

Dear reviewers,

Thanks for your careful reading and helpful comments, which will help us to improve the quality of the paper. The detailed replies to your questions are given below point by point.

Best regards,

Dan Xue on behalf of all authors

Comment 1: row 41

Reply: When the width and number of cracks exceed the allowable range, it will lead to structural decay, and affect compressive strength variation^[1], structural response and seismic fragility^[2]. It should cause the high attention, detected and repaired in time.

[1] Porco F, Ruggieri S, Uva, G. Seismic assessment of irregular existing building: Appraisal of the influence of compressive strength variation by means of nonlinear conventional and multimodal static analysis. *Ingegneria Sismica*. (2018)35.

[2] Ruggieri S, Porco F, Uva G. A practical approach for estimating the floor deformability in existing RC buildings: evaluation of the effects in the structural response and seismic fragility[J]. *Bulletin of Earthquake Engineering*, 2019(9).

Comment 2: row 77

Reply: sett --> set

Comment 3: How did the authors defined Figure 1? Maybe a reference or an explanation of Projection curve is suggested

Reply: The gray value distribution of the image in Figure 1 is described by the black horizontal projection curve and the red vertical projection curve. Where, the horizontal-axis of the horizontal (vertical) projection curve represents the column (row) serial number of the image, and the vertical-axis represents the gray mean of the image counted by columns (rows). Therefore, the gray value of the vertical-axis can reflect the brightness and darkness of the image, that is, the distribution of light.

Comment 4: row 117

Reply: i.e. --> For example

Comment 5: The paragraph at Row 150 is not very clear. Maybe authors could be rewrite it

Reply: The crack appears as a low gray value in the image. When the crack is on a background with higher brightness, the gradient value is larger. In the tunnel lining image, the pixels occupied by cracks are much smaller than the background pixels, then the background gray value can be reflected by the gray value of the projection curve. Therefore, the greater the gray value of the projection curve, the greater the gradient value of the crack line. Then, It can be seen that in the

original Gaussian model, the threshold T is related to the gradient of the line, and this gradient is related to the gray value of the projection curve. Therefore, a new Gaussian model threshold T is constructed:

Comment 6: The title of Section 6 is not very formal. It should be changed

Reply: Algorithm Steps in this Paper. --> Steps of the Proposed Algorithm

Comment 7: row 260

Reply: In the multi-scale space fusion of $w=5\sim 15(\sigma\in(1.45,4.33))$, adjust the parameter k in equation (16-17) with 0.1 as a step, the crack detection results obtained are shown in Figure 7 (a)

Comment 8: Figure 11 presents captions in Chinese. Please, to replace them

Reply:

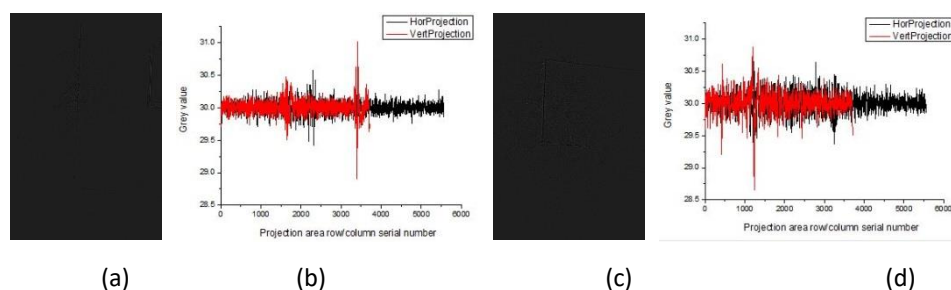


Figure 11. Detection results of step 1 of the crack detection algorithm in Reference [8]: (a) Light balanced result of image 1; (b) Gray projection curve of light balanced image1; (c) Light balanced result of image 2; (d) Gray projection curve of light balanced image2

Comment 9: Observing the good capacity of the algorithm to survey little cracks, I'm guessing what is the main advantage in this accurate survey, also considering that the concrete cracks in this kind of infrastructure is natural, due to phenomena of viscosity and shrinkage?

Reply: Considering the influence of cracks on the bearing capacity performance, seismic vulnerability and durability of building structures, international standards show that cracks exceeding 0.2mm in width need to be regularly tested and repaired in time. For the cracks with such a small width, the traditional detection method is to block the tunnel, people stand on the inspection vehicle close to the tunnel lining, and detect with handheld equipment. In this paper, the image acquisition device installed on the detection vehicle can complete the image acquisition of tunnel lining while the detection vehicle is running. The algorithm detection of the captured images can greatly improve the detection efficiency.

Concrete cracks mainly include naturally formed shrinkage cracks and artificial construction joints. The gaps of artificial construction joints are wider and have certain regularity, such as repeated occurrences in the image, the gaps are straighter, etc. The cracks formed naturally have a narrow crack width at first, and the propagation direction is indefinite. In addition, due to the darkness in the tunnel, to capture a clear image, an external light source is required, which inevitably brings about uneven illumination of the captured image. This light distribution behaves

differently in different images, which also makes it difficult to detect crack algorithms.

The advantage of the method proposed in this paper is that it can automatically divide the area and set the dynamic threshold based on the image projection analysis. The darker area uses a smaller threshold, the brighter area uses a larger threshold, and can detect lines for a certain width range. Avoid artificially wide construction joints, and only detect naturally formed cracks with narrow widths.