve span zero.

In this note we will show that refinable maps of continua preserve surjective

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