Design of Robust 2D Barcodes for Industrial Environments

Teză susținută pentru obținerea titlului de doctor în domeniul de doctorat
Inginerie Electronică şi Telecomunicații

(sinteză)

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Rezumat: This thesis addresses the decoding of 2D barcodes in industrial environments. A new class of 2D barcodes is introduced that is based on low-density parity-check (LDPC) codes. The major accomplishments of this work include the design and the decoding of both codes, the LDPC code as well as the developed LDPC-based 2D barcode. A design method for short irregular LDPC codes is introduced that yields better decoding performance for the AWGN channel and the Markov-modulated Gaussian channel (MMGC) compared to optimization methods known from literature. Estimation-decoding has been extended to include a reestimation method of the transition probabilities for the MMGC. For the application of LDPC codes on 2D barcodes an intelligent interleaver, a channel-model for 2D barcodes in industrial environment, a 2D hidden Markov model and a decoder that operates based on estimation-decoding and the 2D hidden Markov model have been developed. For the evaluation of the new class of 2D barcodes a test-environment and a test-procedure have been created. This test environment proves that the developed LDPC-based 2D barcode has a substantially better error-correction performance compared to the standard Reed-Solomon (RS)-based Data Matrix code.

Principalele contribuții revendicate: a new design method for short irregular LDPC codes, a new variant of estimation-decoding, a new class of 2D barcodes based on LDPC codes, an intelligent interleaver has been designed to place the LDPC code's symbols in the data region of the 2D barcode, a channel-model for 2D barcodes, algorithm called estimation-decoding in 2 dimensions (ED2D) based on a 2D hidden Markov-model, a test-environment that provides an evaluation of 2D barcodes in industrial environments.

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