Comparing high-resolution photographs from past, present could hold key to restoring Hastings' fire-damaged pier

April 18 2011

This is the Hastings pier in July 2010, before the fire. Credit: NPL

On the 5th October 2010 the historic Hastings Pier was set on fire, destroying 95% of the Grade II listed building, leading to concerns over its future. Now scientists from the UK's National Physical Laboratory (NPL) are helping to show that the future of the pier is more positive than expected.

Prior to the fire, NPL, the UK's National Measurement Institute, had been surveying the pier to support redevelopment plans and to monitor long-term changes in the pier. The project was part of the development of a world leading low-cost technique to assess long-term degradation of structures.

The technique is called Digital Image Correlation. It has been used in the laboratory for some time but NPL have recently been pioneering its use for looking at civil engineering structures. It involves taking ultra high-resolution panoramic photos – images up to 1.4 Giga Pixels in size - at two different times to identify structural changes. Advanced

mathematical programs then analyse the pair of images to identify changes in the structure pixel by pixel. Using this information, engineers can understand how large structures change over time.

Following the devastating fire, NPL scientists returned to Hastings to take their second set of photos. They were then required to develop more advanced analysis techniques, which could deal with the much larger than anticipated changes to the Pier, and produce meaningful information about the structure. This work is proving more valuable than expected as considerable change has now taken place. In addition, the large panoramic images provide a snapshot of the structure in time, which is useful for archival purposes.

Up to 45 images were stitched together to produce an ultra high-resolution final image 80,000 pixels wide - 300-400 times more detailed than a typical camera-phone photograph. Processing a pair of these images, one before the fire and one after, can help highlight where the structure has apparently changed because of the fire.

Results have been very positive. Whilst the super-structure has been severely damaged and there are large visual changes, the cast iron framework - or sub-structure - seems much less affected. The sub-structure on the west side of the Pier appears to be remarkably similar pre and post fire. On the East side there are small areas where there are some changes, and one localised area of the sub-structure about half way along showing significant distortion. But the vast majority of the sub-structure seems largely unchanged. The area showing the most distortion - presumably caused by the extreme heat - was at a downwind point where anecdotally the fire was seen to be fiercest.

This is the Hastings pier in October 2010, after the fire. Credit: NPL

Digital Image Correlation allows the computer to effectively carry out the laborious checking of the whole structure. This means quicker and cheaper identification of areas which have been deformed or damaged, and hence may need closer inspection. This is important on large structures such as piers as it allows civil engineers to focus their efforts on the parts that most need attention, dramatically speeding the inspection process and reducing the cost of repair.

The project has also helped prove the concept of Digital Image Correlation for the measurement of changes in large structures, by providing NPL with a real-life case study enabling development of key analysis software.

Nick McCormick, Principle Research Scientist at NPL, said: "It was fortunate that we began the project before the fire, as the results will be invaluable in regenerating the pier when restoration funding is secured. From a scientific point of view, the scale of the changes actually proved very interesting, although challenging, and required us to develop far more advanced analysis techniques than originally intended. These will be hugely important in our work to develop low cost monitoring solutions for other structures. Obviously we hope the next one won't be so badly damaged part way through our study. For most applications we work on we would expect to monitor much less significant changes over time - for example small cracks appearing in bridges or building subsidence - so that problems can be remedied before they escalate to cause such serious damage."

Digital Image Correlation is one of a number of techniques that NPL is

developing for low-cost examination of large civil engineering structures such as bridges, buildings, tunnels and piers.

Provided by National Physical Laboratory