Chapter 6
A Scientometric Analysis and a Review on Current Literature of Computer Vision Applications

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ABSTRACT

Computer vision methods are widespread techniques mostly used for detecting cracks on structural components, extracting information from traffic flows, and analyzing safety in construction processes. In recent years, with the increasing usage of machine learning techniques, computer vision applications have been supported by machine learning approaches. So, several studies have been conducted which apply machine learning techniques to image processing. As a result, this chapter offers a scientometric analysis for investigating the current literature of image processing studies for the civil engineering field in order to track the scientometric relationship between machine learning and image processing techniques.

INTRODUCTION

Construction works need frequent monitoring and investigation. Computer vision applications are becoming essential techniques for monitoring components autonomously. Besides investigating construction components, image processing methods are suitable for monitoring traffic-flows and for making safety-level valuations. As far as developing various measurement techniques, image processing tools have become a versatile technique for various applications. In the field of civil engineering, image processing techniques are used for several applications. These include object detection, object tracking, action recognition (Seo, Han, Lee, & Kim, 2015), and crack detection (Yamaguchi & Hashimoto, 2010). Object detection is a comparatively primitive method among these methodologies. Object detection techniques are convenient algorithms for detecting the degree to which a construction site is unsafe, by detecting data regarding construction workers and their equipment. The basic principle of object detection methodology is dividing up the image into several mini-sized frames, and then detecting the searched-for object by

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scanning these mini frames. (Murphy, Torralba, Eaton, & Freeman, 2006). One of the other applications for object detection is vehicle detection transportation video records (Bas, Tekalp, & Salman, 2007). A second methodology, object tracking, is a more sophisticated methodology than the object detection method. To implement object tracking methodology, video records are needed. In the first frame of the video record, the object is detected; and in the subsequent frames, the same object is tracked to obtain the object's trajectory. Three type of methodologies are used for object tracking: (1) point tracking, (2) kernel tracking, and (3) silhouette tracking (Yilmaz, Javed, & Shah, 2006). Structural health monitoring is another object tracking application by which buildings' frequencies are determined from video recordings (Feng & Feng, 2018).

In recent years, machine learning techniques have been developed to fulfill the demand for frequent use of image processing and computer vision applications in the civil engineering field. The most frequent methodology for image processing applications is a kind of neural network algorithm named *Convolutional Neural Networks* (CNN) that uses a framework analogous to the functioning of an animal's neural cortex. LeCun et al. (1989) first applied CNN methodology, and applied it for identifying written numbers. However, after more than a decade, this methodology has become more applicable to the field following the spread of GPU technologies. Additionally, there are various competitions in image recognition for various fields. Traffic sign recognition is one of the most prominent areas in these competitions (Stallkamp, Schlipsing, Salmen, & Igel, 2012). Other than traffic sign recognition, the CNN method is used for several areas in the field of civil engineering such as safety level assessment from site images in construction projects (Ding et al., 2018; Fang, Ding, Luo, & Love, 2018), and crack detection in structural components (Cha, Choi, & Buyukozturk, 2017; Huang, Li, & Zhang, 2018). For assessing the impact of these studies and new trends in the field of construction building technology, a scientometric analysis is a convenient methodology which has been used for various fields. In this study, these various applications are tracked with a scientometric analysis, and frequently-cited publications are investigated through their keywords and research area.

The impact of publications depends on citation statistics, and scientometrics is a quantitative methodology that uses citation statistics of publications and generates some statistical output using bibliometric data in the literature. In the context of scientometrics, the whole body of literature can be modeled as a network structure (Price, 1965). Additionally, each publication is variable input within scientometrical analysis. Analyzing and defining citation mechanisms are the main way in which articles that are joined to one another with citation and co-citation relationships in order to constitute citation graphs in order to assessing their impacts. Additionally, utilizing inner-citation statistics enables publications to be grouped together. Using scientometric analysis, author and publication contributions can be evaluated after these citation statistics are obtained. In the context of construction building technology, the study of Zhao (2017) is a prominent scientometric review regarding BIM research studies. Other studies have been found to be focused on such topics as safety searches (Jin et al., 2019), and green building searches (Zhao, Zuo, Wu, & Huang, 2019). The focus of the scientometric analysis of this particular study is measuring the impact of computer vision applications for construction building technology in which results are given with visual citation maps. In the first section, the concept of scientometrics is briefly introduced. In subsequent sections, the analysis of current publications on computer vision techniques is given. In the last section, the outputs of scientometric analysis are given. In the conclusion, research trends are discussed.