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Probabilistic Modelling of Printed Dots at the Microscopic Scale

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Abstract

Microscopic analysis of paper printing shows regularly spaced dots whose random shape depends on the printing technology, the configuration of the printer as well as the paper properties. The modelling and identification of paper and ink interactions are required for qualifying the printing quality, for controlling the printing process and for application in authentication as well. This paper proposes an approach to identify the authentic printer source using micro-tags consisting of microscopic printed dots embedded in the documents. These random shape features are modelled and extracted as a signature for a particular printer. In the paper, we propose a probabilistic model consisting of vector parameters using a spatial interaction binary model with inhomogeneous Markov chain. These parameters determine the location and describe the diverse micro random structures of microscopic printed dots. A Markov chain Monte Carlo (MCMC) algorithm is thus developed to approximate the Minimum Mean Squared Error estimator. The performance is assessed through numerical simulations. The real printed dots from the common printing technologies (conventional offset, waterless offset, inkjet, laser) are used to assess the effectiveness of the model.

Keywords: Probabilistic model; Bernoulli process; Metropolis Hastings within Gibbs; Microscopic printing; Markov chain.

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