Satellite Image Classification Based on Fuzzy with Cellular Automata

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ABSTRACT: Satellite image classification is a significant technique used in remote sensing for the computerized study and pattern recognition of satellite information, which make possible the routine explanation of a huge quantity of information. Nowadays cellular automata are implemented for simulation of satellite images and also cellular automata relates to categorization in satellite image is used simultaneously. Based on information of stored image value to the cell and dimension of neighbourhood cells. Inoder fine tune classification rate of cellular automata algorithm fuzzy rules with cellular automata are used . In this paper cellular with fuzzy rules have been implemented for classifying the satellite image and quality of classified image is analyzed.

I. INTRODUCTION

Remote sensing is the acquisition of physical information of an object without touch or contact. The representation is acquired by the sensor which is fitted to the scanning object and it is sent back to the earth station for processing and analysis.

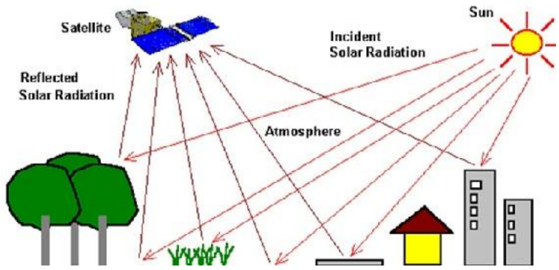

Fig1.1: principle of remote sensing.

Remote sensing operates in several region of the electromagnetic spectrum. The ultraviolent (UV) portion of the spectrum has the shortest wavelength that is practical use of remote sensing. Remote sensing images are usually in the appearance of digital images. In order to dig out valuable information from the images, image processing methods may be employed to progress the image to facilitate visual explanation, and to The neighbourhood of a cell, called the core cell (or central cell), consists of the core cell and those surrounding cells whose states establish the next state of the core cell [7].

accurate or renovate the image if the image has been subjected to numerical misrepresentation, blurring or deprivation by other factors. There are numerous image investigation techniques obtainable and the methods used depend on the requirements of the precise trouble concerned. In image segmentation and classification algorithms are used to outline diverse areas in an image into thematic classes. The resulting creation is a thematic map of the revise area. This thematic map can be combined with erstwhile databases of the test area for supplementary analysis and utilization.

The classifications algorithms are one of the most significant methods used in remote sensing that assist developers to understand the information contained in the satellite images. The aspire of satellite images categorization is to split image pixels into discrete classes. The consequential classified image is really a thematic map of the unique image. These algorithms have reached a immense progress in the last years. The analysts utilize the classification algorithms to deduce the information contained in the satellite images.

II. CELLULAR AUTOMATA

Cellular automata (CA) have establish frequent place purposes in numerical and hypothetical physics and are linked to considerations of confusion hypothesis and fractal geometry [6] . CA hypothesis was initially introduced by John von Neumann in 1950s and gained considerable attractiveness two decades shortly through the effort of John Conway in the game of life. CA is nonlinear lively numerical systems based on discrete time and space. The fundamental proposal is very straightforward: a cellular automaton evolves in discrete time-steps by updating its states according to a evolution rule that is applied commonly and synchronously to every cell at every time-step. The importance of all cell is determined based on a geometric composition of neighbour cell

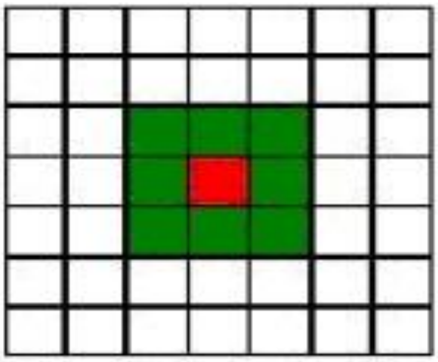

Fig1.2: Moore neighbourhood cell

(i-1, j-1)	(i-1, j)	(i-1, j+1)
(i, j-1)	(i, j)	(i, j+1)
(i+1, j-1)	(i+1, j)	(i+1, j+1)

Fig1.3: Representation of Moore neighbourhood.

Moore neighbourhood has nine cells, consisting of the cell and its eight surrounding neighbours and has a radius of 1.

2.1 WORKING OF CELLULAR AUTOMATA

States: Each cell can acquire an integer value that corresponds to its existing state. There is a limited set of states.

Neighbourhood: A set of cells that correlate with the present one.

Transition function *f*: Takes as input arguments the cell and neighbourhood states, and returns the recent state of the existing cell.

Rules: The transition function *f* utilizes a lay down of rules that recognize how the states of the cells vary.

