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TOPOLOGY PROCEEDINGS
Volume 54, 2019
Pages 271–282

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Electronically published on April 18, 2019

Topology Proceedings

Web: http://topology.auburn.edu/tp/
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E-mail: topolog@auburn.edu
ISSN: (Online) 2331-1290, (Print) 0146-4124

http://topology.auburn.edu/tp/
http://topology.nipissingu.ca/tp/

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E-Published on April 18, 2019

TOPOLOGY AND EXPERIMENTAL DISTINGUISHABILITY

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Abstract. In this work, we introduce the idea that the primary application of topology in experimental sciences is to keep track of what can be distinguished through experimentation. This link provides understanding and justification as to why topological spaces and continuous functions are pervasive tools in science. We first define an experimental observation as a statement that can be verified using an experimental procedure and show that observations are closed under finite conjunction and countable disjunction. We then consider observations that identify elements within a set and show how they induce a Hausdorff and second-countable topology on that set, thus identifying an open set as one that can be associated with an experimental observation. We then show that experimental relationships are continuous functions, as they must preserve experimental distinguishability, and that they are themselves experimentally distinguishable by defining a Hausdorff and second-countable topology for this collection.

1. Introduction

The successful use of mathematical ideas in experimental sciences is long established and celebrated [8]. Topology is perhaps the most widespread, either directly (see [6] and [3]) or as a foundation to other tools (see [5] and [1]). This leads one to ask, why is it so successful? What property is captured by topological spaces that is so fundamental for scientific investigation?

2010 *Mathematics Subject Classification.* 54H99, 00A79.
Key words and phrases. function space, scientific foundations, topological spaces.
Funding for this work was provided in part by the MCubed program of the University of Michigan.