Editor's Corner

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Pavement Imaging Boosted by the Progresses in Computer Vision

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Pavement systems are essential to economy and affect our daily lives. Highway maintenance is a huge public investment requiring more than $40 billion each year in the U.S.A. Over the past decade, the amount of available resources for highway maintenance have been shrinking. To preserve the quality of our lives, pavement systems need to be carefully designed to increase durability and performance. Secondly, optimized maintenance and rehabilitation strategies need to be developed and implemented. Pavement imaging technology can play a critical role in data collection to solve the problems inherent in both of these areas.

Imaging is ranked among the top 20 greatest engineering achievements of the 20th century by the National Academy of Engineering of the USA. According to a report from Tractica, a market intelligence firm, the market for computer vision technologies will grow from $5.7 billion in 2014 to $33.3 billion by 2019, representing a compound annual growth rate (CAGR) of 42%. Pavement imaging is a real world application of computer vision. It will be greatly benefited from the rapid growing computer vision market. This short note explores several possible changes in pavement imaging that we may observe in the short future.

Hardware System: We can expect to see lower noise and higher resolution (2D/3D) pavement images in the next couple of years. Recently, SONY introduced IMX 252 series CMOS imaging sensors as the next-generation products with a global shutter function for industrial applications. These lower price and higher performance imaging sensors will make it possible for the wide adoption of high resolution pavement (2D/3D) image collection systems.

Data: Supported by the advanced imaging sensors, various pavement image collection systems and image data formats have been developed during the last decade. In order to unify data analysis, reporting, sharing and evaluation, a common and interchangeable data format for 2D/3D pavement image data needs to be developed. In June 2015, the Federal Highway Administration (FHWA) of the USA has solicited quotations (DTFH6115Q00022) to establish a standard data format for 2D/3D pavement image data that is used to determine pavement distresses and profiles for both highway agencies and equipment suppliers. The adoption of this standard image format in the future will allow pavement image data from various sources to be shared across different analysis software platforms. More and more 2D/3D pavement images in a standard format will be accessible for these interested researchers from academia. This trend will create an unprecedented demand for more powerful and effective pavement image processing algorithms.

Software: A new version of the open source public computer vision library, OpenCV 3.0, was released in June, 2015. It includes source codes of more than one thousand image processing algorithms. As an effective software tool, it can facilitate pavement imaging research dramatically. To speed up the research in pavement image analysis, both software tools and algorithms can be borrowed from the computer vision community. For example, automatic detection of the blood vessels in retinal images have been studied for several decades. Building a crack detection software upon these very developed blood vessel detection algorithms would save us a lot of time. It has been observed that these best algorithms in blood vessel detection, such as match filters, also work very well in crack detection.

During the last decade, computer vision research was largely driven by the availability of challenging public datasets. Much in the same way, publicly available 2D/3D pavement image benchmark datasets should be established to spur interest and drive innovation in pavement image analysis. Currently, this kind of benchmark datasets does not exist in the pavement imaging community. Moreover, we are also short of a widely accepted performance metric, which can measure the progresses of distress detection on a firm quantitative ground. A desired metric should make a direct, unbiased comparison of various detection algorithms possible.

It can be anticipated that pavement imaging, aided by the rapid progress of sensors on the computer vision market, standard image format, benchmark datasets, and effective software tools, will continue to make great advances. (Dr. Cheng Chen is a senior team member of professor Kelvin C.P. Wang's research group at Oklahoma State University, which is engaged in automated pavement survey systems through both 3D sensors and software solutions.)