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Classification of Oil Spills using Computational Intelligence

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ABSTRACT

Rough set theory is one of the useful computational intelligence tools which can be used to deal with vague information and to take important decision in uncertain domain. Rough set theory is useful for decision making in situation where indiscernibility is present. Rough sets do not require experienced knowledge engineers to provide dditional information about the membership functions for being processed. In this paper Rough Set method is used or dimensionality reduction of oil spill feature space in SAR imagery. Reducing the number of features results in reduced feature space which improves the prediction accuracy and minimizes the classification time.

Keywords: **Classification, Computational intelligence, Dimensionality reduction, Oil spill, Rough set.**

I. INTRODUCTION

Computational Intelligence (CI) research includes Low-level cognitive functions like perception, object identification, signal analysis, discovery of structures in data, simple associations and control. Methods developed for this type of problems include supervised and unsupervised learning by adaptive systems, and they encompass not only neural, fuzzy and evolutionary approaches [1-3] but also probabilistic and statistical approaches, such as Bayesian networks or kernel methods. These methods are used to solve the same type of problems in various fields such as pattern recognition, signal processing, classification and regression, data mining. Higher level cognitive functions are required to solve non-algorithmizable problems involving systematic thinking, reasoning, complex representation of knowledge, episodic memory, planning, understanding of symbolic knowledge. These problems are at currently solved by Artificial Intelligence community using methods based on search, symbolic knowledge representation, reasoning with frame-based expert systems, machine learning in symbolic domains, logics and linguistic methods. There is little overlap between problems solved using low and high-level mental functions, although they belong to the same broader category of non-algorithmizable problems.

Release of oil or oil products in the environment is known as oil spill. Among the different types of marine pollution, oil is a major menace to the sea. Main issue in oil spill detection system is discrimination between oil spill and lookalikes. Oil on the water surface reduces the back scatter values which results in dark spot in SAR imagery. Different phenomena like low wind area, organic film, natural film, rain cells and others resulted in dark spot in SAR imagery. Before applying the dark spot extraction algorithms, the quality of the SAR image is enhanced by enhancement techniques. Reducing the noise and smoothing the image are the most vital steps in preprocessing of image. 41 features are extracted from the dark spot which are used as input for

the classifier. Before giving the features to classifier the prominent features are selected using dimensionality reduction methods. By reducing the size of the feature vector both time and memory requirements are reduced. Time is reduced in terms of extraction time as well as classification time. From a computational efficiency point, it is beneficial to have a minimal set of features involved in the classification process.

Reducing the number of features results in reduced feature space which improves the prediction accuracy and minimizes the classification time. This is achieved by removing irrelevant, redundant and noisy features (i.e.) it selects the subset of features that can achieve the best performance in terms of accuracy and computation time. Basically, it is a dimensionality reduction process. Very few methods like Genetic Algorithm (GA) and Principal Component Analysis (PCA) are used already in Oil spill detection system. . In this paper rough set method [4-7] is used for feature selection. This method is a selection based method. It selects the features instead of transforming the feature set.

The organization of the article is as follows: Section 2 provides a brief overview of rough set theory and relevant design details of feature selection using rough set theory. Section 3 discusses experimental results and conclusion is given section 4.

II. Feature Selection By Rough Set Method

To define the rough set let us consider a knowledge base K= (E, R) where, E is the set of objects of interest called the Universe and an indiscernibility relation $R \subseteq E \times E$, is an equivalence relation. Any set X, which is a subset of E, can be characterized with respect to R as follows:

The R-lower approximation of X is the set of all objects, which can be certainly classified as X with respect to R and that can be given as

$$\underline{R}(X)=\{Y \mid Y \in E/R \text{ and } Y \subseteq X\} \quad \ldots (1)$$

where, E/R means the family of equivalence classes of R (or classification of E).

The R-upper approximation of X is the set of all objects, which can be possibly classified as X with respect to R and that can be given as

$$\overline{R}(X)=\cup\{Y \mid Y \in E/R \text{ and } Y \cap X \neq \emptyset\} \quad \ldots (2)$$

The R-boundary region of a set X with respect to R is the set of all objects, which can be classified neither as X nor as not-X with respect to R, and is given as

$$RN_R(X) = \bar{R}(X) - \underline{R}(X) \quad \ldots (3)$$

From the above definitions it is evident that if the boundary region is empty then the set X is crisp i.e. exact with respect to R but if the boundary region is nonempty then the set X is rough. The rough set model is shown below.

