Analyzing the Separability Matrix for ECOC coding

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Abstract

Error Correcting Output Codes (ECOC) have demonstrated to be a powerful tool to treat multi-class categorization problems. Nevertheless, state-of-the-art standard designs do not benefit from error-correcting principles for a particular multi-class data. In this poster, we introduce a novel tool to analyze the correction capabilities of ECOC designs, as well as a new coding technique that shows great performance results.

1. Error Correcting Output Codes (ECOC)

A common way to deal with Multi-class Object Categorization problems is by means of a divide- and-conquer approach. In this scope, ECOC have been applied with successful results.

2. The Separability Matrix

The Separability Matrix S contains the pairwise distance δ between codes. In Figure 1 we show an example for the coding and separability matrices for a One Vs. All and Compact coding designs.

3. The CSE Coding Algorithm

The CSE coding algorithm is an iterative algorithm that computes an extension matrix of a given ECOC coding matrix.

4. Experiments and results

The first bench of experiments consists of seven multi-class problems extracted from the UCI Machine Learning Repository. In addition, we test our methodology over 3 challenging Computer Vision multi-class problems. First, we classify 70 visual object categories from the MPEG dataset. Then, 50 classes of the ARFace database are classified. Finally, we test our method in a real traffic sign categorization problem consisting of 36 traffic sign classes.

5. CONCLUSIONS

In conclusion, results show that the proposed method outperforms the One vs. All standard cod- ing design in most cases, using far less number of dichotomizers. This is caused by the fact that the proposed algorithm focus the correcting capa- bility in those classes more prone to be confused, and thus, less redundancy is needed. Nevertheless, when comparing Dense Random coding with our method in terms of performance, no significance is found since both methods have a comparable rank.

References


Figure 1. (a) Compact ECOC coding matrix. (b) Separability Matrix of a Compact ECOC. (c) One vs. All coding matrix. (d) Separability Matrix of One vs. All coding.

Figure 2. Example of the CSE coding algorithm in a 5-class toy problem.