



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 12, December 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)



# Application of Fuzzy Soft Set in Real Life Decision Making Problems Based on Grey Theory

Dr. Rajesh Kumar Pal

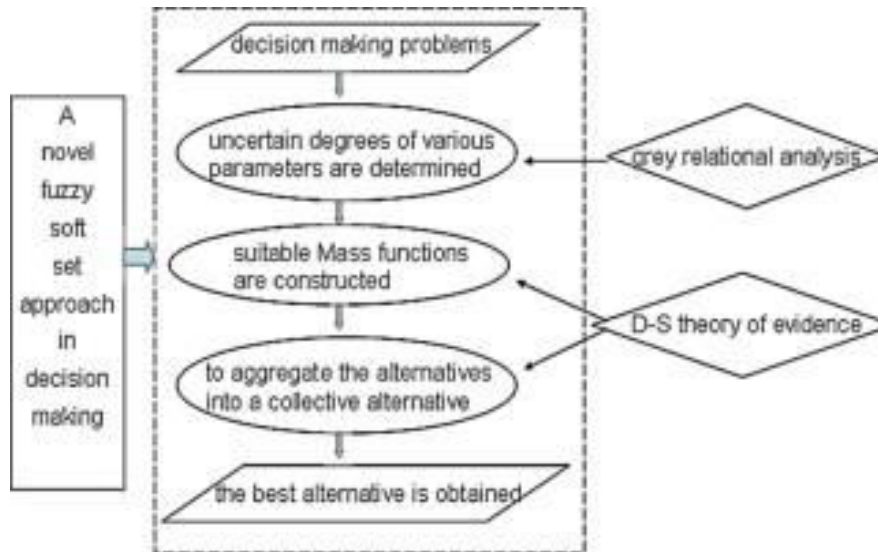
Associate Professor, Department of Mathematics, D.A.V. (PG) College, Dehradun, India

**ABSTRACT:** There are many uncertain problems in practical production and life which need decisions made with soft sets and fuzzy soft sets. However, the basis of evaluation of the decision method is single and simple, the same decision problem can obtain different results from using a different evaluation basis. In this article, in order to obtain the right result, we discuss fuzzy soft set decision problems. A new algorithm based on grey relational analysis is presented. The evaluation bases of the new algorithm are multiple. There is more information in a decision result based on multiple evaluation bases, which is more easily accepted and logical to one's thinking. According to the previous results for decision making in fuzzy soft sets, researchers focus on a direction as the evaluation basis, such as choice value (the sum of all membership grades for one object), score value (the number of parameters of relatively larger membership value of an object), or other evaluation bases. The evaluation methods are completely different. For the same problem, the results may be inconsistent. Decision making problems may use different factors, so it is not easy to judge which result is right. Furthermore, we don't know which method should be chosen for making decisions. Two examples (a) and (b) are listed to make decisions depending on two different evaluation bases, choice values and score values. It is a quantitative analysis to explore the similarity and dissimilarity among factors in developing dynamic processes. The theory proposes a dependence to measure the correlation degree of factors; the more similarities develop, the more factors correlate. Grey relational analysis of grey theory is a well known approach that is utilized for generalizing estimates under small samples and uncertain conditions. We apply grey relational analysis of grey theory to combine multiple evaluation methods into a single evaluation value. Finally, we use the evaluation value to make the decision. The evaluation sequence associates to a kind of evaluation method, so this new algorithm is a hybrid evaluation method for comprehensive evaluation. Also, this new algorithm is objective, numerical and accurate, and we can compare the value to obtain the optimal choice, suboptimal choice, and so on.

**KEYWORDS:** fuzzy soft set, real life, decision, grey theory, correlation, evaluation, algorithm

## I. INTRODUCTION OF THE REVIEW

The most recent Coronavirus (COVID-19) epidemic was an outbreak in China at the start of 2020. China increased its national public-health response to the highest level on January 23, 2020. A variety of initiatives have introduced public social distancing to reduce the rate of COVID-19 transmission as part of the emergency response. The infection is transmitted through droplets when a person contacts a person with respiratory symptoms (such as coughing or sneezing) in close contact (within a distance of 1 meter), which puts this person at risk of exposing his mucous membranes (mouth and nose) or conjunctiva (eye) into potential respiratory droplets. Infection can also be spread through contaminated equipment found in the area around an infected person, making it an infection. [1,2] As a result, many papers were published by several researchers to study and analyze this virus, such as. The concepts of the core and the reduced are two central concepts of the rough set theory in the case of attributes and knowledge. The development of artificial intelligence has been implemented worldwide in recent years and linked to data analysis. Recently, work on soft set theory is advancing rapidly, for instance, fuzzy set theory and intuitionistic fuzzy set theory. [3,4]



