Sigma-Delta Modulation und Druckraster

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In our work, we study error diffusion techniques for digital halftoning from the perspective of 1-bit quantization. We introduce a method to generate schemes for two-dimensional signals as a weighted combination of its one-dimensional counterparts and show that various error diffusion schemes proposed in the literature can be represented in this framework via schemes of first order. Under the model of two-dimensional bandlimited signals, which is motivated by a mathematical model of human visual perception, we derive quantitative error bounds for such weighted schemes. We see these bounds as a step towards a mathematical understanding of the good empirical performance of error diffusion, even though they are formulated in the supremum norm, which is known to not fully capture visual similarity of images.

Motivated by the correspondence between existing error diffusion algorithms and first-order schemes, we study the performance of the analogous weighted combinations of second-order schemes and show that they exhibit a superior performance in terms of guaranteed error decay for two-dimensional bandlimited signals. In extensive numerical simulations for real world images, we demonstrate that with some modifications to enhance stability this superior performance also translates to the problem of digital halftoning. More concretely, we find that certain second-order weighted schemes exhibit competitive performance for digital halftoning of real world images in terms of the *Feature Similarity Index* (FSIM), a state-of-the-art measure for image quality assessment.

This is joint work with Prof. Felix Krahmer from the Technical University of Munich.