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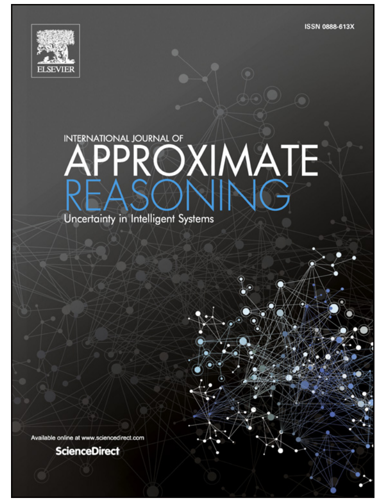

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Notes on covering-based rough sets from topological point of view: Relationships with general framework of dual approximation operators

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Abstract

In the recent article "On some types of covering rough sets from topological points of view" [14], the author develops a topological approach to covering-based rough sets. In this context, a number of corresponding approximation operators are introduced, their inclusion relationships are verified, and various conditions under which the operators coincide are proven.

On the other hand, a lot of effort has recently been dedicated by several authors to study covering-based approximation operators within a general framework of dual approximation operators [2, 3, 7–10, 12].

In this note, we study correspondences between the framework of Zhao and the framework established in [2]. In particular, we evaluate how the newly introduced topological approximation operators relate to existing ones in terms of equalities and partial order relations.

Keywords: rough sets, coverings, approximation operators, topology

1. Introduction and preliminaries

Over the past two decades, numerous definitions of covering-based rough set approximations have been proposed in literature, see e.g. [1, 8–10, 13, 15–17]. Yao and Yao [12] were the first who attempted to categorize them within a general framework of dual approximation operators, and their efforts were later extended in e.g. [2, 3, 6, 7]. Apart from establishing equalities between the different proposals, a pertinent research question has been to order approximation operators in order to reach conclusions on their approximation accuracy (i.e., the ratio between the lower and the upper approximation) [3, 7]. Indeed, from a practical perspective, it is reasonable to consider the most accurate pair of operators, as the approximations will be the closest to the approximated set.

Zhao [14] recently introduced a number of covering-based approximation operators inspired by a topological approach. This paper aims to relate those operators to the general framework, making it clear which operators coincide with existing ones, and how the remaining ones fit in the Hasse diagram representing the partial order of approximation operators.

We start with discussing the basic notions of covering-based rough sets and provide both the general and topological framework of approximation operators.

1.1. Basic notions of covering-based rough sets

Throughout this work we assume that the universe U is a non-empty set. In Pawlak's rough set model [5], given an equivalence relation E on U and a set A in U,

$$\underline{\text{apr}}(A) = \{x \in U\colon [x]_E \subseteq A\} = \bigcup\{[x]_E \in U/E\colon [x]_E \subseteq A\}, \tag{1}$$

$$\overline{\text{apr}}(A) = \{x \in U\colon [x]_E \cap A \neq \emptyset\} = \bigcup\{[x]_E \in U/E\colon [x]_E \cap A \neq \emptyset\}, \tag{2}$$

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