Mixed Pixel Resolution by Evolutionary Algorithm: A Survey

Er. Mittu Mittal, Er. Gagandeep Kaur

Abstract: ***Now a day's Remote Sensing is a mature research area. Remote sensing is defined as a technique for acquiring the information about an object without making physical contact with that image via remote sensors. But the major problem of remotely sensed images is mixed pixel which always degrades the image quality. Mixed pixels are usually the biggest reason for degrading the success in image classification and object recognition. Another major problem is the decomposition of mixed pixels precisely and effectively. Remote sensing data is widely used for the classification of types of features such as vegetation, water body etc but the problem occurs in tagging appropriate class to mixed pixels. In this paper we attempted to present an approach for resolving the mixed pixels by using optimization algorithm i.e. Biogeography based optimization. The main idea is to tag the mixed pixel to a particular class by finding the best suitable class for it using the BBO parameters i.e. Migration and Mutation.***

Keywords: ***Biogeography based optimization, Evolutionary algorithms, mixed pixel, Migration, Mutation, Remote Sensing.***

I. INTRODUCTION TO REMOTE SENSING

Remote sensing is the practice of deriving information about the earth's land and water surfaces using images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, reflected or emitted from the earth's surface. This definition certainly does not cover all areas (e.g. meteorological or terrestrial remote sensing), it does serve well as a description of remote sensing. Remote sensing makes use of electromagnetic radiation. The strongest and best-known source of electromagnetic radiation is our sun, which emits radiation over the entire electromagnetic spectrum see fig 1. Besides this natural source of illumination, which is used for passive remote sensing, it is also possible to use an artificial source of electromagnetic radiation, in which case we speak of active remote sensing.

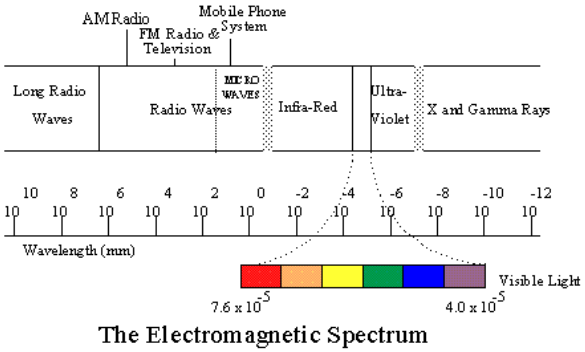

Figure 1: Principal divisions of the electromagnetic spectrum

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Remote sensing map takes pixel as a measurement unit in the ground detection. Since the limited precision of satellite remote sensing detection, sometimes there are several kinds of ground objects in the range of one pixel, which is named mixed pixel. On the contrary, the pixel that consists of one kind of ground object is described as typical pixel. Generally the spectrum features of different ground objects are different. The spectrum of mixed pixels is a mixture of poly-type spectrum of ground objects according to some proportion. The existence of mixed pixel is one of the main factors that affect classifying precision in image recognition. Especially it affects the classification and recognition of linear ground objects and petty ground objects. A lot of mixed pixels are bound to appear at the edge of ground objects. The key to resolve the problem is to find out the Proportion of different objects.

<u>There are various methods for the decomposition of mixed pixel as follows</u>

1. linear discriminate analysis
2. probabilistic, geometric-optical
3. stochastic geometric
4. fuzzy
5. Artificial Neural Network models
6. Evolutionary algorithms

All of the above mentioned methods are traditional. But evolutionary algorithms are new approach for resolving mixed pixel problem of remote sensing images.

II. BIOGEOGRAPHY BASED OPTIMIZATION

Biogeography is the study of the distribution of biodiversity spatially and temporally. Over real ecological changes, it is also tied to the concepts of species. Immigration is the introduction of new people into a habitat or population. It is a biological concept and is important in population ecology. A habitat (which is Latin for "it inhabits") is an ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism. It is the natural environment in which an organism lives, or the physical environment that surrounds (influences and is utilized by) a species population. Biogeography unfolds the geographical distribution of biological organisms. Their interest was primarily focused on the distribution of species among neighboring islands. The application of biogeography to engineering is similar to what has occurred in the past few decades with genetic algorithms (GAs), neural networks, fuzzy logic, particle swarm optimization (PSO), and other areas of computer intelligence. The term "island" here is used descriptively rather than literally. That is, an island is any habitat that is geographically isolated from other habitats. We therefore use the more generic term "habitat" in this paper (rather than "island"). Geographical areas that are well suited as residences for biological species are said to have a high habitat suitability index (HSI). Features that

correlate with HIS include such factors as rainfall, diversity of vegetation, diversity of topographic features, land area, and temperature. The variables that characterize habitability are called suitability index Variables (SIVs). SIVs can be considered the independent variables of the habitat, and HSI can be considered the dependent variable. Habitats with a high HSI have many species that emigrate to nearby habitats, simply by virtue of the large number of species that they host. We call this approach to problem solving biogeography-based optimization (BBO).

