Extended Abstract

Introduction

Hyperspectral satellite imagery like Hyperion implies collecting data from large number of spectral bands. Therefore, they can be used for some applications that cannot be executed by multispectral satellite images. The advantage of higher spectral resolution is accompanied by the weakness of lower spatial resolution for some applications. Consequently, we are always facing with mixed pixels, i.e. mixed, or a mixture of spectral responses of background and several objects (Fauvel et al., 2006). Sub-pixel target detection methods are able to identify the percentage and location of objects in a mixed pixel. Accordingly, more attention has been paid to them compared to the classification procedures. In recent years, due to some shortages in pixel-based classification methods, the number of methods and publications in sub-pixel target detection have been increased, especially for mineral mapping and alteration in geological units (Kruse et al., 2003; Ellis and Scott, 2004; Qiu et al., 2006; Zhang et al., 2007; Mezned et al., 2009; Gabr et al., 2010; Hosseinjani and Tangestani, 2011; Kruse, 2012). Some studies show the superiority of sub-pixel over pixel-base methods for these fields of applications. Kruse, et al., (2013) compared mineral maps obtained from airborne hyperspectral with space borne EO-1/Hyperion using Mixture Tuned Matched Filtering (MTMF), Minimum Noise Fraction (MNF) and N-dimensional visualization, in Nevada and Wissy valley. Hosseinjani and
Tangestani (2011) used ASTER data by LSU and MTMF methods. They classified three different groups of alterations, including Perilofiet - Aloniet, Serisit - Caleouniet, Clorit - Calsit - Ipidot. In this work, after prerequisite stages of image pre-processing for Hyperion images, MTMF method was utilized for determining mineral alteration in Mozahem-Babak city (volcanic area).

**Methodology**
Mozahem volcano area is one of the greatest Caldera in Iran which is located between 55°16’0"E to 55°22’0" longitude and 30°15’0"N to 30°21’0"N latitude. Lithological studies were conducted by field measurements and laboratory analysis. The mineralogical studies, X-Ray Diffraction (XRD) test and spectroscopy on various samples from the study area were also carried out. The obtained results in combination with geochemical studies indicate that there are three types of alterations rocks in the central parts of the Caldera; weak altered, semi altered and intense altered. After pre-processing the satellite data using MRNF transformation the optimal bands were selected. The Matched Filtering (MF) values computed training data that were obtained from field studies. Using the earlier results, the MT values were evaluated. The data cloud of MF Score and Infeasibility value were adopted as threshold. Consequently, the classification of these units was produced by images. The final results were compared with Liner Spectral Unmixing method to assess the accuracy of the classification performed.

**Results and Discussion**
The results of MTMF showed that the main part of intense alteration has been located in the central part of the Mozahem Caldera. The surrounding area also belongs to the alterations with lower intensity. After calculating the confusion matrix from classification of three alteration areas, the accuracy of 77.7 % and Kappa coefficient of 0.6757 was obtained for MTMF method while the accuracy of LSU was 57.6% and its Kappa coefficient was 0.4456. Also the ROC curve evaluation showed that the better performance of MTMF method compared to LSU method.

**Conclusion**
The results of this study show that for discriminating the alteration units, sub-pixel target detection procedure is more powerful than pixel-based techniques of classification. On the basis of the mechanism of MTMF, MT part could offer classification results with higher accuracy for decreasing the false positive. The MT part is considerably stronger than conventional methods for detection in sub-pixel level as LSU. Also, due to the MT part and reduction of false positive alarms in the structure of MTMF method, the performance was better than the MF method used by Khaleghi and Ranjbar (2010). Therefore, the presented method in this paper can do better in detecting alterations.

**Keywords:** Hyperspectral Remote Sensing, Alteration Mapping, MTMF, Hyperion.