The fuzzy topology is extended to the general topology’s fundamental principles, which is very helpful in solving many life problems .[5,6]

**Algorithm 1: CVBDM**

Step1: Input an interval-valued fuzzy soft sets  $(\tilde{Z}, P)$ .

Step2: Generate the choice value  $c_i$  for each object  $h_i$  by the formula as

$$c_i = [c_i^-, c_i^+] = \left[ \sum_{p \in P} \mu_{\tilde{Z}(p)}^-(h_i), \sum_{p \in P} \mu_{\tilde{Z}(p)}^+(h_i) \right].$$

Here  $\mu_{\tilde{Z}(e_j)}^-(h_i), \mu_{\tilde{Z}(e_j)}^+(h_i)$  are the upper and lower degrees for object  $h_i$  and parameter  $e_j$ , respectively.

Step3: Produce the score  $r_i$  of  $h_i$  by the following formula as

$$r_i = \sum_{h_j \in U} ((c_i^- - c_j^-) + (c_i^+ - c_j^+))$$

For every  $h_i \in U$ .

Step4: Find  $r_k = \max_{h_i \in U} \{r_i\}$ . That is, find the maximum overall choice value and then the corresponding object is the optimal choice object.

One such application used with a soft fuzzy collection in the field of medical diagnostics is presented. In this technique, soft fuzzy set is developed as a prediction framework for COVID-19 with the aim of solving many issues that have been found by insufficient knowledge from intelligent systems. [7,8]



**Algorithm 2:**

**Step 1:** Input HFS-sets  $(hfs, A)$  and  $(hfq, B)$ .

**Step 2:** Construct HFS-topology  $\tilde{\tau}$  such that  $(hfs, A)$  and  $(hfq, B)$  are HFS-open sets in  $\tilde{\tau}$ .

**Step 3:** Calculate score matrix corresponding to each HFS-open set.

**Step 4:** Find the cardinal of all HFS-open sets by using

$$C(hfs, A) = \left\{ \frac{Chfs(\varsigma)}{\varsigma} : \varsigma \in A \right\} \tag{1}$$

where

$$Chfs(\varsigma) = \sum_{\varrho \in X} \frac{hfs(\varrho)}{|X|} \tag{2}$$

**Step 5:** Find the aggregate fuzzy set of score matrix by using

$$|E| * M_{(hfs, A)^*} = M_{(hfs, A)} * M_{C(hfs, A)}^t \tag{3}$$

where  $M_{(hfs, A)^*}$ ,  $M_{(hfs, A)}$ , and  $M_{C(hfs, A)}^t$  represent aggregate fuzzy matrix, score matrix, and transpose of cardinal set, respectively.

**Step 6:** Add  $(hfs, A)^*$  and  $(hfq, B)^*$  to find decision HFS-set

**Step 7:** Determine optimal choice given by

$$\max\{(hfs, A)^* + (hfq, B)^*(\varrho)\} \tag{4}$$

Decision making plays a critical role in our everyday lives, and among multiple alternatives, this mechanism offers the best alternative.

**Algorithm 3:** Using 3-polar Fuzzy soft set.

**Step 1.** State  $\mathcal{A}, \mathcal{B} \in [([0,60]^2)^X \times ([0,60]^2)^X]^I = [([0,60]^4)^X]^I = [([0,60]^4)^I]^X = ([0,60]^4)^{X \times I}$

**Step 2.** Compute  $\mathbb{C} = \mathcal{A} \wedge \mathcal{B} \in [([0,60]^2)^X \times ([0,60]^2)^X]^I$

**Step 3.** Compute the 3-polar Fuzzy soft set  $\tilde{\mathbb{C}} \in ([0,60]^{2 \times 3})^X$ , defined by

$$\tilde{\mathbb{C}}(x)(i, j) = 60 \wedge \sum_{k=1}^3 (p_k \circ p_1 \circ \mathbb{C}(x)(i, j) \times p_k \circ p_2 \circ \mathbb{C}(x)(i, j)) \quad \forall (i, j) \in I^2, \forall x \in X$$

