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Decomposing into Essentially One-Dimensional Spaces Two-Dimensional Planar Sets that are not Homotopy Equivalent to Anything One-Dimensional

This paper has been motivated by an example of one of the authors for a two-dimensional subset of the Euclidean plane that in collaboration with J. Cannon und G. Conner could be proven to be not homotopy equivalent to any one-dimensional space. The original example had an uncountable fundamental group. In the present paper we first give an improved version of such an example with the same dimension-properties that in addition is a cell-like set with only trivial fundamental group. Then we show that any subset X of the Euclidean plane can in such a way be decomposed into two subsets $X_1 \& X_2$ that each of them and their non-empty intersection is homotopy-equivalent to a one-dimensional set. $X_1 \cap X_2$ contains the entire one-dimensional part of X, and for the two-dimensional part we have that $X_1 \cap X_2 \cap \mathrm{Int}(X)$ is open. Finally, by an according example it is also shown, that this decomposition result cannot be improved by finding in any case such X_1 and X_2 that also $X_1 \cap X_2$ is open.

*This is a joint work with Umed Karimov, Dušan Repovš and Witold Rosicki