Automated surface crack detection with inductive thermography

Beata Oswald-Tranta[1]

[1]Institute for Automation, University of Leoben, Austria

Many metal parts and semi-finished products have to be 100% inspected to locate any surface cracks and to avoid delivering defective products. Nowadays, mainly three standardized techniques are used for surface crack detection: magnetic particle, eddy current and penetrant testing. A new alternative method is the active thermography combined with inductive heating. This has several advantages compared to the previous methods: it is fast, it provides well-documented images, it can be fully automated and it also gives the possibility to estimate the depth of a surface crack. In inductive thermography, a short inductive heating pulse (0.1 - 1 s) is applied to the workpiece and the surface temperature distribution is recorded by an infrared camera. Since surface cracks disturb both the eddy current distribution and the heat flow, the infrared images reveal the defects. Instead of evaluating only one single infrared image at the end of the heating pulse, the entire temporal evolution of the temperature distribution is evaluated by Fourier transform to calculate a phase image. Such a phase image is more reliable for detecting cracks and distinguishing them from artifacts and from surface effects, than the temperature images. Furthermore, since the signal strength depends on the crack depth, the phase image can be used to estimate how deep a crack goes into the material. In a fully automated inspection, the phase images are evaluated by image processing routines to decide whether a part is ok or defective. In the case of forgings and castings with more complex geometry, edges could be wrongly misinterpreted as defects. Therefore, a comparison method has been developed: first, reference parts without defects are inspected and the images are stored. In a second step, the measurements of further parts are compared to these reference images. For the inspection, a crack depth limit can be defined, when a product is ok, when it is still acceptable, and when it has to be rejected as defective. For a complete inspection, a part needs to be inspected from several different views. Therefore, a robot is used to position the parts in a reproducible way, and the images are compared with the stored reference images. After all positions have been inspected, the software decides whether the workpiece is ok or not ok, and the robot sorts the parts accordingly.