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Optimum Feature Selection for Efficient ISAR Image Classification

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Abstract

***Objective**: To identify optimum features from the initial feature set to classify ship ISAR images with good accuracy. The optimum feature selection brings down the computational complexity and also removes the redundant features in the feature vector.*

***Methodology**: Colour moments computed from R, G, B, RG, GB, RB component images are taken as one feature vector. The average wave energy values of horizontal, vertical and diagonal details of images decomposed up to five levels using wavelet transform are considered as second feature vector. The ship ISAR images measured with high resolution Radar are used as data set to test the classification performance of the two feature sets, which is explored uniquely in this work. Genetic algorithm and particle swarm optimization techniques are used to find the optimum feature sets. Probabilistic neural network is used to compare the classification accuracy achieved with full length feature vectors and optimum feature vectors of the two considered feature sets.*

***Findings**: Data set of two ships is taken. The data of each ship is divided in to two parts training data and test data. The feature vectors computed from training set are used to train the classifier and that computed from test set are used to test the classification accuracy. The number of variables (number of features in the feature vector) of optimization algorithms Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) is varied to find the optimum feature set to classify the ship ISAR image data. The function that computes the classification accuracy is used as the objective function of the optimization algorithms. From the initial feature vector of thirty colour moments a set of four features is identified that gives 100% accuracy for both the targets considered. From starting set of fifteen average energy levels, a set of four energy levels identified by PSO and the set of three energy levels are found to be more effective in classification of the ship ISAR images with classification accuracy of 66.6% for the first target and 75% for the second target. Both the optimization techniques performed in similar way. Other optimization algorithms can be explored to find feature combinations that classify ship ISAR images with better accuracy.*

***Application**: Classification based on ISAR images has application in automatic non-cooperative target recognition, development of monitoring systems for surveillance along transportation corridors etc. to avoid illegal immigration.*

***Future Work:** Different classifiers Self Organizing Maps, Support Vector Machines etc. can be used to study the possibility of obtaining optimum solution in smaller time.*

Author Keywords

Classification, Feature Selection, ISAR image, Optimum Feature Set, Optimization Techniques

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