ESPI HOLE DRILLING METHOD

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Basis of Method - This technique is based on the proven strain-gage hole drilling method, but a sensitive ESPI (electronic speckle-pattern interferometer) replaces the strain gage. The ESPI system digitally records intensity information for each pixel in the area surrounding the hole. This intensity information can be converted to deformation along the sensitivity angle. The deformation is then converted to residual stress by doing a best fit to a library of finite element data. The system integrates a drill mounted on a computer-controlled stage for accuracy and repeatability. A graphical user interface controls the drilling as well as the data acquisition and analysis.

Procedure

1. Focus camera on location where hole is to be drilled.
2. Acquire pre-drill images of surface
3. Drill hole
4. Acquire post-hole images
5. (Repeat steps 3 and 4 for incremental drilling if desired)
6. Analyze results

Results - Each hole drill provides the principal stresses and the angle to the principal stresses in the plane of the specimen surface at the hole drilling location. The stresses are the weighted average of the stress over the depth of the hole.

Equipment – ESPI system, precision milling and positioning device, end mills. Drilling has been successfully performed using air turbines, electric drills, and air abrasive methods.

Assumptions - Isotropic linearly-elastic material, stresses less than one half yield, stresses do not vary significantly with depth, and stresses uniform over the area of the drilled hole.

Limitations - Near room temperature measurement, surface results are limited to the minimum depth of hole possible (appr. 0.001”), holes must be drilled in the part, the area of interest must be accessible by drill, and profiling with depth results lose accuracy as depth increases.

The accuracy of this system is comparable to strain gage hole drilling.

References:

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