**Statistical methods for crack detection in large 3D concrete images**

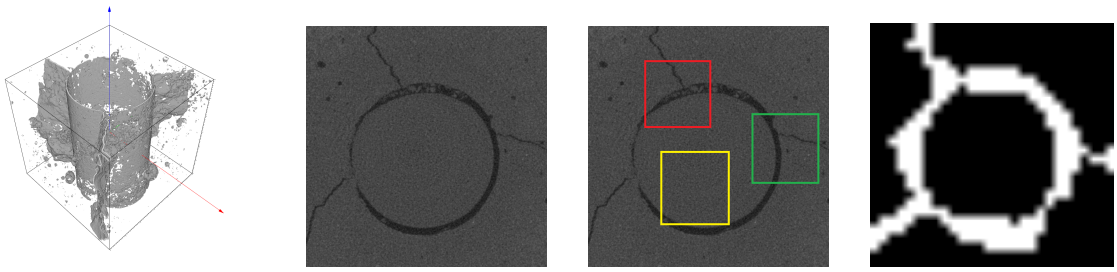

Figure 1: 3D visuaization and 2D slice of concrete with cracks and fibres in different types of concrete.

Concrete is the traditional material of choice for constructing buildings, bridges, and road infrastructure, underscoring the critical importance of safety in their design, monitoring, and maintenance. In the pursuit of enhancing safety, one approach is the investigation of material microstructures and crack propagation through computed tomography (CT). However, large real-world CT input images are often affected by environmental factors, making crack segmentation a complex and time-consuming task. Consequently, a robust algorithm for detecting crack-containing regions is needed. This algorithm should enable the focus to be directed towards anomaly regions, substantially reducing computational costs.

We are aiming at creating a framework including three phases: an edge-detection method, computing geometry characteristics of objects within the material and performing multiple hypotheses testing based on a CUSUM statistic to indicate the presence of cracks in some prespecified region(see [1], [2], [3]). Therefore, the study of the distribution of a CUSUM statistic under the assumption of no existence of anomalies is required due to the need to control errors of testing procedures, which must detect the anomaly regions with high power as well as minimize the false positive rate.

# References


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[2] D. Dresvyanskiy, T. Karaseva, V. Makogin, et al. Detecting anomalies in fibre systems using 3-dimensional image data. *Stat Comput*, 30:817–837, 2020.

[3] A. Frangi, W. Niessen, K. Vincken, and M. Viergever. Multiscale vessel enhancement filtering. *Medical Image Computing and Computer-Assisted Intervention — MICCAI'98. MICCAI 1998. Lecture Notes in Computer Science, vol 1496. Springer, Berlin, Heidelberg*, 1998.