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APPLYING GRAPH-BASED CLUSTERING TO TRACKLET-TRACKLET CORRELATION

Abstract

In order to identify new space resident objects from observations like e. g. tracklets, well-known algorithms are applied like the tracklet-tracklet correlation which estimates if a pair of tracklets might belong to the same resident space object. This procedure is known to be time consuming. We will show, that an interposed clustering analysis both enhances the computational speed of the whole process by reducing the number of needed validations, and increases the number of correct associations by simultaneously reducing the number of false associations. Cluster analysis is a commonly used machine learning technique to group objects. It has been shown to be very successful in many fields. In medicine, for example, it can be used for the distinction between malign and benign cancer cells. Starting from other research in this field we used Markov Clustering, a graph-based clustering algorithm. We used a large observation dataset provided by SMARTnet, which was split into subsets for training, testing and validation. In order to successfully train the clustering and to evaluate the results on the test dataset, the correct choice of evaluation methods is important. Furthermore, it has to be considered that this problem requires a specific evaluation of the clustering. This is the case, because the result of the tracklet-tracklet correlation defines which tracklets will be connected in the graph. Depending on the data and the setting of the tracklet-tracklet correlation, it is possible that tracklets of the same object are in different connected components of the graph. In such a case, it is impossible to obtain a cluster containing all tracklets of one object. Such a scenario is not considered in the established evaluation methods of clustering results. We present modifications of these evaluation methods which allow for evaluating the clustering results and to optimize the cluster analysis for object identification. Furthermore, we show that our training results in a successful clustering for diverse test data. The whole process is realized in a data management and processing system for orbital objects called "Backbone Catalogue of Relational Debris Information" (BACARDI).