Where  $p_k: [0,60]^2 \rightarrow [0,60]$  is the  $k$ -the projection ( $k = 1, 2, 3$ );

**Step 4.**  $\mathbb{C}_M: X \rightarrow R$ , by  $\mathbb{C}_M(x) = \sum_{(i,j) \in I^2} \beta(x)(i, j)$ , where

$$\beta(x)(i, j) = \begin{cases} \mathbb{C}(x)(i, j), & \mathbb{C}(x)(i, j) = \max\{\mathbb{C}(x)(s, t) : (s, t) \in I^2\}, \\ 0 & \text{Otherwise.} \end{cases}$$

**Step 5.** The maximal value of  $\mathbb{C}_M$  to state the optimal alternative for suitability of S-box to image encryption based on 3-polar Fuzzy soft set.

There exist several decision making applications, such as, Fuzzy soft applications have made great progress, especially in decision making, such as soft level sets applied to solve fuzzy soft set-based decision making. Several attempts have been made to further generalize the fuzzy soft set and their applications in various fields .[9,10] In this theory, the notions of the fuzzy soft lower (resp. upper) approximations used can be helpful in fixing the knowledge concealed in



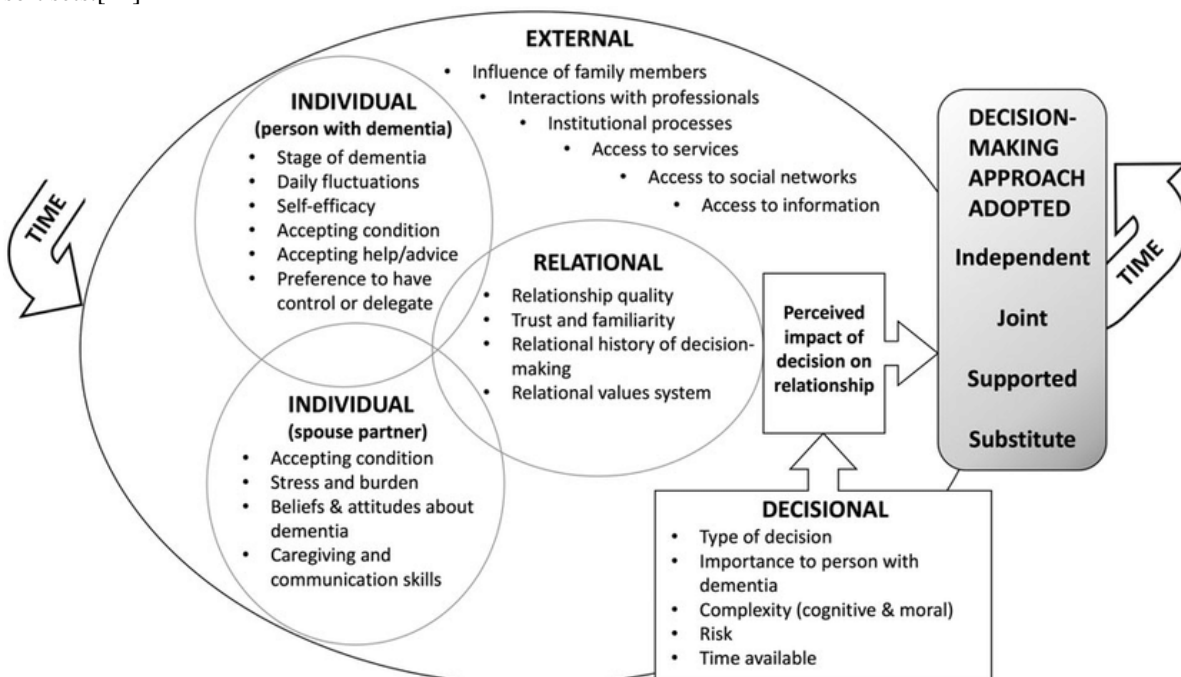
the information system and then articulated in the form of a problem of decision making . A decision model has been proposed based on the optimal solution and the fuzzy soft set. A novel fuzzy soft set approach in decision making focused on grey relational analysis. The main contribution in the current work is to introduce a new concept based on fuzzy soft relation with level fuzzy soft relation called Union-Intersection decision making method and it enables us to determine the optimal traits or elements most affected by the disease. Finally, we also used the algorithms to get the basic symptoms casing of the COVID-19 coating of a sample of patients. These results may help the physician in making the best decision.