Iterations: The transition assignment *f* is applied to every cell of the lattice across several iterations.

III. FUZZY IMPLEMENTATION

The FIS Editor GUI implements authorizing the maximum level features of the fuzzy inference system, such as the quantity of input and output variables. The FIS Editor is the high-level display for whichever fuzzy logic inference system. It agree to to call the various other editors to function on the FIS.

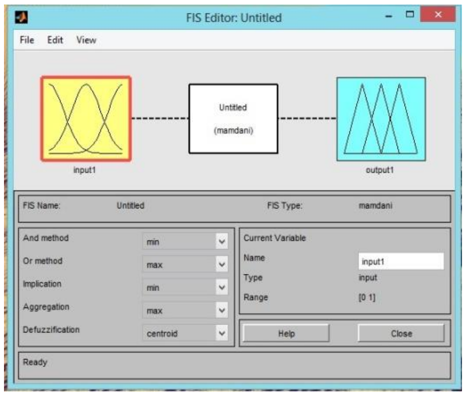

fig1.4: fis editor window

3.1 MEMBERSHIP FUNCTION

A membership function for a fuzzy set A on the universe of conversation X is defined as μ_a:X → [0,1], where each element of X is mapped to a rate between 0 and 1. This rate, called membership value or degree of membership, quantifies the standing of membership of the constituent in X to the fuzzy set A. Membership function agree to to graphically represent a fuzzy set.

The *x* axis represents the creation of conversation, whereas the *y* axis represents the degrees of membership in the [0,1] interval.

Easy functions are used to build membership functions. since are defining fuzzy concepts, using supplementary complex functions does not include extra accuracy.

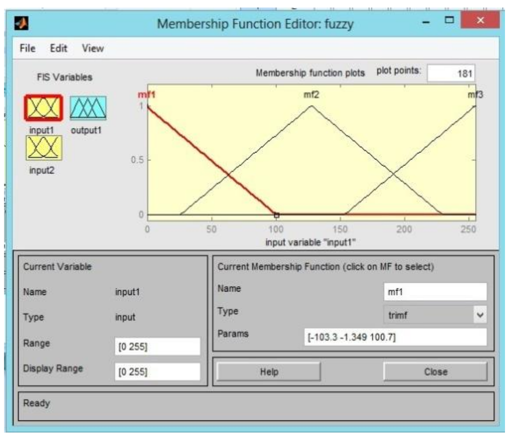

Fig1.5: Membership function editor

3.2 RULE VIWER

The Rule Viewer tolerates to assume the absolute fuzzy inference progression at once. The Rule Viewer also demonstrates the plan of exact membership functions influences on the whole outcome. It presents a sort of micro view of the fuzzy inference system. To distinguish the whole output surface of system then the complete length of the output set based on the complete duration of the input to unlock up the Surface Viewer.

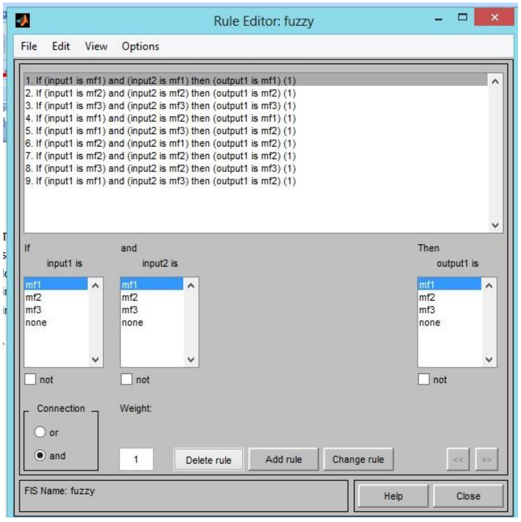

Fig1.6: Rule editor window

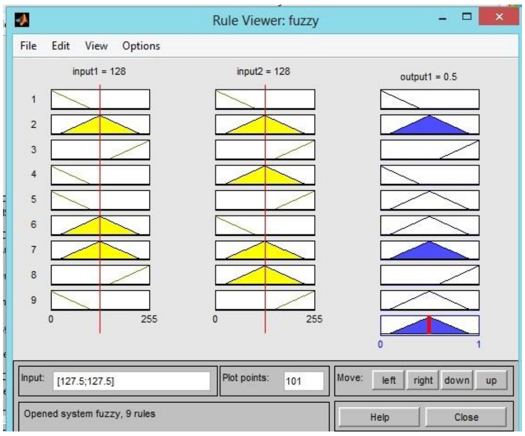

Fig1.7: Rule viwer window

This is the explanation of the rules that the scheme compact with.

The first column in this preparation corresponds to the input variables.

