BSc/MSc thesis/internship projects Collaboration between Hanze (Ihsan Bal) and RUG (Jiri Kosinka) Goal: Improve AI-based crack detection by using artificial images

An AI algorithm has been developed which can detect cracks on masonry structural surfaces in pixel resolution. This method is promising since it allows simple damage monitoring of structures. It is openly available at https://doi.org/10.1016/j.autcon.2021.103606, and the code in Python is available at https://github.com/dimitrisdais/crack_detection_CNN_masonry

The crack detection algorithm works fine when the image contains only a masonry surface; see Figure 1. However, if the image contains other noise sources, then the algorithm ends up with several false positives, as shown in Figure 2.



Figure 1. Cracks detected by the AI model



Figure 2. False positives when the AI model is tested with an actual photo with background noise

The AI algorithm is very much dependent on the type and amount of the training data. One major problem is that not many actual crack photos are available. Furthermore, even in the available photos, physical dimensions (length, position and width of the crack) are missing. So the model can be validated only with its performance on detecting the existence of the crack, but not on accurately quantifying the physical properties of the crack.

One possible way to avoid this problem is to create an artificial environment (potentially using an open game engine) where buildings with cracks on their walls are simulated. This should involve conditions that can affect the AI model performance, such as: resolution of the (rendered) images, the distance to the object, and the position and the strength of the light source. If realistic conditions are created, a framework for testing can be established. When the framework is established, the next step is testing, where two sets of tests can be conducted: i) train the model with artificially generated images and test with real images, and ii) train the model with real images and test with artificially generated images. One important improvement can be that the crack detection algorithm can be restrained only to the area where a masonry surface is visible. This will tremendously decrease the number of false positives.

The given tasks can be distrubuted among two (or potentially more) students, depending on their seniority/type of internship/thesis.