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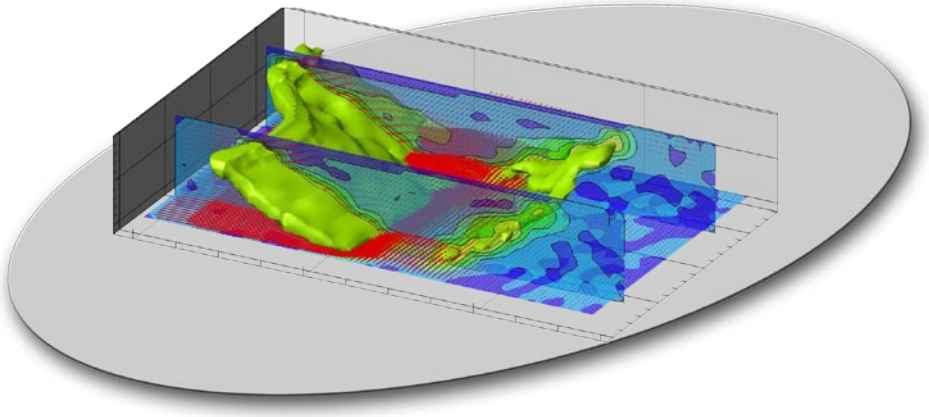
StrainMaster Digital Volume Correlation

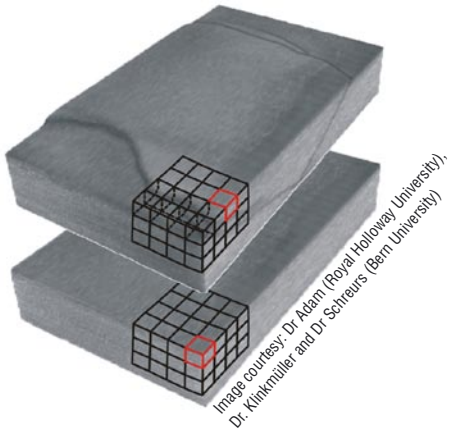
full volume material displacement and strain measurements

StrainMaster Digital Volume Correlation (DVC) is a novel technique for full 3D strain and deformation measurements. The technique imports volume images of the component in reference and deformed states and is able to calculate the full 3D displacement and strain map. Images are typically acquired from X-ray Computed Tomography (X-ray CT) systems, but can equally be obtained by Magnetic Resonance Imaging (MRI) systems for biological subjects, or via optical tomography for transparent media; for which LaVision offer our patented Tomographic reconstruction algorithms as an add-on. **DVC** is a powerful non-intrusive technique for the identification of sub-surface material deformation and is capable of identifying defects, discontinuities or other material characteristics.



Applications:

- **Biological research:** Bone, fracture, cell deformation, tissue displacement
- **Geological:** Tectonic plate simulation, compression tests
- **Metal powder:** Material charaterisation, compaction processing
- **Structural:** Concrete bend test, crack analysis
- **Composites:** Tensile testing, delamination
- **Polymers:** Rapid prototypes, transparent media



Typical volume image (tectonic plate model with visible fault line)

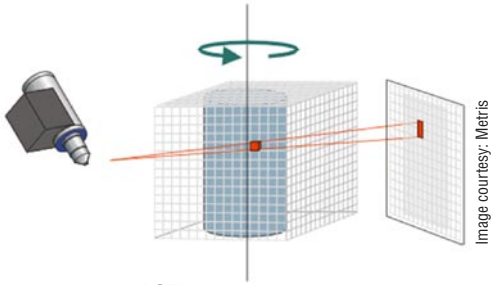
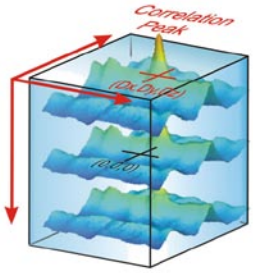


Illustration of CT scanning process



Sub volume and correlation peak which shows 3D displacement

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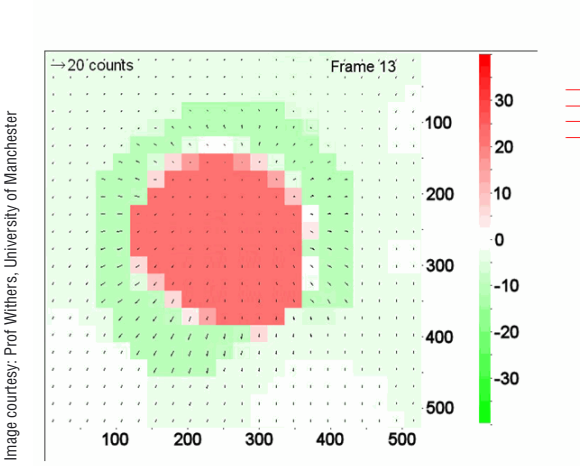
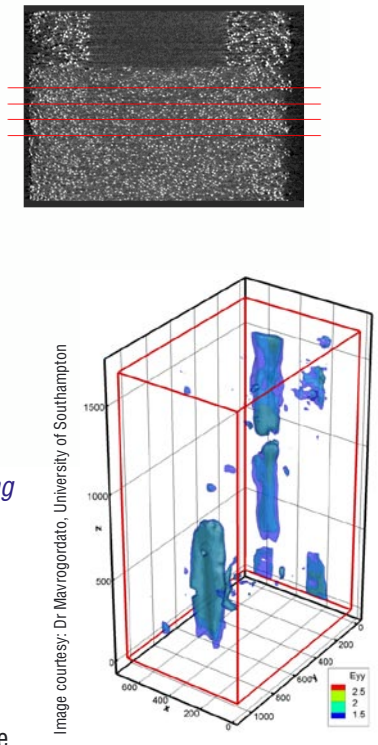
Like its counterpart, Digital Image Correlation (DIC) which is restricted to surface-only measurements, in order for **Digital Volume Correlation** to be successful the volume images must contain a random pattern. That random pattern is seen as changes in local contrast. In the case of X-ray CT scans the pattern will be produced by changes in material density such as air voids in concrete, or particles of different material type within the main body matrix, such as tin particles distributed in an aluminium powder. The volume image is sub-divided into interrogation volumes within which robust and highly accurate algorithms calculate the displacement of the pattern, which represent the material shift. **Digital Volume Correlation** is capable of yielding over one million displacement vectors per volume image pair.

Advantages:

- 3-dimensional 3-component (3D3C) displacement field in a complete volume
- Full data management and processing within powerful DaVis software
- Over 1 million displacement vectors possible
- Advanced cross-correlation with deformed interrogation volumes, multi-pass iterations.
- Reconstruction with extremely large volumes: > 2000 x 2000 x 2000 voxel possible
- Displacement accuracy to 0.05 pixel



Slice through powder compaction process showing radial displacement vectors and through-view displacement as coloured contours



Carbon fibre composite with longitudinal split

Particle Tracking

For sparse pattern or particle distributions it is possible to employ LaVision's highly accurate Particle Tracking algorithm. Although the data yield is lower, this can be more appropriate in certain circumstances – LaVision will be happy to look at your volume images and determine the appropriateness of each approach.

Data provided by LaVision are believed to be true. However, no responsibility is assumed for possible inaccuracies or omissions. All data are subject to change without notice.

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