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Model-based Inversion for Flash Thermography

Stephen D. Holland and Brian Schiefelbein, Center for Nondestructive Evaluation, Iowa State University, 1915 Scholl Road, Applied Sciences Complex II, Ames, IA 50011

The thermal image sequences from thermography experiments are blurred by lateral diffusion and therefore hard to interpret. The widely used one-dimensional heat flow model provides a robust interpretation of thickness or delamination from "break time" where lateral diffusion is significant, but is less effective otherwise. As a result, it remains quite common to interpret defects by contrast from the surrounding "acreage" rather than by the intrinsic properties of the defect signal itself.

In this paper, we present an approach for model-based inversion of flash thermography image sequences that attempts to approximately reconstruct the flow or back-surface geometry from the thermal image sequence. The reconstruction is based on representing reflectors as buried heat sources and interpreting the spatial and temporal heat distribution on the surface as a linear combination of the Green's functions of those sources through linear inversion.

The result is a spatial map, such as shown in Fig. 1 of reflector intensity at a series of layers. Resolution decreases with depth, representing the inherent blurring due to thermal diffusion.

The reconstruction is not perfect; the representation of lateral diffusion is approximate and the reconstruction causes substantial noise gain. Defects behind or nearly behind other defects may not be represented correctly. But the reconstruction does provide a physical interpretation that includes lateral heat flows observed in a flash thermography experiment.

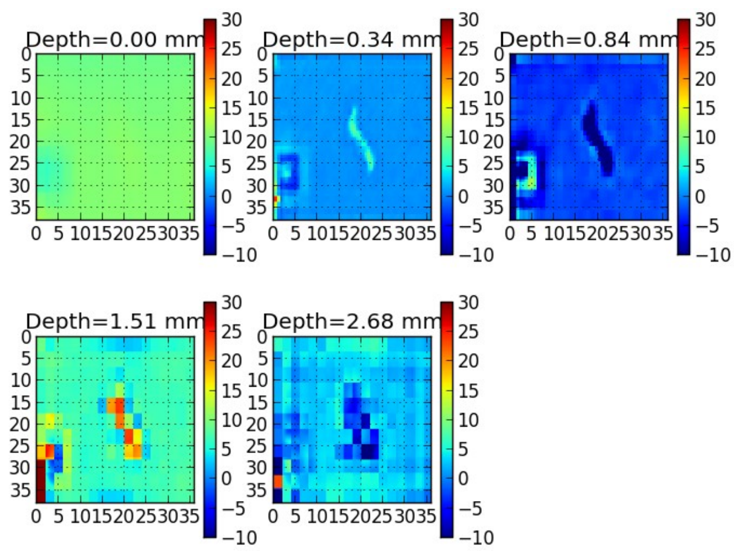

Figure 1. Example model-based inversion maps of impact-induced delamination in a composite specimen

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