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Radar Track-based Classification of Birds and UAVs

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Abstract : In recent years, the number of Unmanned Aerial Vehicles (UAVs) has significantly increased. The rapid development of commercial and recreational drones makes them an important part of our society. Despite the growing list of their applications, these vehicles pose a huge threat to civil and military installations: detection, classification and neutralization of such flying objects become an urgent need. Radar is an effective remote sensing tool for detecting and tracking flying objects, but scenarios characterized by the presence of a high number of tracks related to flying birds make especially challenging the drone detection task: operator PPI is cluttered with a huge number of potential threats and his reaction time can be severely affected. Flying birds compared to UAVs show similar velocity, RADAR cross-section and, in general, similar characteristics. Building from the absence of a single feature that is able to distinguish UAVs and birds, this paper uses a multiple features approach where an original feature selection technique is developed to feed binary classifiers trained to distinguish birds and UAVs. RADAR tracks acquired on the field and related to different UAVs and birds performing various trajectories were used to extract specifically designed target movement-related features based on velocity, trajectory and signal strength. An optimization strategy based on a genetic algorithm is also introduced to select the optimal subset of features and to estimate the performance of several classification algorithms (Neural network, SVM, Logistic regression…) both in terms of the number of selected features and misclassification error. Results show that the proposed methods are able to reduce the dimension of the data space and to remove almost all non-drone false targets with a suitable classification accuracy (higher than 95%).

Keywords : birds, classification, machine learning, UAVs
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