

Preface

Every day, people shoot millions of photographs. The absolute majority of the images stay in digital form only. A small proportion of them are still assigned for printing, but even this amount represents a huge number of pictures. Frequently, the quality of the images is not very high. Usually, users do not have time for substantial manual editing of the captured images. How can the best visual quality of a hard copy be provided in automatic mode? This book describes in detail several algorithms for the image processing pipeline of photo-printer and photo-editing software tools.

The material is based on the experience of the authors in industrial research and development. We have worked on the development of algorithms for the Printing Division of Samsung Electronics for more than 10 years. In the book, we consider several techniques that we have developed at different times for processing images in documents and photographs. The algorithms presented in the book were disclosed earlier in dozens of patents worldwide, presented at international conferences, and realized in devices and software manufactured and utilized by the company.

We should especially note that this book in no way pretends to present an in-depth review of the achievements accumulated to date in the field of applied image processing and digital printing. Instead, in the book, the main results of our own studies carried out during more than ten years, that is, 2005–2016, are summarized. We hope that the main approaches, optimization procedures, and heuristic findings are still up to date and can be used as a basis for new intelligent solutions for the processing of photographs.

There are three groups of topics covered by the book: image enhancement algorithms, smart techniques for changing the aspect ratio for borderless printing, and approaches for peculiar printing modes. In the first group, we consider an image enhancement pipeline based, in part, on Exchangeable Image File Format (EXIF) information, adaptive local and global contrast improvement, the fusion of photographs captured with exposure bracketing, red-eye correction, reduction of JPEG

artefacts, inverse halftoning, and sharpening. Smart cropping, image complementing, and retargeting are employed for changing the aspect ratio in the second group. The third group includes algorithms for printing anaglyph images, the generation of colour sketches for eco-draft-printing, detection of photo-orientation, and generation of collage from photographs. Almost all enumerated algorithms can be adjusted for any image enhancement applications, and only some of the algorithms have specifics intended for printing only. We do not describe methods related to specific printing devices or technologies, for example, laser or inkjet printing. Besides, the subjects of colour management and halftoning are also out of the scope of this book.

How can algorithms capable of being adaptive to image content be developed? In many cases, inductive or deductive inference can help. Many of our algorithms include lightweight classifiers or other machine-learning-based techniques, which have low computational complexity and model size. This allows them to be implemented on embedded platforms. The quality metrics is a key component in the development of the algorithm. In this book, we demonstrate various approaches for quality assessment.

As mentioned, the majority of the described techniques were implemented in the firmware of system on chip or in computer software products. This was a challenge because for each industrial task, there are always strong specification requirements and subsequent limitations on computational complexity and memory consumption. In the book, as a rule, we do not describe any device-dependent optimization tricks, but we provide ideas for effective methods from an algorithmic point of view.

This book is intended for all those who are interested in image processing and want to know how it works for photo-printing and how to apply machine learning techniques for the creation of effective adaptive algorithms. We hope the book will serve as a useful guide for students, researchers, and practitioners.

It is the intention of the authors that each chapter can be used as an independent text. In this regard, at the beginning of a large fragment, the main provisions considered in the preceding text are briefly repeated with reference to the appropriate chapter or section. References to the works of other authors and discussion of their results are given in the course of presentation of the material.

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