## II. METHODOLOGY AND EXEMPLIFICATIONS

As well as we know, it is critical to manage uncertainty in medical diagnosis. By considering the medical diagnosis problem, we compare the proposed method with the related methods . Finally, the proposed method is as efficient as the related methods. Supposing that the universe set  $U$  that consists of four diseases is given by  $U = \{\text{acute dental abscess, migraine, acute sinusitis, peritonsillar abscess}\} = \{x_1, x_2, x_3, x_4\}$ , and the set of parameters  $B$  is given by  $B = \{\text{fever, running nose, weakness, orofacial pain, nausea vomiting, swelling, trismus, history, physical examination, laboratory investigation}\} = \{e_1, e_2, e_3, e_4, e_5, e_6, e_7, f_1, f_2, f_3\}$ . Let  $I_1$  and  $I_2$  be two subsets of  $E$ , given by  $I_1 = \{e_1, e_2, e_3, e_4, e_5, e_6, e_7\}$  and  $I_2 = \{f_1, f_2, f_3\}$ . Supposing that  $(F, I_1)$  is the fuzzy soft that expresses ‘‘symptoms of the diseases’’, and  $(G, I_2)$  is the fuzzy soft set that represents ‘‘decision making tools of the diseases’’. Supposing that a patient who is suffering from a disease has three symptoms  $P = \{\text{fever, runny nose, orofacial pain}\}$ . [11]  
 A doctor requires to make the most suitable diagnosis regarding to the patient’s symptoms, physical examination, history, and laboratory investigation. To figure out this problem, ‘‘ $(F, P) \wedge (G, I_2)$ ’’ is constructed . There are four diseases, i.e.,  $x_1, x_2, x_3, x_4$ , and nine pairs of parameters, i.e.,  $s_1 = (e_1, f_1), s_2 = (e_1, f_2), s_3 = (e_1, f_3), s_4 = (e_2, f_1), s_5 = (e_2, f_2), s_6 = (e_2, f_3), s_7 = (e_4, f_1), s_8 = (e_4, f_2), s_9 = (e_4, f_3)$ , where  $s = (e, f)$  denotes the pair of one symptom and one decision making tool. A forementioned, the frame of discernment is  $U = \{x_1, x_2, x_3, x_4\}$  that is constructed by four diseases, and the set of parameters which is considered as the set of evidence is  $Q = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9\}$  that is constructed by the pairs of the symptoms and the decision-making tools.

## III. DISCUSSION

There are many uncertain problems in practical production and life which need decisions made with soft sets and fuzzy soft sets.[12]



However, the basis of evaluation of the decision method is single and simple, the same decision problem can obtain different results from using a different evaluation basis. In this paper, in order to obtain the right result, we discuss fuzzy soft set decision problems. A new algorithm based on grey relational analysis is presented. The evaluation bases of the new algorithm are multiple. There is more information in a decision result based on multiple evaluation bases,



which is more easily accepted and logical to one’s thinking. For the two cases examined, the results show that the new algorithm is efficient for solving decision problems.

We have introduced a method for fuzzy soft set in decision making by combining grey relational analysis with D-S theory of evidence and given a practical application to medical diagnosis. This method allows us to avoid the problem of selecting suitable level soft sets, reduce uncertainty caused by people’s subjective cognition, and raise the decision level. Then it is more feasible and practical for dealing with applications under uncertainty. Our future work will concentrate on applications of interval-valued intuitionistic fuzzy soft sets in decision making.[13] The uni-int decision making method is a preprocessing method and cannot give the final decision. Furthermore, the uni-int decision making method can only deal with soft set decision problems. For fuzzy soft set decision problems, it does not work well. The algorithm in this paper is suitable for soft set and fuzzy soft set decision making problems and unconstrained for evaluation methods. Whatever kind of evaluation methods we choose, as long as every evaluation sequence is given, such as choice value sequence, score value sequence, or other sequences, then we can make the decision using this new algorithm. The evaluation sequence associates to a kind of evaluation method, so this new algorithm is a hybrid evaluation method for comprehensive evaluation. Also, this new algorithm is objective, numerical and accurate, and we can compare the value to obtain the optimal choice, suboptimal choice, and so on.

