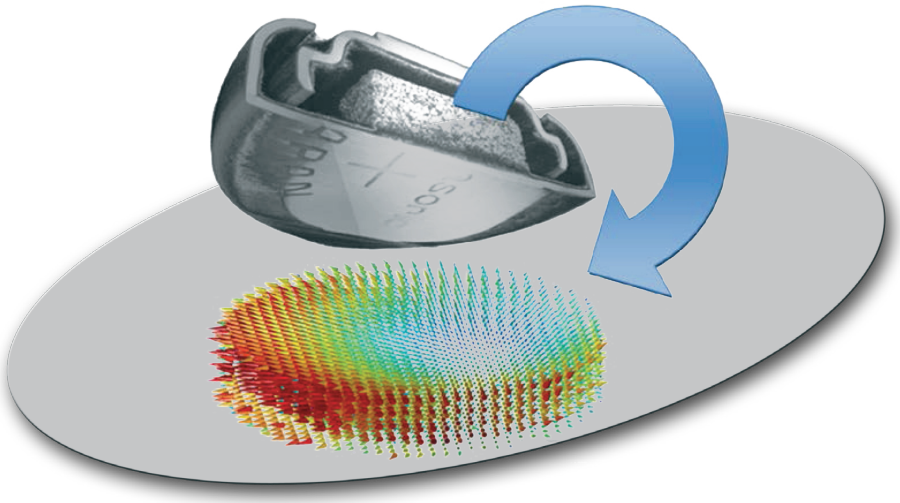
LaVision

FOCUS ON IMAGING

StrainMaster Digital Volume Correlation

full volume material displacement and strain measurements

LaVision's state-of-the-art **Digital Volume Correlation** (**DVC**) software is a novel technique for full volume 3D strain and deformation mapping. **DVC** is capable of identifying defects and cracks before they are visible in the raw image, and to quantify material characteristics. The technique utilizes volume images of the component in reference and deformed states. 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.



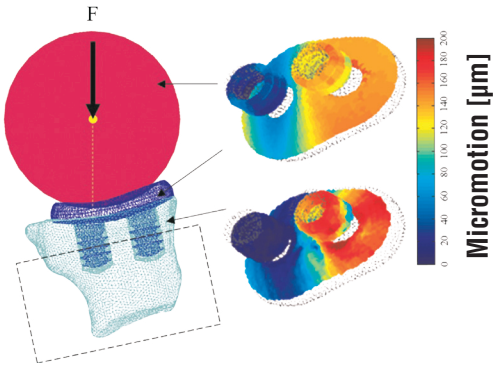
Applications

The above image (image courtesy of Eastwood et al, University of Manchester) shows an example where **DVC** was used to explore the spatial variation in particle dilation as a function of battery state of charge. Other applications include:

- **Biological research:** bone, fracture, cell deformation, tissue displacement, implants
- **Geological including oil and gas:** compression tests, shale rock
- **Metal powder:** material charaterization, compaction processing
- **Composites:** tensile testing, delamination, failure modes
- **Structural:** concrete bend test, crack analysis
- **Polymers:** rapid prototypes, transparent media

Biomechanics

Before **DVC**, measuring the mechanical properties of bone and computing full-field strain measurements at a microstructural level was almost impossible. Traditional experimental techniques were restricted to bulk material or the surface only. **DVC** has allowed users to make accurate full volume measurements of bone deformation including micromotion relative to implants. In turn this allows validation and improvement of finite element (FE) models; an example being shown in the images opposite.



Images courtesy of Sukjamsri et al, Imperial College London

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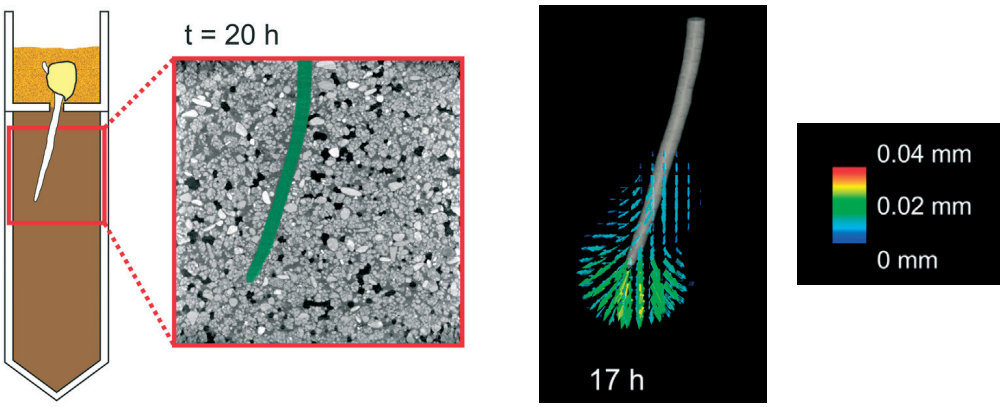
Technique

DVC sub-divides the image into interrogation sub-volumes. For each sub-volume the displacement of the contained features ("pattern") is calculated. In the case of X-ray CT the pattern is due to changes in material density such as variations in material characteristics, the existence of particles of different material type, or air voids present in materials like concrete or soil. In the example below the displacement of soil relative to maize root growth was measured: An extremely important subject because the mechanical impedance of soils determines the growth patterns of plant roots.

Geology and environment



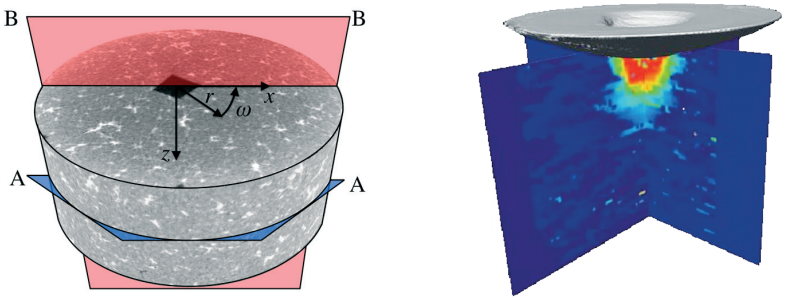
Images courtesy of Keyes et al, University of Southampton

Features

- import from any volume imaging device with no volume size restrictions
- 3-dimensional 3-component (3D3C) displacement field in a complete volume
- identify cracks and discontinuities before they are visible in the image
- rigid body shift correction and volume alignment routines
- over 1 million nodes can be calculated per volume
- displacement precision better than 0.01 voxels

Cracks Defects Localization

The high accuracy of the measured displacements allows **DVC** to detect very early stage crack initiation or defect onset, and several users have employed **DVC** to generate 3D crack propagation maps in the analysis of fracture mechanisms. Material behavior as a result of indentation can also be studied. The example below shows the indentation of aluminium-silicon carbide composite (Al-SiC). Here the three-dimensional full-field displacements beneath the indentations were measured.



Images courtesy of Mostafavi et al, Universities of Bristol and Oxford

Please contact us with your **DVC** requirements – we are happy to process images for feasibility studies and to prove the value and power of **DVC** for your particular application.

Aug-17

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