Review

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A Survey of Infrared and Visual Image Fusion Methods

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Abstract: Infrared (IR) and visual (VI) image fusion is designed to fuse multiple source images into a comprehensive image to boost imaging quality and reduce redundancy information, which are widely used in various imaging equipment to improve the visual ability of human and robot. The accurate, reliable and complementary descriptions of the scene in fused images make these techniques be widely used in various fields. In recent years, a large number of fusion methods for IR and VI images have been proposed due to the ever-growing demands and the progress of image representation methods; however, there has not been published an integrated survey paper about the this field in last several years. Therefore, we make a survey to report the algorithmic developments of IR and VI image fusion. In this paper, we first characterize the IR and VI image fusion technique based applications to represent an overview of the research status. Then we present a synthesize survey of the state of the art. Thirdly, frequently-used image fusion quality measures are introduced. Fourthly, we perform some experiments of typical methods. At last, we summarize the corresponding tendencies and challenges in IR and VI image fusion. This survey concludes that although various IR and VI image fusion methods have been proposed, there still exist further improvements or potential research directions in different applications of IR and VI image fusion.

Keywords: Image fusion; Infrared and visual image; Image representation; Feature extraction; Image quality assessment

1. Introduction

In the natural environment, objects will radiate electromagnetic wave with different frequencies, called thermal radiation, which cannot be seen by human eyes [1] [2]. IR images are taken by infrared sensor to record the thermal radiation of different objects, these could be used in ground object identification and surface parameters inversion, such as hidden targets and identification of camouflage [1] [3]. The characteristics of IR images would reduce the influence of external environment, such as sunlight, smog and other condition factors [1] [4]. IR images are sensitive to the objects and areas with obviously infrared thermal characteristics which could not be represented in VI images [5] [6]. VI images are taken to record the visibly reflective properties of spectrum information of the objects, these contain numerous visible edges and details of objects, which could provide a perceptual scene description for human eyes and are consistent with human visual characteristics [1] [5]. The goal of IR and VI image fusion is to obtain a complementary fused image with abundant detail information in VI images and effective target areas in IR images [5]. As a result, IR and VI image fusion techniques are widely used in night-vision imaging equipment which could improve the nocturnal ability of human and robot [7]. The rapid expansion of computer imaging technologies and sensor technologies will help to improve the quality and efficiency of night-vision imaging equipment which often lead to robust information processing for robot vision, and reveal information that is invisible to human eyes [8]. The accurate, reliable and complementary descriptions of the scene in fused IR and VI images make these techniques be widely applied to military surveillance[9][10][11], agricultural automation[12] [13],