Abstract

The topic of this dissertation is image sequence processing, with a focus on motion recovery and reconstruction of missing data, often called *Inpainting*. The main tools used are the Calculus of Variations and Partial Differential Equations.

In the first part, we discuss the difficult problem of motion recovery, and some classes of approaches that have been used to address it. This introduction to motion recovery is not a state of the art, the subject is much to vast. We nevertheless try to provide a overview of several important approaches and a series of pointers to the literature. We then present a state of the art for still image inpainting as well as principles that have been used for for image sequence inpainting, for these methods differ largely from the 2D case.

In the next part, a particular class of motion recovery methods is studied, local linear least squares methods, where *Structure Tensors* appear naturally. We propose a simple probabilistic modeling of these tensors and develop two approaches based on least squares, first a non-linear smoothing of structure tensor fields for a more robust motion estimation and then a coarse to fine, multiscale approach to overcome some of the problems of least squares methods.

The third part is concerned with image sequence inpainting. After having discussed some multidimensional methods and their drawbacks, we introduce a simple and generic Bayesian Framework, from which variational formulations are deduced. We instanciate such a variational formulation using the spatial Total Variation and a recent optical flow algorithm. A specific optimization scheme is presented and a corresponding numerical discretization is carefully detailed. Several examples are presented in order to validate this approach.

In the last part, a simple Partial Differential Equations based deinterlacing scheme is introduced, which corresponds to a simplified situation of the image sequence inpainting scheme presented in the previous chapter. It compares positively to some related algorithms.

We finish with a somewhat uncommon use of 2D inpainting methods, where a standard algorithm is applied to X-rays for a medical purpose, the assessment of lumbar aortic calcification.