

Preface

Sequential images captured from a region may be used to detect changes there. This technique may be used in different fields such as video surveillance, medical imaging, and remote sensing. Especially in remote sensing, change detection is used in land use and cover analysis, forest or vegetation inspection, and flood monitoring. Although manual change detection is an option, the time required for it can be prohibitive. It is also highly subjective depending on the expertise of the inspector. Hence, the need for automated methods for such analysis tasks emerged. This book is about such change detection methods from satellite images. Our focus is on changes in urban regions. The layout of the book is as follows.

We start with a brief review of change detection methods specialized for remote sensing applications. While the first Earth observation satellites were equipped with 30–100 m resolution sensors; modern ones can capture images up to 0.5 m resolution. This also led to the evolution of change detection methods for satellite images. Early methods were generally pixel based. As the detail in the image increased, more sophisticated approaches emerged (such as feature based methods) for change detection.

Next, we consider pixel based change detection. We summarize well-known methods such as: image differencing, image ratioing, image regression, and change vector analysis. We introduce median filtering based background subtraction for satellite images. We also propose a novel pixel based change detection method based on fuzzy logic.

To benefit from color and multispectral information, we explore several methods such as PCA, KTT, vegetation index differencing, time dependent vegetation indices, and color invariants. Since these methods depend on a linear or a nonlinear color space transformation, we labeled them as such. Naturally, they can only be applied to the dataset having color or multispectral information.

We also considered texture based descriptors for change detection. Here, we benefit from the gray level co-occurrence matrix. We extracted four texture descriptors from it to be used for change detection. We also benefit from entropy to summarize the texture.

Different from previous approaches, we introduced a change detection framework using structure information. Here, we extract the structure in an image by edge detection, gradient magnitude based support regions, matched filtering, and local features. Graph formalism also helped us to summarize the structure in the image.

Finally, we introduced fusion of change detection methods to improve the performance. Since different change detection methods summarize the change information in different ways, they can be fused to get a better performance. Therefore, we considered the decision level fusion based on binary logic. We also developed a fusion method based on association.

We statistically evaluated the performance of the mentioned change detection methods. On a large dataset, we obtained very promising results. Especially, the change detection performance after fusion is noteworthy.

The brief summary above indicates that this book may be useful for automated change detection studies. It summarizes and evaluates the existing methods on change detection. It also proposes several novel methods for satellite image based change detection. Therefore, the interested reader may benefit from both categories to solve his or her research problems.

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