Automatic X-ray Inspection with Dynamic Reference Data Sets

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Abstract. The automatic radioscopic inspection of security relevant parts usually is made with several projections from different perspectives so that all regions of a part are covered. An alternative is to acquire a CT volume data set. These data sets are being processed to determine defects in material according to quality rules as prescribed by the customer.

Modern handling systems allow exact positioning of the parts. This is the precondition to use reference based information - like image or volume data from good parts - to process the data sets. This method is established in this field and has advantages in comparison to other methods. It allows a set-actual comparison which is not possible with other methods and particularly applies to low contrast defects.

There are also some disadvantages using reference data. The main issue is that parts can vary within the specification during the production process. One example is aluminum die casting. During the lifetime of a mold, abrasions are common. Also sand cleaning of the molds leads to variations. These subtle variations are visible in the X-ray data sets. This results in a more difficult comparison of older reference data sets with current ones. The probability of false rejections is increased.

This disadvantage can be encountered by not using an initial reference data set. The new method described here, dynamically creates reference data during production from the acquired inspection data of several parts. By using the latest inspection data the created reference always represents the current state of the production process as well as the condition of the molds.

Sporadic variations in the data created e.g. by flashes are eliminated by the use of data sets of multiple parts. This allows even to introduce data sets containing defect structures without compromising the reliability of the evaluation process. An optional validation of the inspection data with respect to quality factors is possible to exclude unwanted outliers from the reference data set generation.

This new method creates a reference data set of an idealistic part which is in average more similar to the current parts than any initial reference data set. Variations within the production process can be compensated and lead to an inspection process with a 100% defect detection and a very low false rejection rate.

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AUTOMATIC X-RAY INSPECTION WITH DYNAMIC REFERENCE DATA SETS

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PROBLEM STATEMENT

Using reference data sets for automatic X-ray inspection has several advantages in comparison to other methods. It allows a set-actual comparison which is not possible with other methods and particularly applies to low contrast defects. The main issue using reference data sets is that specimen to be tested can vary within the specification during the production process. One example is aluminum die casting. During the lifetime of a mold, abrasions are common. Also sand cleaning of the molds leads to variations of e. g. the wall thickness. These subtle variations are visible in the X-ray data sets. This results in a more difficult comparison of older reference data sets with current images to be inspected. As a consequence the probability of false rejections is increased.

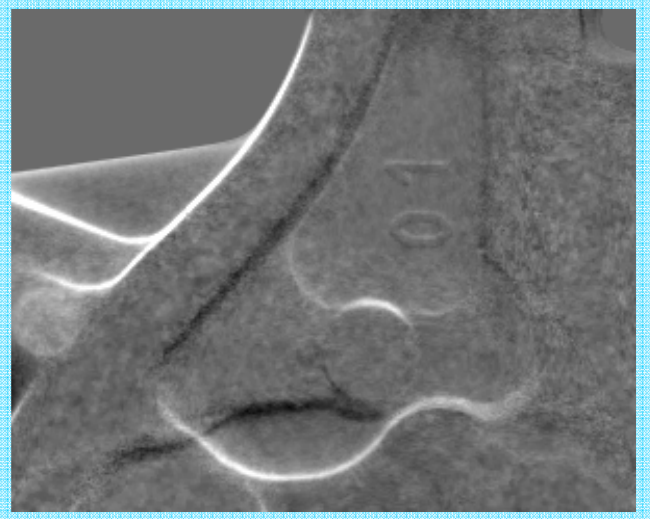
APPROACH

To encounter the above mentioned disadvantage, the static reference data sets have to be replaced by dynamic ones. The new method dynamically creates reference data during production from the acquired inspection data of several parts. By using the latest inspection data, the created reference always represents the current state of the production process which includes the acutal condition of the molds.

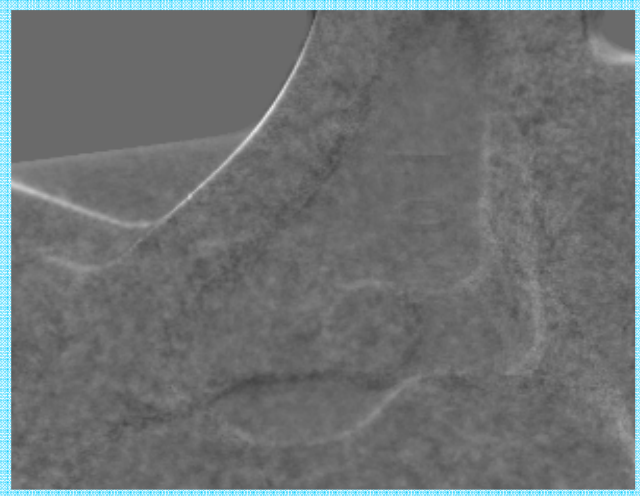
SUMMARY

This new method creates a reference data set of an idealistic part, which is in average more similar to the current parts than any static reference data set. Variations within the production process can be compensated and lead to an inspection process with a 100% defect detection, a very low false rejection rate and increases the already high sensitivity of the reference based inspection method further more.

RESULTS



Differential image without using dynamic reference data sets



Differential image using dynamic reference data sets