U.S. Department of the Interior
Bureau of Reclamation
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Automatic Concrete Crack Detection

Using Previously Collected UAS Data

Research Bulletin
S&T Project 20105

Mission Issue:
Water Infrastructure

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Problem

There are several issues related to traditional crack mapping operations.

These include access to the surfaces of the structure, inaccuracies that develop from hand-sketching the cracks, inconsistency in identifying cracks, overlooked or missed cracks, distortion in photographs from the perspective and angle of the camera, weather conditions affecting the surface such as water, and that the operation is time consuming–for some large data sets, crack mapping can require up to a month to complete.

Solution

Though initially time consuming, computer-based deep learning can be used to train a computer to analyze data and, in this case, a deep learning model can be used to analyze images for cracks. In addition, once a deep learning model is set up to find cracks, it can be improved to detect cracks in different environments and even other types of defects by providing more data. Eventually, the computer can find cracks in data with greater precision and in less time than alternate methods. In addition, the computer can operate all times of the day without needing a break.

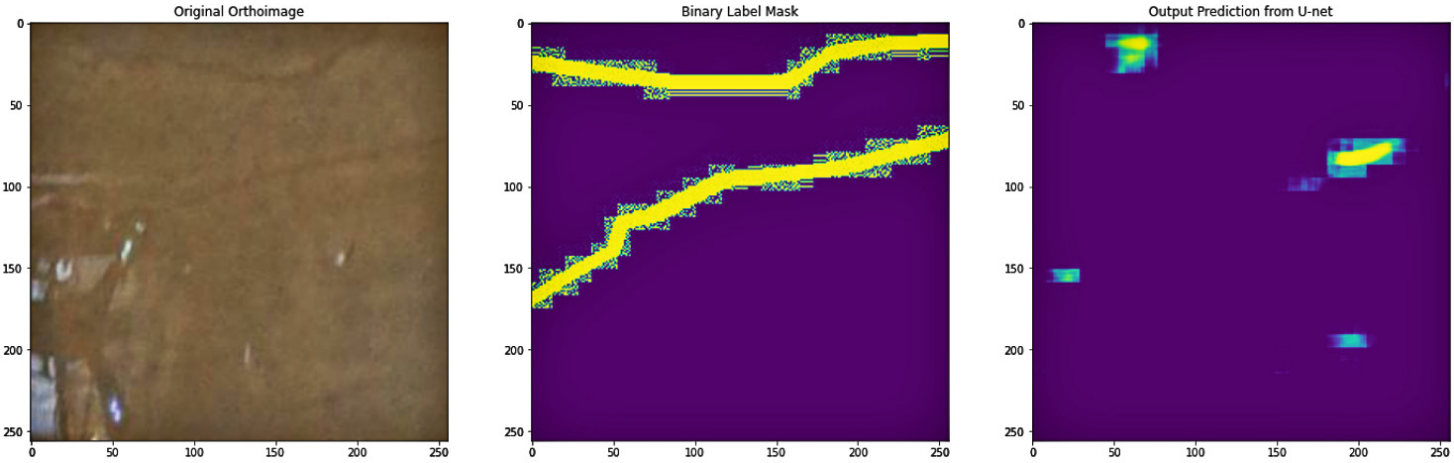
"Automated detection of deficiencies will save countless staff hours and improve the accuracy of our detailed investigations. It is a tool that will become more refined and valuable as technologies advance."

Katie Bartojay
Supervisory Civil Engineer
TSC - Concrete &
Structural Laboratory

Application and Results

This research made significant progress in producing a deep learning pipeline that can detect or identify concrete cracks within Reclamation structures such as dams. However, this project is only the beginning of a very powerful and economically valuable tool that could reduce future costs of concrete monitoring efforts, while enhancing the safety and maintenance procedures around concrete infrastructure.

Additionally, Reclamation stands well poised to capitalize on an integrative and collaborative approach with other agencies for expanding a future deep learning crack detection method to concrete canals, bridges, roads, highways, and buildings.



Example automatic crack mapping data set: input (left), label mask (center), and output prediction (right).

More Information

https://www.usbr.gov/research/projects/detail.cfm?id=20105

Future Plans

The proof-of-concept deep learning model demonstrated clear promise for future work to expand on. The big takeaway should be that an automated crack detection deep learning model is only as good as the data that it is provided. Thus, more data from across Reclamation should be collected and fed to the model. In time, the model will become more and more accurate and will be able to analyze the data in less and less time.

It should be highlighted that detecting cracks in concrete infrastructure is not a task limited to Reclamation as an agency and it is likely the future value and collaboration should be explored with other agencies with facilities like Reclamation such as the United States Corps of Engineers (USACE), water districts and other federal, state and local municipalities.