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Application Note

Surface Cracking in VIC-2D and VIC-3D

2026

Surface Cracking in VIC-2D and VIC-3D

Introduction

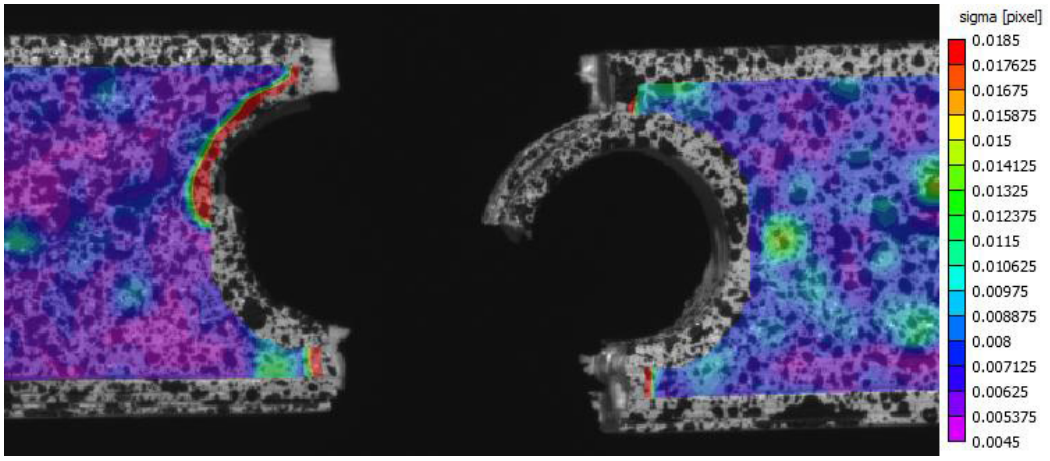
There are two main characteristics of the digital image correlation (DIC) technique that make measuring a cracking or breaking specimen difficult. Firstly, tracking between images is accomplished using subsets of pixels. Cracks or other discontinuities that form in the specimen's surface can make their containing subset significantly different looking and unable to be matched or introduce erroneous displacement and strain.

Secondly, by its definition, strain is a measure of deformation of a continuous body. The presence of cracking or other discontinuities cannot be described by strain theory; there is no such thing as measuring the strain of a crack.

By the combination of these, there are a couple realities that must be considered when using DIC to measure specimen with surface cracking.

Detection of cracks and pre-cracked surfaces

Unfortunately, for pre-cracked specimen, there is no way for the software to tell a difference between a crack and a line on the surface. Since DIC is fundamentally a surface technique, a crack would appear as part of the speckle pattern in DIC and may give you erroneous data. If a crack appears in a previously un-cracked surface, we could detect this because the surrounding sigma would be reported as very high. If the specimen is pre-cracked, you either have to draw the area of interest around the crack, leaving the user to detect the crack and not the software, or draw the area of interest over the crack, introducing potential error.



Lower measurement confidence (higher sigma) at edge of data near the break

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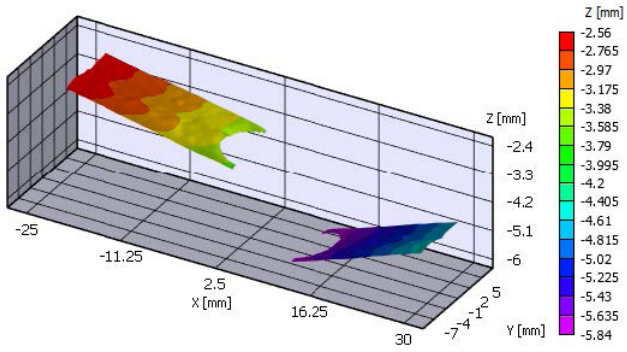
Shape and displacement measurement

Positional and displacement measurements in VIC-2D/3D depend solely on the individual subset. For this reason, these values will be accurately measured using DIC as long as subsets are correctly matched and cracks are not included. Due to the robustness of algorithms in VIC-2D/3D, when entire areas of interest (AOIs) are split, correlation can still continue on the separated areas. In the event this does not automatically occur, add a start point within each area and re-run the correlation.