The second column communicates to the output changeable.

.The third column displays the weight applied to every rule.

The fourth column is shorthand that point out whether this is an OR (2) rule or an AND (1) rule.

3.3 SURFACE VIWER

The Surface Viewer is equipped through drop-down menus X (input), Y (input), and Z (output) that prefer any two inputs and any one output for plotting. This capability allows staying the calculation time reasonable for multifaceted problems. The Surface Viewer has a special ability that is very supportive in cases with two inputs and one output grab the axes.

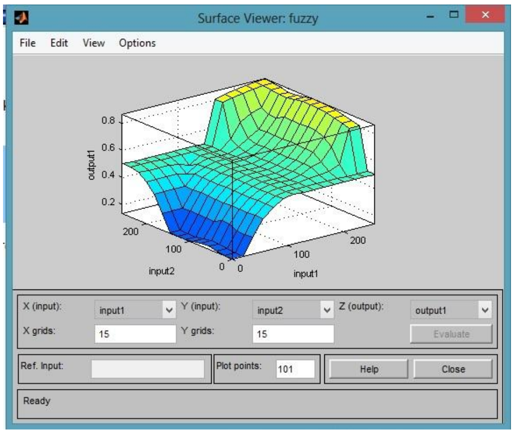

Fig1.8: surface viewer window

IV. AREA OF STUDY

The input image is taken for production of land covers is central coast of Tamil Nadu comprising Cuddalore and Villupuram districts and various land features are needed to be identified, the land features consists of rivers, agricultural land, settlement area and waste land needed to be classified by means of supervised and unsupervised algorithm and it accuracy assessment every class and algorithm used is analyzed.

The satellite data obtained for categorization process is AWFIS camera is an improved description compared to the WIFS camera flown in IRS-1C/1D.AWIFS functions in four spectral bands matching to LISS-III, providing a spatial resolution of 56 m and covering a swath of 737 Km.

Fig1.9 Area selected for study.

To enclose this broad swath, the AWIFS camera is separate into two separate electro-optic modules.

V . METHOD OF IMPLEMENTATION

The Indian remote sensing satellite data product is implemented and tested in MATLAB environment and image value is about 256 x256 is used, cellular automata is applied as image classification process based on the neighbourhood value pixel assigned to each class in different iterations ,in this method upto 10 iterations carried out and percentage of edge, focus, noisy and uncertain pixel is show in command window if percentage of uncertain pixel is more then incorporate fuzzy rule to cellular to eliminate uncertain pixel and it may enhance the classification accuracy.

Fig1.10 input image

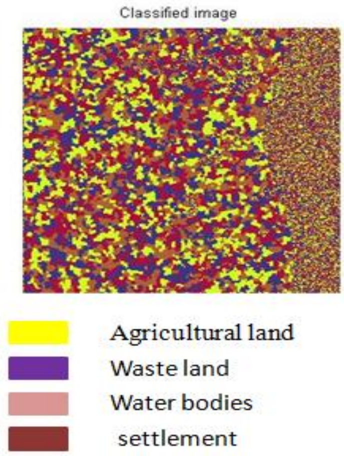

Fig1.11: output of cellular automata

Pixel type	percentage
Edge pixel	0.38
Focus pixel	0.17
Noisy pixel	0.06
Uncertain pixel	0.43

Table 1.1:pixels type

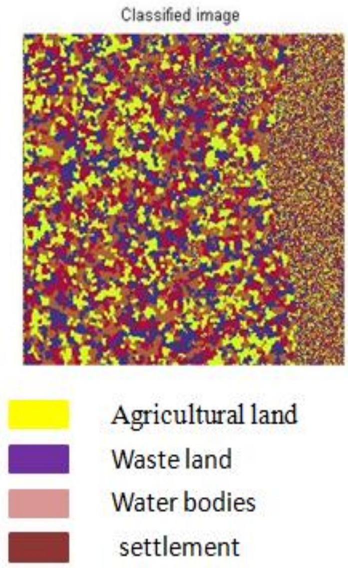

Fig1.12 : output of fuzzy with cellular automata.

Pixel type	Percentage
Edge pixel	0.54
Focus pixel	0.17
Noisy pixel	0.06
Uncertain pixel	0.23

Table 1.2: pixel type

VI. CONCLUSION AND FUTURE WORK

The accuracy rate of cellular automata is very much increased when fuzzy rules are implemented to this systems, uncertain pixels which are still present in the classification process is eliminated and uncertain pixel is classified to each class its give paths to well classified image with high accuracy. As a future work would like develop new version of cellular automata based on neural network which will further enhances accuracy rate of classification process.

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