A. MIXED PIXEL PROBLEM

The importance and impact of spatial resolution is also witnessed by the mixed pixel 'problem'. Mixed pixels, sometimes known as '**mixels**', occur where the image pixels are not homogenous, or 'pure'. Instead a pixel contains a measure of the energy reflected or emitted from several different materials or land surface objects and the sensor records a composite of these responses (Fig 2).

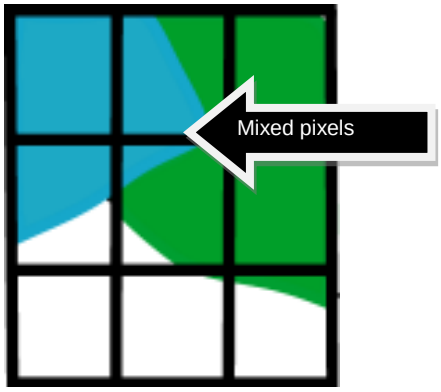

Figure 2: The mixed pixel problem. Many of the pixels in this 9 cell grid contain more than one class.

In many cases this spectral mixing can make it very difficult for the image analyst to identify the different sub-pixel fractional components that serve to make up the landscape under observation. Under these circumstances the analyst may wish to employ a finer resolution data set, in order that a greater number of 'pure' pixels may be recorded. Even with very fine resolution, however, there is still the issue of edge pixels, where pixels can show the boundaries between different land surface properties. Land surface features do not follow the arbitrary confines of the pixel and therefore even very fine spatial resolution data of the order of a few meters' will still experience some degree of confusion and spectral missing.

As you can imagine, mixed pixels can cause great difficulties in the stages of image analysis and interpretation. One of the common tasks in this process is image classification. Classification is widely used as it allows users to easily discriminate information from images presented as a series of categories (classes) rather than raw digital number (DN) values. Images are classified on the basis of their spectral properties. Each pixel of remote sensing image contains the information from multifarious ground objects due to the difference from the resolution of remote sensing image, called **Mixed pixel.**

There are three main causes for mixing pixels in any remotely sensed image which are listed below:-

- Mixed caused by the presence of small, sub pixel targets within the area it represents(Fig 3)

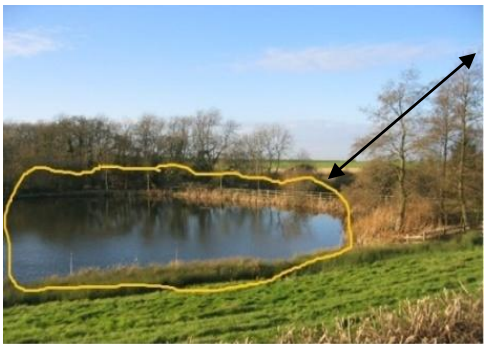

Figure 3: Mixed pixel

- Mixing as a result of the pixel straddling the boundary of discrete thematic classes (Fig 4)

Figure 4: Mixed pixel

- Mixing due to gradual transition observed between continuous thematic classes.

To resolve these problems we proposed a new methodology using BBO algorithm which is described in next section.

III. METHODOLOGY

INPUT: Data set of pure and mixed pixels

- Read an image and identify the data set of pure and mixed pixels.
- Clustering is done on the basis of color intensity, texture etc.
- Initially choose a set of pure pixels and calculate the best pixel value using G.A.
- Now calculate HSI of each of the Habitat.
- Take one class of mixed pixel and transfer each of corresponding mixed pixel to both the Habitats to which it belongs i.e. Immigration & Emigration.
- Recalculate the HSI of those two Habitats. If recalculated HIS (A) <HIS (B) then absorb the mixed pixel in feature A otherwise in feature B.
- Repeat till all the mixed pixels of class taken are resolved.

OUTPUT: All mixed pixels are classified

IV. DISTINCTIVE FEATURES OF BBO

- First, Biogeography-Based Optimization is a type of evolutionary algorithm. As its name implies, Biogeography is the study of the migration, speciation, and extinction of species. This clearly distinguishes it from reproductive strategies such as GAs and evolutionary strategies.
- BBO also clearly differs from ACO, because ACO generates a new set of solutions with each iteration. BBO, on the other hand, maintains its set of solutions

from one iteration to the next, relying on migration to probabilistically adapt those solutions.

- In BBO the original population is not discarded after each generation. It is rather modified by migration.
- Another distinctive feature is that, for each generation, BBO uses the fitness of each solution to determine its immigration and emigration rate.
- BBO is easier to implement and there are fewer parameters to adjust.
- BBO has a more effective memory capability than GA.

V. CONCLUSION & FUTURE SCOPE

Mixed pixel resolution is a big problem in any remotely sensed imaging. Thus our method can resolve greater number of mixed pixels problem in effective way and also helpful in providing great accuracy in output images. Future work could focus on combining BBO with other EAs like PSO, ABC etc to resolve the problem of mixed pixel resolution.

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