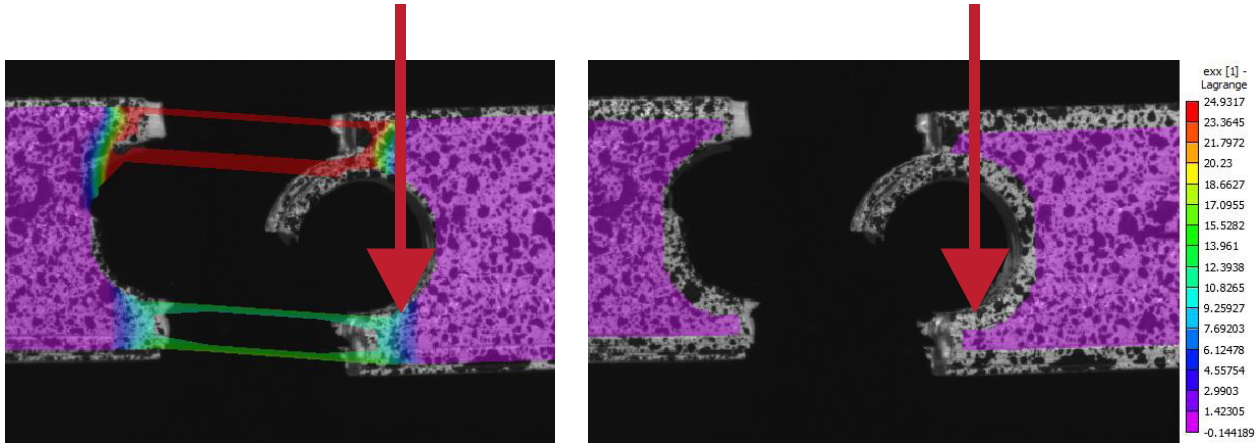
Reliable shape measurement even if specimen cracks or breaks

Strain measurement

Strain calculation, on the other hand, is reliant on multiple data points to compute the strain tensor which is then spatially filtered to reduce noise. This poses two concerns when surface discontinuities are present. In order to obtain accurate strain measurement, the discontinuities MUST be excluded. Failing to do so will not only mischaracterize the material behavior of the crack, but also the nearby area (even if this area remains continuous). VIC-2D/3D contains thresholds that will often automatically exclude subsets that do not behave continuously. It may be necessary to adjust thresholding or even manually exclude areas by adjusting your AOI. It is much better to exclude the few data points than introduce additional error to nearby points.

