Detecting Material Defects using a Scanning Laser Beam

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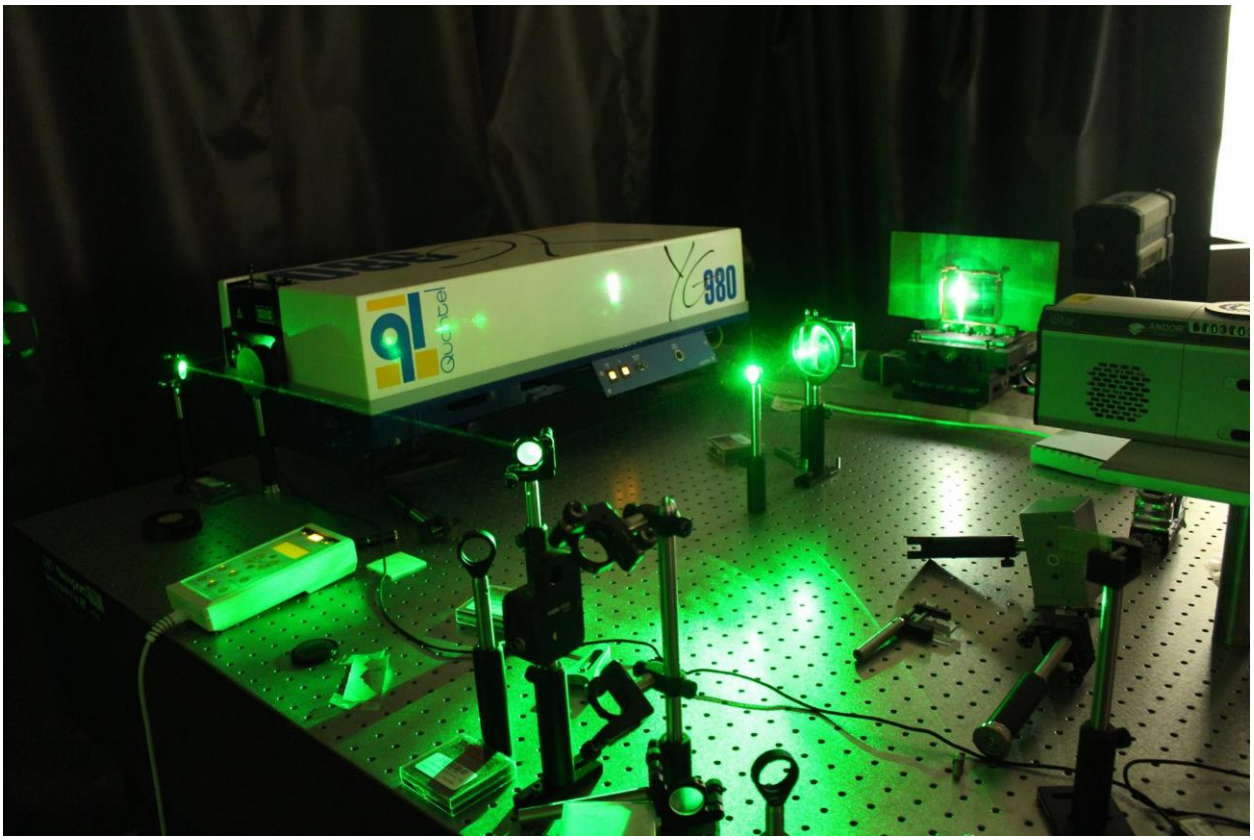

Thermal Non Destructive Testing (TNDT) is one non-destructive testing method that facilitates the detection of subsurface defects in materials and prevents potential failure using a transient (active) or steady-state (passive) procedure. A stable energy source is necessary when implementing a transient process. In this research, a laser beam is used for this purpose. The biggest benefit of using a laser beam is that the energy input is being focused on a relatively small area. This makes the experiment more sensitive to defects and therefore more effective. A FLIR 8000 thermal camera is used to record the temperature distribution on the non-heated side of the sample.

The laser beam applied is used as a source of a moving linear energy input. To simplify the experiment, the testing material is moved through the laser beam with a constant speed instead of actually scanning the laser across the surface of the sample. In order to maximize the sensitivity of the method, a 2-D numerical model made in MATLAB is fitted to the experimental data collected by the thermal camera with non-linear regression. The temperature field generated by the numerical model is then subtracted from the measured temperature field. Anomalies and spikes in the residual temperature field are perceived as locations for potential defects.

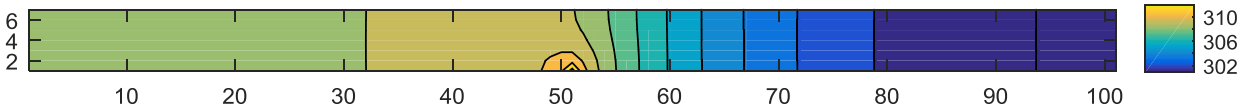

Figure 1: MATLAB model of laser heating half-way across plate.

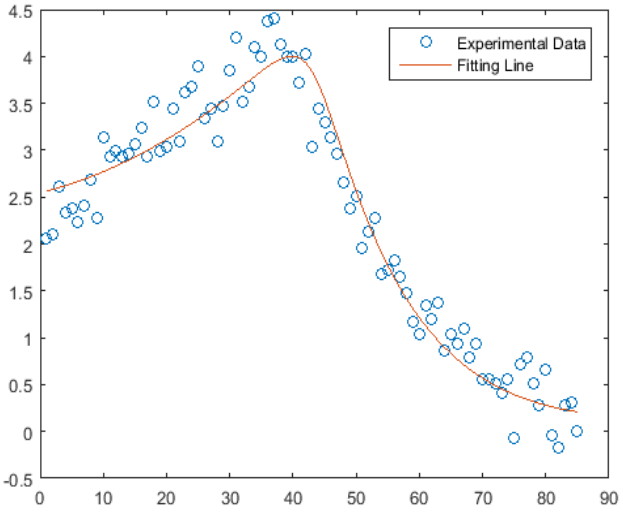

Figure 2: Non-linear regression of experimental data matched with numerical model using MATLAB

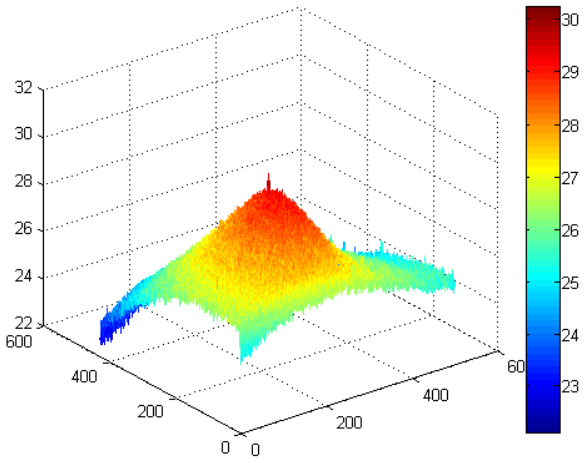

Figure 3: Temperature distribution surface plot.