**SVEUČILIŠTE U ZAGREBU**
**GRAFIČKI FAKULTET**
**ZAGREB, Getaldićeva 2**

## Postupak ocjene doktorskog rada

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| **DOKTORAND/ICA:** | Darija Ćutić, mag. ing. techn. graph. |

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| **NASLOV RADA na hrv. jeziku:** | Optimizacija konverzije digitalnoga zapisa višebojne fotografske slike u crno-bijelu zadržavanjem semantičkih svojstava |
| **NASLOV RADA na engl. jeziku:** | Optimizing the conversion of digital record of multicolor photographic image into black and white by preserving semantic properties |

**SAŽETAK:**

Digitalni zapis fotografske slike snima se u višebojnom RGB prostoru boja. Kako bi se višebojni fotografski zapis pretvorio u crno-bijeli jednobojni prikaz koriste se različiti modeli konverzije. Kod različitih konverzija gubi se određeni dio informacije koju prenosi digitalni zapis slike, jer su ovisni o tehničkim karakteristikama ponajprije kod L vrijednosti kanala Lab zapisa te o sintaktičko-semantičkim karakteristikama fotografske slike. Pomoću istraživanja promatranjem tehničkih mjernih karakteristika slike, promjene vrijednosti kanala RGB zapisa višebojnog originalnog fotografskog zapisa i vizualnom usporedbom višebojnog originala te crno-bijelog konvertiranog zapisa slike provedena je optimizacija sa ciljem zadržavanja informacija na fotografskim zapisima. Cilj disertacije je optimizacija konverzije višebojnog u crno-bijeli digitalni zapis fotografske slike zadržavanjem semantičkih svojstava slike.

Ključne riječi: konverzija digitalne slike, digitalni zapis fotografske slike, RGB prostor boja, crno-bijela slika, optimizacija

**EXTENDED ABSTRACT:**

The digital recording of photographic images is captured in a multicolored RGB color space, composed of three primary channels: red (R), green (G), and blue (B). Each of these channels contains specific information related to brightness and color at particular wavelengths. Their combination allows for a broad spectrum of colors, contributing to the accurate and detailed representation of real-world visual information. However, converting a multicolored photographic image into a black-and-white digital format results in the inevitable loss of chromatic data, which can impact the accuracy and interpretability of the image. Various conversion models exist, each producing different results depending on the technical settings and the applied transformation methodology. One of the main challenges in this process is the loss of crucial information that the digital image initially conveys. This loss depends on multiple factors, including the technical characteristics of the recording process, particularly the L value within the Lab color space, which determines brightness, as well as the syntactic and semantic properties of the photographic image. Different conversion models apply various algorithms to process RGB channels, leading to varying levels of information preservation. Some algorithms prioritize brightness, while others emphasize contrast and texture preservation, both of which are essential for an accurate visual representation. The challenge lies in determining an optimal conversion approach that minimizes information loss while maintaining the semantic integrity of the image.

To address this issue, an optimization study was conducted based on a combination of technical measurements and visual assessments. The research involved analyzing RGB channel variations in multicolored original images, evaluating the impact of different grayscale conversion techniques, and visually comparing black-and-white outputs to their original counterparts. The aim was to identify an optimized method that ensures the retention of essential image details and enhances the perceptual quality of black-and-white photographic representations. Through a detailed analysis of various conversion techniques, the study highlights the advantages of specific approaches that strategically adjust brightness and contrast mapping, ensuring that grayscale images remain visually meaningful and semantically accurate.

The findings indicate that certain models can be optimized to minimize semantic and perceptual data loss, improving the quality of black-and-white images for diverse applications such as artistic photography, technical documentation, and visual data archiving. This dissertation focuses on enhancing grayscale image conversion methods to ensure the preservation of key visual and semantic properties.

The proposed optimization techniques improve the usability of black-and-white digital images across different professional and artistic domains, allowing for a more accurate and meaningful representation of the original multicolored image. Future research could build upon these findings by integrating adaptive machine learning techniques to refine grayscale conversion processes based on image content.

Additionally, this study emphasizes the significance of context-aware grayscale conversion, where different photographic genres and use cases require tailored approaches. For example, high-contrast grayscale conversions may be preferable in medical imaging and forensic analysis, whereas fine tonal gradation might be more suitable for

artistic photography and archival purposes. By considering these contextual differences, the research opens pathways for further advancements in grayscale image processing, ensuring that optimized conversion methods align with the specific needs of different fields while maintaining the highest possible fidelity of visual information.

Keywords: conversion of a digital image, digital recording of a photographic image, RGB color space, black-and-white image, optimization

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