#### IV. RESULTS AND APPROACH

The existing approaches have significant contributions to solve fuzzy soft sets in decision making. However, these approaches are mainly built on the level soft set, and the decision makers select any level soft set with much subjectivity and uncertainty . What’s more, there does not exist any unique or uniform criterion for the selection, and the same decision problem may obtain different results from using a different evaluation criterion. As a result, it is difficult to judge which result is right, and we do not know which method or level soft sets should be chosen for selecting the optimal choice object. The key to this problem is how to reduce subjectivity and uncertainty when we choose making decisions method. Then it is necessary to pay attention to this issue.[14]

## Fuzzy ranking

Since  $d(\text{MAX}(A, B), A) > d(\text{MAX}(A, B), B)$ , we may conclude that, according to the first ranking method,  $A \leq B$ . When applying the second method to the same example, we can easily find, from Fig. 12.5a, that  $A \leq B$  for any  $\alpha \in [0, 1]$ . According to the third method, we construct the priority fuzzy set  $P$  on  $\{A, B\}$  as follows:

$$P(A) = \sup_{r_1 \geq r_2} \min[A(r_1), B(r_2)] = 0.75,$$

$$P(B) = \sup_{r_2 \geq r_1} \min[A(r_1), B(r_2)] = 1.$$

Hence, again, we conclude that  $A \leq B$ .

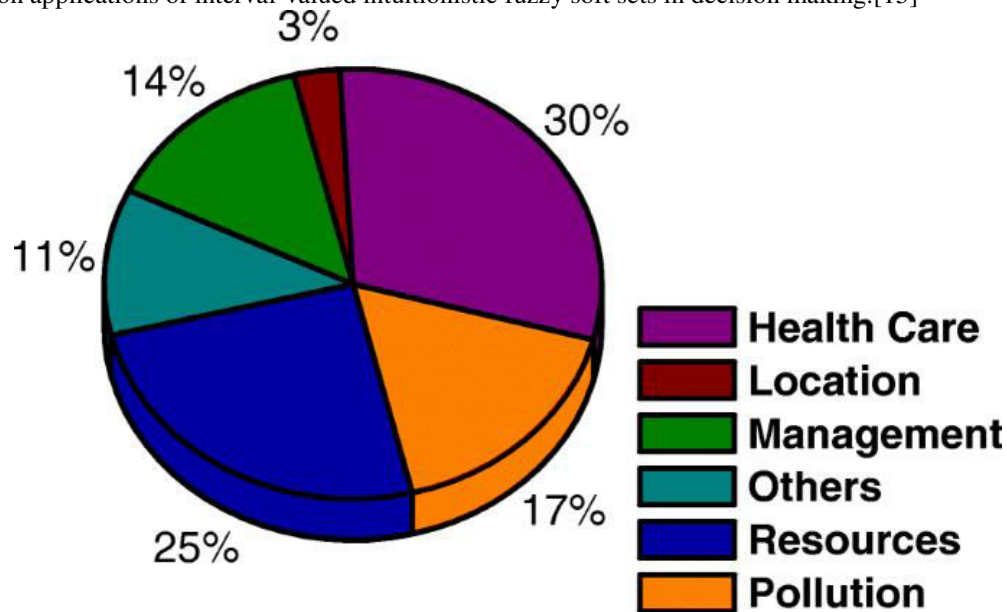
Consider now the fuzzy numbers  $A$  and  $B$  whose membership functions are given in Fig. 12.5b. The horizontally and vertically hatched areas have the same meaning as before. We can easily find that

$$d(\text{MAX}(A, B), A) = 1, d(\text{MAX}(A, B), B) = 0.25.$$

Hence,  $A \leq B$  according to the first method. The second method gives the same result only for  $\alpha > 0.5$ . This shows that the method is inconsistent. According to the third method, we again obtain  $P(A) = 0.75$  and  $P(B) = 1$ ; hence,  $A \leq B$ .

