Displacement measurement

Surface Measurement of 2D displacement by Digital Image Correlation (DIC)

Surface measurement
The presented method consists in measuring of a plane surface. DIC allows us to calculate plane components of gradient tensor and to achieve plane components of strain tensor under some hypotheses (axisymmetric transformation, no variations of volume, small strains…)

\[ \begin{align*}
\mathbf{F} &= I + \frac{\partial \mathbf{u}}{\partial X}, \\
\mathbf{F} &= \begin{pmatrix}
F_{xx} & F_{xy} \\
F_{yx} & F_{yy}
\end{pmatrix}
\end{align*} \]

Principle
This technique consists in matching two images corresponding to 2 strain states of the sample surface.
A natural and artificial speckle (roughness, texture or black and white paint spray, chemical polishing relief…) providing sufficient gradients of grey levels is used to assure the convergence of DIC process.

**Example of speckle pattern**
References
The details of our DIC technique are given in following publications:


**Software**
Our DIC method is developed in a home-made software named CORRELA.

**Performances**
Non-contact surface measurement
Displacement range up 0.01µm to some centimeters (according to observation setup used to record images)
Strain range up 0.1% to some percent tens

**Devices**
Numerical cameras with lenses or coupled with optical microscope, scanning electronic microscope, atomic force microscope…
Automatic analysis software CORRELA

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Examples of applications

Study of dynamic behaviour of polyurethane foam under compression

Displacement fields for two strain states

Vertical strain fields
Determination of displacement and strain fields in the vicinity of crack tip

H. Al Husseini; Ph D thesis, University of Poitiers
Study of mechanical behaviour of refractory ceramics under 4-point bending test