Optimizing Texture Feature Extraction in Image Analysis by Using Experimental Design Theory

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I. Introduction

On of the most critical steps in image analysis is the selection of the relevant features of interest. The variety of techniques available to extract characteristics from the images may result in a high amount of data to be analysed. Commonly, the optimal set of features is chosen by visually inspecting their performance according to the goal of interest. In this method known as the best guess approach, results are often produced from several experiments without guarantee of optimality. This method does not evaluate dependences between techniques decreasing reliability of results and inferences. To add reliability to the results we propose to perform a planning phase in advance by using the experimental design theory [1]. This methodology has been included in many industrial processes to increase the quality of goods for international competition since it optimizes findings while reduces the development time and overall costs. The main advantage of this type of evaluation is the identification of dependences between methods, being able to detect optimal combinations in processes.

II. Experimental Design

In the planning phase, characteristics from the image outcomes are first quantified to be able to compare the techniques. Then, an experimental design model is chosen for establishing the experiments to conduct. Finally, inferences and results are clearly stated and communicated. To compare, an analysis of variance ANOVA is performed. ANOVA is a powerful test that in its simple form permits to check whether there is at least one significant difference between different techniques. ANOVA results are probabilities, termed p-values, where a p-value less than a given α means that there is at least one difference between the techniques with $100(1-\alpha)\%$ of confidence. In case of differences (p-value less than a given α), ANOVA does not specify the differences and a test for multiple comparison, like the Scheff test, must be performed. In the Scheffe test, significant differences are detected also when p-values are less than a given α. For valid p-values, the techniques must be independent. The dependences are identified also by ANOVA where a p-value less than a given α means that there are dependences between the associated elements. In case of dependences, the group is subdivided performing analysis in each subgroup that does not reveal dependences among techniques, assuring the validity of the p-values.

III. Conclusions

By using experimental design theory for optimizing the feature extraction in image analysis an objective selection of techniques combination can be performed, incrementing the reliability of results and inferences.

References

[1] Orjuela, S. A. *Experimetal Design Theory as a Tool for Optimizing Feature Extraction in Image Analysis*, Tutorial, STSIVA 2010.

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