Error propogates to nearby points

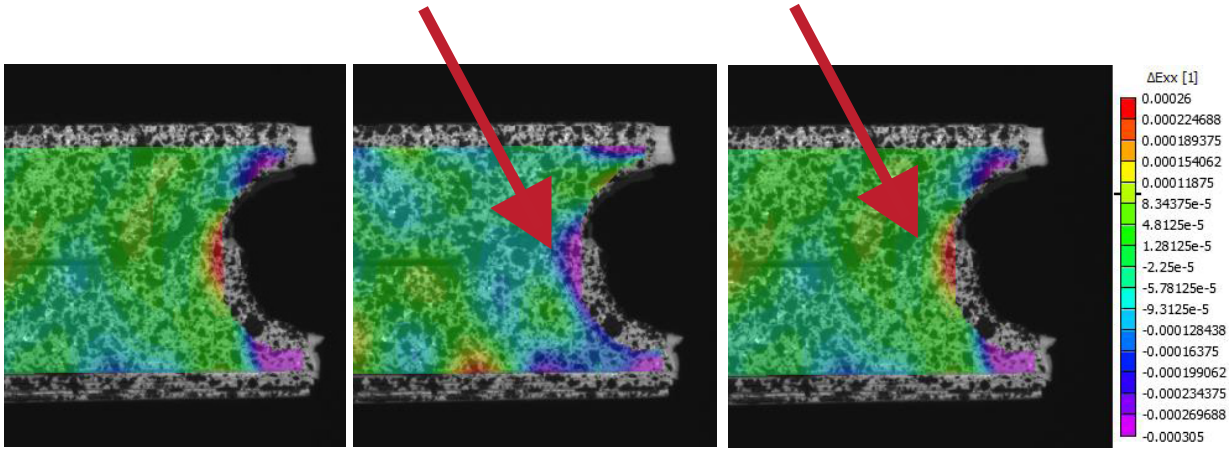
Same location, no error propagation



Axial strain when data is not correctly dropped (left) vs when it is correctly dropped (right)

Secondly, even if discontinuities are removed, strain measurement near the edge of data can be of lower confidence. This is true for all DIC strain measurement, as there are fewer data points to interpolate from towards the boundary of the AOI. Be aware that the strain measurement close to the edge is noisier.

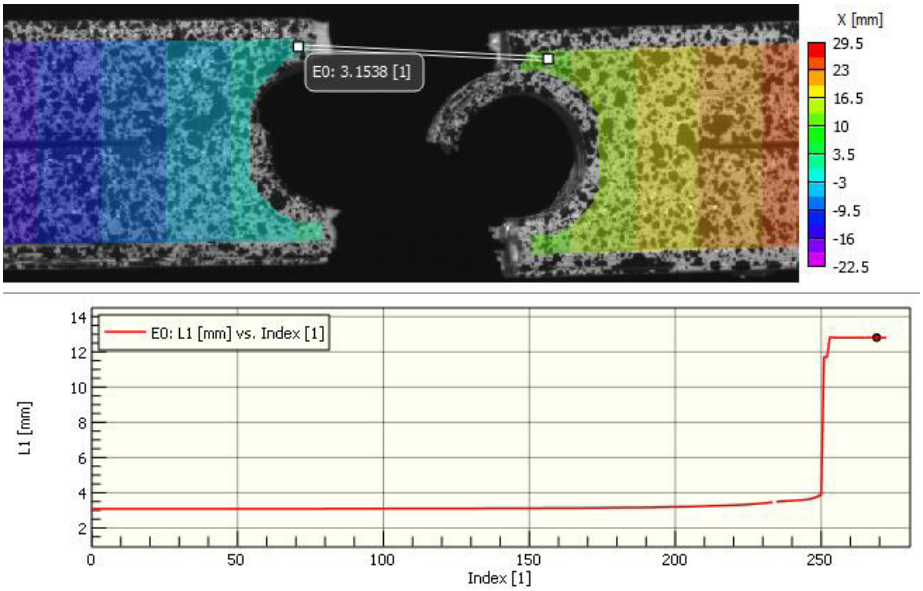
More variation in strain measurement at edge of data.



Change in axial strain in three sequential images. Material was not deforming so any changes are error.

Extension

The total extension of a specimen across a crack can be measured in VIC-2D/3D using the virtual extensometer inspection tool. By placing each endpoint on either side, the extensometer length and change in length can be extracted by *Plot extractions* and selecting to display *Extensometers*. This method is useful for determining opening and displacements of cracks.



Extension measured using *Inspect extensometer* tool

Crack opening

If you are interested specifically in measuring the crack opening displacement, the best way to do this is using the virtual extensometer. Place each end of the extensometer on the edge of the data at the desired opening location. Be aware that the DIC technique does not produce data right up to the material edge (about half of a subset size will contain no data), so deformation that occurs in that region can influence the displacement measurement.

Support

If you have any questions about this document or any other questions, comments, or concerns about our software, please contact us at support@correlatedsolutions.com, or visit our website at correlatedsolutions.com/support.