PREFACE

Special section on

Applications of Incompleteness and Uncertainty Management Methods

The world is currently facing an explosion in the availability of data, as well as an ensuing interest in computational techniques that allow us to (semi-)automatically extract knowledge and value from the data. Despite their abundance, data can be affected by different types of uncertainty, some of which are not usually accounted for when conducting data analysis: label or data noise, missing data (in different forms, e.g., values that are not known or are voluntarily not collected), or vagueness and ambiguity (such as values described in linguistic terms). In light of these considerations, it is important to become aware of the potential sources of uncertainty in data and to conceive novel methods to both mitigate and manage their impact. Indeed, several methodologies have been developed for representing and managing incompleteness and uncertainty; these include, among others, probability theory and statistics, rough set theory, fuzzy set theory, the three-way decision, belief functions and imprecise probability, granular computing, as well as their hybridizations. These techniques are being increasingly applied in order to comprehensively model uncertainty in real-life applications.

This special section aims to showcase extended versions of papers presented at the International Joint Conference on *Rough Sets, IJCRS 2023*, which was held in Kraków (Poland) on 5–8 October 2023, and focuses on demonstrating applications of techniques and methodologies for representing and managing incomplete and uncertain information in a variety of scenarios.

The first paper, *Detection of potentially anomalous cosmic particle tracks acquired with CMOS sensors: Validation of rough k-means clustering with PCA feature extraction*, presents an analysis of the behavior of the rough k-means clustering algorithm in the astronomy domain. The main goal of the manuscript is to evaluate the application of a principal components analysis-based features extraction method and rough k-means clustering for outlier detection in detecting potentially anomalous cosmic particle tracks.

The second paper, *On explainability of cluster prototypes with rough sets: A case study in the FMCG market*, focuses on the problem of machine learning explainability in the setting of fast moving consumer goods markets. The manuscript proposes a novel, interpretable approach to optimize supply management using a variety of techniques including rough sets, distance-based clustering and dimensionality reduction methods. The results illustrate the effectiveness of the proposed approach in reducing the work done by experts for applying delivery plans.

The third paper, *Evidence-theoretical modeling of uncertainty induced by posterior probability distributions*, is the most theoretical one and studies the relationships between the posterior probability distributions produced by machine learning models and mass functions in the framework of evidence theory. The authors investigate the mathematical properties of these structures as well as construct uncertainty measures that are then applied in active learning scenarios.

The last paper, *From rough mereology to robust navigation: Expanding mobile robot strategies with diverse maps and enhanced goal-targeting mechanisms*, presents an application in the field of mobile robotics. The paper illustrates how an approach inspired by rough mereology and potential fields can be used to improve real-time path planning in real-world scenarios involving complex obstacle configurations.

The editors hope that this special section and the presented applications will be of interest to a wide range of scientists from various fields. We would like to thank all the authors who submitted their research papers to our special section for their hard work on filling this publication with interesting results, both from a theoretical and an application point of view. We also want to thank the reviewers—we believe that their comments and suggestions did improve the manuscripts under consideration. We also wish to acknowledge Professor Józef Korbicz, the journal's Editor-in-Chief, for his acceptance of this special section and his cooperation throughout the process.

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March 2025

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