Optimal statistical detection of rolled sheet's surface defects

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Abstract : Our work consists in developing a method for detecting surface defects on cold-rolled sheetin order to integrate it into a machine vision system. We opted for a detection method based on a statistical approach using essentially the Bayesian philosophy seconded by specific criteria of detection and carefully selected attributes. Our work is divided into three parts: The classification, the detection of the presence of a defect and the recognition of this type of defect. We chose two defects (cracks and hole) to simulate our study. First, we proceeded to a preliminary study to obtain the density functions and the priori probabilities of the sheet and defects, and then we integrated them in the Bayes formula. Such as the histograms of sheet flawless and two chosen defects have an allure close to the Gaussian distribution, we made a statistical inference from a significant number of samples of these histograms and we estimate the parameters (expectation μ and standard deviation ?) of Normal distribution representatives of these density functions with method of the maximum-likelihood. Seen that these histograms overlap on a common interval, only the calculation of the probabilities of belonging of each pixel to sheet metal and to the defects are not sufficient and detecting the presence of a defect will be always with a probability of error. It was then necessary to add a criterion of differentiation to minimize this error and ensure the reliability of the detection of presence of the defect. Finally, to optimize the operation of defect detection, we introduced geometrical attributes of each defect (elongation criteria dimensional criteria, criteria specific to the shape and area ratios). This method will subsequently be implemented in a program using image processing software adapted to a matrix camera. In conclusion, this work will increase the quantity and the quality of the product, prevent the evolution of defects (and therefore the stops of the chain), simplify working conditions of the operator and it allow the optimization of the sheet rolling process thanks to early detection of surface defects.

Keywords : optimization, statistical inference, probability, histogram, density function, sheet.