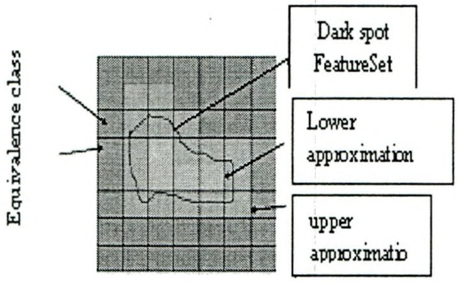

Figure 2.1 rough set model

Decision Tables

A decision table consists of two different attribute sets namely conditions (C) and decision (D). Each row of a decision table describes a decision rule, which indicates a particular decision to be taken if its corresponding condition is satisfied. If a set of decision rules has common condition but different decisions then all the decision rules belonging to this set are inconsistent.

Dependency of Attributes

If all the values of attributes from D are uniquely determined by values of attributes from C then D depends totally on C is denoted by $C \Rightarrow D$. If D depends on some of the attributes of C then it is a partial dependency $C \Rightarrow_k D$ and a degree of dependency (k; $0 \le k \le 1$) can be computed as $k = \gamma(C, D)$, where $\gamma(C, D)$ is the consistency factor of the decision table. $\gamma(C, D)$ is defined as the ratio of the number of consistent decision rules to the total number of decision rules in the decision tables.

Reduction of Attributes Decision tables are the feature vectors of the condition (C) and desired values for corresponding classes are the decisions (D) that can also represent classification of feature vectors. Now the dimensionality reduction can simply be considered as removal of some attributes from the decision table preserving its basic classification capability. If a decision table contains some redundant data then remove them.

To perform such reduction of attributes in rough set theory indispensable attributes are selected. In rough set theory indispensable attributes are selected using two fundamental concepts: reduct and core. They are defined as follows:

- Let Q be a subset of P and let ***a*** belong to Q.
- ***a*** is dispensable in Q
  if I(Q) = I(Q − {a}); otherwise ***a*** is indispensable in Q.
- Set Q is independent if all its attributes are indispensable.
- Subset Q' of Q is a reduct of Q
  if Q' is independent and I (Q') = I (Q).

Thus a reduct is the minimal subset of attributes that performs as the whole set of attributes. Attributes that are in reduct subset can be eliminated. The core of a set T is the set of all indispensable attributes of T, which can be given as

$$CORE(T) = \cap REDUCT(T) \quad \ldots (4)$$

where, REDUCT (T) is the set of all reducts of T.

Since the core is the intersection of all reducts, no element of the core can be eliminated affecting the classification power of attributes. The steps in reducing feature set by rough set method are presented below. The rough set selects the features based on the reduct values.

Table 2.1 Algorithm for Feature Selection by Rough Set

Step 1. Let F be the oil spill SAR imagery feature set and obtain, discrete form of F ie F_d

Step 2. Construct the decision table F_d as condition and attribute value representing corresponding class as decision.

Step 3. Find the respective core for each of the decision rules and redraw the table.

Step 4. Find the value reduct and redraw the table.

Step 5. Reduce the table.

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features are extracted by skipping DR phase in the oil spill detection system. That saves memory as well as time in the detection system.

Table 3.1 Features selected by Rough Set

S. No.	Feature selected
1	Area
2	Centroid
3	HGRE
4	Kurtosis
5	LRHGE
6	Major Axis length
7	Maximum intensity
8	Minimum intensity
9	Minor Axis length
10	Perimeter
11	Skewness
12	SRHGE
13	Standard Deviation

IV. Conclusion

In this paper, the feature space of the oil spill detection system is reduced to large extent using rough set method. Dark spot feature space consists of forty one features of dark area. In this paper selection based DR technique is used. Hence, the meaning of the feature set is still retained. The rough set method is applied on feature space of the oil spill. This method is not already used in this oil spill detection system. Rough set method selects thirteen features; 68.29% of reduction is achieved by the RS method. The reduced feature set is given as input to the classifier for classification.

References

[1]. Włodzisław Duch, Norbert Jankowski1 and Krzysztof Grąbczewski, Computational intelligence methods for information understanding and information management, 2006.
[2]. Włodzisław Duch, What is Computational Intelligence and what could it become?, 2007.
[3]. J. C. Bezdek, What is computational intelligence? In: Computational Intelligence Imitating Life, pp. 1–12, IEEE Press, New York.
[4]. Bhattacharjee, D. K. Basu, M. Nasipuri, M. Kundu, Reduction of feature vectors using rough set theory for human face recognition, 2010, available in arxiv.org.
[5]. Q.H. Hu, D.R. Yu, J. F Liu, C. X Wu, Neighborhood rough set based heterogeneous feature subset selection, *International Journal on Information Sciences*, 2008, pp. 3577–3594.
[6]. Z. Pawlak, Rough sets, *International Journal of Computer and Information Sciences*, *vol. 11*, 1982, pp. 341-356.
[7]. Qinghua Hu, Daren Yu, Witold Pedrycz. Degang Chen, Kernelized Fuzzy Rough Sets and Their Applications, *Vol. 23 No. 11*, Nov 2011, pp. 1649-1667.

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