

Chapter 7

Characterization of Complex Patterns: Application to Colorimetric Arrays and Vertical Structures

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ABSTRACT

This chapter tackles the problem of a colorimetric sensor array description method within the machine olfaction field for the visual enhancement of volatile organic components (VOC). The proposed method is based on preliminary investigations done during the elaboration of an existing machine vision system for quality control, based on the interpretation of specific structured light patterns for the visual enhancement of defective surface parts.

The primary purpose of this chapter is to demonstrate the similarity between the colorimetric and the structured pattern interpretation. The investigations are based on a linear spatial transformation between both types of patterns based on the main features characterizing the patterns, i.e. the red, green and blue for the color and the intensity, left and right deviations for the structured. Thus, such a different representation of VOC characterization patterns allows the use of other existing structured pattern description methods. Within this context, different pattern recognition processes, consisting of the combination of different feature retrieval and classification methods, but also of feature combination and selection approaches will be considered.

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The feature-based investigations are based on a reference annotated structured pattern dataset. The purpose of these investigations is to introduce an optimized feature combination, selection, and classification principle. Three top-down and one bottom-up methodologies are evaluated for retrieving, combining, and selecting the most appropriate structured feature sets. It will be demonstrated that an increase of more than 2% of the classification rates can be reached.

Hence, the same approach can be applied for the characterization of colorimetric patterns in case of particular machine olfaction tasks, as the proposed developments can be further used integrated into other quality control systems, in order to bring more “intelligence” to this technique.

INTRODUCTION

A major challenge of a typical machine inspection process is to provide rugged and cost-effective solutions for real-time problems. Such systems use different and appropriate sensors for the automatic detection and identification of various suspicious components, as production defects or VOSs and serve as a valuable process feedback and control utility. A step towards the cost reduction of such processes is, to define approaches that can be applied to a wide range of applications, provided the efforts to adapt such a solution to a specific task are minimal.

The major perspective of this chapter is to propose a general approach for real-time pattern interpretation for different quality control processes. The case of structured patterns for industrial specular surface inspection will serve as basis. The method using the interpretation of a basic *periodical and vertical* light pattern was recently proposed for the inspection and characterization purposes of cylindrical specular surfaces (Caulier et al., 2007; Caulier et al., 2009). This sensor technique permits the visual *enhancement and discrimination of various defective parts* of the specular surfaces similar to colorimetric sensors allowing the visual enhancement of organic components. Both methods use the interpretation of the visual information to discriminate between different types of components, whether these are defective metallic surfaces or organic and volatile.

In order to propose a new real-time color array description, a transformation function between color arrays and structured images is proposed. This transformation is based on a different representation of each important feature of both arrays, i.e. the hue, saturation, and value components for the former and the intensity, left and right deviation for the latter. This chapter is therefore dedicated to the generalization of *periodical and vertical* structured interpretations. The adaptation to color array description is then straightforward.

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