HIGH SPEED 3D DIFFRACTION IMAGING

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We present for the first time a novel 3D imaging technique that collects simultaneously high intensity coherent X-ray scatter signals and laminographic X-ray absorption data.

Our new approach utilises a novel configuration of a tubular X-ray beam incident upon a ring 'absorption' sensor and a central 'diffraction' sensor. The relative translation of the object under inspection enables image scanning. A continuum of Debye cone elements from around a circular path converges to form a series of foci. We term this novel technique, focal construct geometry. Orders of magnitude increase in the intensity of the diffraction signal is possible in comparison with conventional angular dispersive methods.

We have undertaken initial testing and evaluation of this concept with various arrangements of objects fabricated from a range of different materials. Figure 1 illustrates a simple example of a 'raw diffraction' image collected over a 50mm x 35mm Alumina sheet. The sensing arrangement focussed on depth planes normal to the symmetry axis of the interrogating X-tray beam. Quantising the 2-Theta foci produced by the Alumina provides the intensity values of the pixels that comprise the resultant diffraction image (the dashed outline represents the relative position of the sheet). The intensity gradation around the periphery of the image is due to the diameter of the tubular interrogating X-ray beam extending beyond the periphery of the sheet. Deconvolving this data with the appropriate aperture restores the outline of the image as shown in Figure 2. A ring sensor collects absorption data from a circular path about each diffraction focus. Synthesis of the ring data produces laminographic information. The mapping of the diffraction images to the corresponding laminograms, by virtue of a common X-ray beam geometry, provides the basis for a new 3D imaging modality.

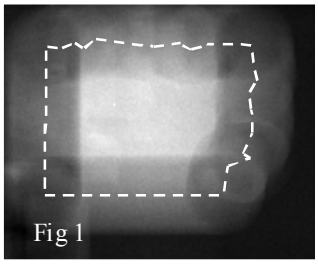
Fig 1

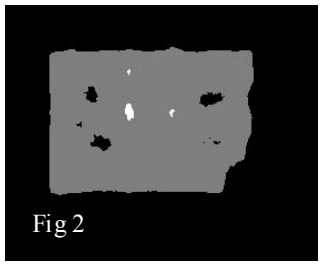
Fig 2

The increased intensity of the diffraction signals has important implications for applications, which demand high speed acquisition of diffraction data. The presentation of our latest results will highlight the new types of 3D visualisations made possible with this novel approach.

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