## V. CONCLUSION OF THE REVIEW

We have introduced a method for fuzzy soft set in decision making by combining grey relational analysis with D-S theory of evidence and given a practical application to medical diagnosis. This method allows us to avoid the problem of selecting suitable level soft sets, reduce uncertainty caused by people's subjective cognition, and raise the decision level. Then it is more feasible and practical for dealing with applications under uncertainty. Our future work will concentrate on applications of interval-valued intuitionistic fuzzy soft sets in decision making.[15]



Firstly, grey relational analysis is used to calculate grey mean relational degrees and determine uncertain degrees of parameters. Then based on uncertain degrees, suitable mass functions of different independent alternatives with different parameters can be constructed. Next, D-S rule of evidence combination is applied to aggregate these alternatives into a collective alternative. Finally, these alternatives are ranked and the best alternative(s) are obtained. Moreover, the effectiveness and feasibility of this method are demonstrated by comparing with the mean potentiality approach and giving an application to medical diagnosis.

## REFERENCES

1. L. A. Zadeh, "Fuzzy sets," *Information and Control*, vol. 8, no. 3, pp. 338–353, 1965. View at: Google Scholar
2. Z. Pawlak, "Rough sets," *International Journal of Computer & Information Sciences*, vol. 11, no. 5, pp. 341–356, 1982. View at: Publisher Site | Google Scholar
3. D. Molodtsov, "Soft set theory—first results," *Computers & Mathematics with Applications*, vol. 37, no. 4-5, pp. 19–31, 1999. View at: Google Scholar
4. P. K. Maji, R. Biswas, and A. R. Roy, "Fuzzy soft sets," *The Journal of Fuzzy Mathematics*, vol. 9, pp. 589–602, 2001. View at: Google Scholar
5. F. Feng, Y. B. Jun, and X. Zhao, "Soft semirings," *Computers and Mathematics with Applications*, vol. 56, no. 10, pp. 2621–2628, 2008. View at: Publisher Site | Google Scholar
6. Y. Jiang, Y. Tang, Q. Chen, J. Wang, and S. Tang, "Extending soft sets with description logics," *Computers and Mathematics with Applications*, vol. 59, no. 6, pp. 2087–2096, 2010. View at: Publisher Site | Google Scholar
7. X. Yang, T. Y. Lin, J. Yang, Y. Li, and D. Yu, "Combination of interval-valued fuzzy set and soft set," *Computers and Mathematics with Applications*, vol. 58, no. 3, pp. 521–527, 2009. View at: Publisher Site | Google Scholar
8. H. Aktaş and N. Çağman, "Soft sets and soft groups," *Information Sciences*, vol. 177, no. 13, pp. 2726–2735, 2007. View at: Publisher Site | Google Scholar
9. Y. B. Jun, "Soft BCK/BCI-algebras," *Computers and Mathematics with Applications*, vol. 56, no. 5, pp. 1408–1413, 2008. View at: Publisher Site | Google Scholar
10. Y. B. Jun and C. H. Park, "Applications of soft sets in ideal theory of BCK/BCI-algebras," *Information Sciences*, vol. 178, no. 11, pp. 2466–2475, 2008. View at: Publisher Site | Google Scholar
11. Y. B. Jun, K. J. Lee, and C. H. Park, "Fuzzy soft set theory applied to BCK/BCI-algebras," *Computers and Mathematics with Applications*, vol. 59, no. 9, pp. 3180–3192, 2010. View at: Publisher Site | Google Scholar



12. F. Feng and Y. Li, “Soft subsets and soft product operations,” *Information Sciences*, vol. 232, pp. 44–57, 2013. View at: [Publisher Site](#) | [Google Scholar](#)
13. P. K. Maji and A. R. Roy, “An application of soft sets in a decision making problem,” *Computers & Mathematics with Applications*, vol. 44, no. 8-9, pp. 1077–1083, 2002. View at: [Publisher Site](#) | [Google Scholar](#)
14. D. Chen, “The parameterization reduction of soft sets and its applications,” *Computers and Mathematics with Applications*, vol. 49, no. 5-6, pp. 757–763, 2005. View at: [Publisher Site](#) | [Google Scholar](#)
15. N. Çağman and S. Enginoğlu, “Soft matrix theory and its decision making,” *Computers & Mathematics with Applications*, vol. 59, no. 10, pp. 3308–3314, 2010. View at: [Google Scholar](#)





**Impact Factor:  
7.569**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details