Speeding up powerful State-of-the-Art Restoration Methods with Modern Graphics Processors

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Abstract. One important aspect of digital image processing is the removal of glitches from the measured data, particularly from observations of physical phenomenons. We propose an approach which realises valid results that have nearly no restoration artefacts. It is based on a further developed state of the art regularisation principle - the restriction of the degrees of freedom of the solution-describing model. The key idea is to use parameterised image elements instead of single pixels which are determined jointly in a bayesian estimation. However, the long duration of a restoration using such an approach is a problem in many applications. This article presents a technique how to speed up this method and reduce the runtime using the example of restoration of kelvin probe force microscopy-data.

Keywords: restoration, regularisation, deconvolution, degree of freedom, GPU

1 Introduction

Generally, a goal of digital image processing is to gain information from two-dimensional measured data. It turns out to be a problem that usually all data is blurry and noisy due to the measuring-process. In order to retrieve meaningful information from the data the corruptions must be removed as well as a possible lack of information must be compensated.

For this purpose a variety of methods have been developed. These methods reach from simple linear deconvolution techniques through bayesian approaches. The latter try to find the real data in an iterative, well-posed process. By estimating the cause of the data, these methods try to maximise the likelihood between measured and real data using a predefined imaging model. In addition, these methods allow to incorporate as many a-priori knowledge of a suitable solution into the restoration process as can be expressed mathematically.

However, the majority of the known methods carry out the restoration of the measured data using a given pixelgrid. Every pixel corresponds to one degree-of-freedom that has to be determined. In real situations the distribution of information doesn't have to fit the given grid. There may be cells that contain too