Automatic Target Recognition of Synthetic Aperture Radar Images Using ART Neural Networks

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ABSTRACT: Modern computers are able to operate at speeds far quicker than the human brain and are able to be much more precise than humans. Despite this speed, they perform badly solving such problems as pattern recognition and categorisation. Adaptive Resonance Theory (ART) neural networks are a family of self-organising, self-stabilising and self-scaling artificial neural network (ANN) models which implement clustering algorithms. ART-1 accepts arbitrarily many binary input patterns and classifies them into arbitrarily many categories or clusters in an unsupervised manner. There are few cases where ART has been applied to Synthetic Aperture Radar (SAR) automatic target recognition. Due to the immaturity of the field, little research has been carried out with the aim of adapting an ART network to this specific task. More often than not in this field, a previously developed ART module is used following a period of pre-processing of the input data to categorise the targets previously picked out from a SAR image. The search of the literature shows that ART can be used to classify and recognise aspects of SAR and other satellite data. It is shown that its low computational complexity gives rise to the possibility that ART could be used in real-time systems. It is also shown that aspects of the ART models need to be improved to make the usage of ART more practical in a more general application. Specific limitations indicated are that the use of ART in noisy environments where the targets to be recognised may be partially obscured, and the fact that the number of true categories present in a data set cannot be known. This paper provides an analytical survey of the field of Adaptive Resonance Theory applied to automatic target recognition (ATR) of synthetic aperture radar imagery. Accomplishments in the field are presented and limitations of ART neural networks are identified. With these limitations and this application area in mind, a course of action has been outlined to remedy some of these limitations and to test newly developed models.

KEYWORDS: Automatic target recognition, Synthetic aperture radar, Adaptive resonance theory neural networks