Rough Set Theory and its Applications in Image Processing
– A Short Review

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Abstract: Rough set theory (RST) is one of the major components of soft computing and has the capability of dealings with vagueness/uncertainty/ambiguity. Recently, significant growth of the applications of RST in various image processing applications has triggered to do this review. This paper presents a short review of the concepts and applications of RST with emphasis on image processing applications.

Keywords: Rough Set Theory, Image Processing, Approximations, Information system

1. Introduction:
Rough set theory, the brain child of Zdzislaw Pawlak [1][2][3][5], is defined by the lower approximation (100% belonging to the set) and upper approximation (union of lower approximation and some of the elements that do not belong to the set but near to the set). The elements that do not belong to the set but that are near to the set represents the boundary region of the rough set [4].

This paper presents a short review of rough set theory and its applications in image processing. The paper is organized as follows. Section 2 gives an overview of rough set. Section 3 focuses on applications in image processing and Section 4 concludes the paper.

2. An Overview of Rough Set:
Rough set theory, the brain child of Zdzislaw Pawlak [1][2][3][5], is defined by the lower approximation (100% belonging to the set) and upper approximation (union of lower approximation and some of the elements that do not belong to the set but near to the set). The elements that do not belong to the set but that are near to the set represents the boundary region of the rough set [4]. Rough set theory is good for modeling/representing uncertainty and vagueness. The application of rough set theory [1][2][5][6] can be seen in data reduction and data relationship/dependencies/similarities/differences [3][5].

The rough set theory approach has found interesting applications in various branches of science including image processing [5][7][9][8], artificial intelligence [10]. Rough sets based algorithms have the capability to get extended on parallel computers [2][3][6].

3. Applications of Rough Set Theory in Image processing:
The information granule [11] helps to represent objects and solve problems in real life and hence it is a good tool for pattern recognition and image processing [12][13][17]. The segmentation of images is one of the challenging issues in image processing. The segmentation of medical images is still more challenging due to the poor image contrast/artifacts resulting in missing/diffuse organ/tissue boundaries [4][8][9].

The idea of segmentation is that some of the pixels will be belonging to the positive region and will be included in the set X. Some other pixels will not be included in the set X and it is called negative regions. The remaining pixels will be in the boundary case [6][7][14][15].

Automatic and computationally efficient identification of the Cellular Automata for image processing systems is another application where rough set is being applied [16]. An integration of rough set theoretic knowledge extraction, EM algorithm and MST clustering for segmentation of multispectral satellite images [12] is another interesting application.

Image classification and retrieval is another important task in image processing. Some of the important researches using rough set theory in this area are mammogram classification [18], object-based image retrieval [19] and image retrieval method insensitive to location variations [21]. Rough set can also be combined with various computational intelligence techniques to provide better results and future research will concentrate on these issues and its implementation.

4. Conclusion:
Rough set theory is good for modeling/representing uncertainty and vagueness. Rough set theory offers effective methods for various image processing applications. This paper presents a short review of rough set theory and its applications in image processing.
Acknowledgement:
The first author would like to thank Bharathiar University and Sri Ramakrishna Institute of Technology for research support. The second author would like to thank Central University of Bihar for research support.

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