











hyperplane adjusts the data patterns or distribution better, leading to a better separation of the classes. The four techniques have a global performance of around 90%, although it is due to the excellent performance obtained in identified known classes.

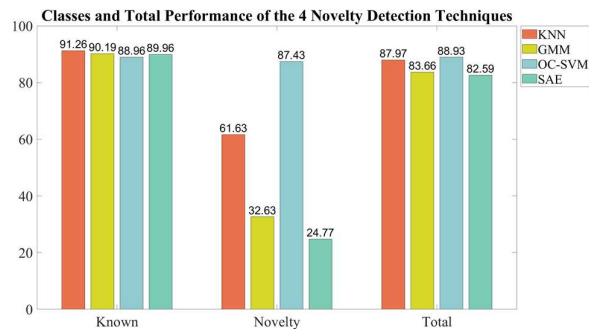


Fig. 5. Overall performance of the four techniques as novelty detectors.

In this sense, suppose that different classes' configurations adding to the complex knowledge model could bring different performances. Also, the considerations of an exhaustive grid search or stochastic search or algorithm to looking for the best hyperparameters of each technique could considerably increase the four techniques' global performance.

## 5. Conclusion

A novelty framework of four techniques is presented and evaluated in various PQ disturbances scenarios as novelty detectors in this work. There are three important aspects in this work. First, the consideration of novelty detection in the PQ area. Although a few works present Novelty Detection in PQ, the increase of the loads attached at the grid leads to complex patterns, and detecting them is a current challenge to improve condition monitoring power systems. Second, the consideration of different scenarios with simple standardized and combined disturbances patterns. However, combined disturbances are not described or defined, and reported them is a need that must face it. Third, the four techniques evaluated are among the most typical in the Novelty Detection area, so considering these techniques involves the different approaches, based in domain, based on distance, based on probabilistic and new trend like deep learning approaches. With the evaluation, advantages, and disadvantages of each of the techniques exposed, the performance results bring an interesting perspective. It showed that some techniques work excellently in detecting novelty patterns, even not present a good performance in the known classes. Also, the configuration of parameters in each technique plays a vital role in achieving a suitable performance. The results achieved for the techniques could be misinterpreted if the global performance is observed. For this reason, detail of performances in detecting the classes known and novelties are depicted and discussed, resulting in some techniques best detecting the known classes. In this sense, a hybrid scheme could provide the potential of detecting adequately known and novelty patterns. Also, the next step in this research is to find a qualitative way to show the approximation of the novelty detection techniques presented to visualize in 2-Dimensional the representation

achieve for each technique without losing information due to the compression technique considered.

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