1 Introduction

During the past few years radioscopy has established itself in many fields that demand instant evaluation, measurement, completeness check and a high degree of automation, as is the case in serial inspection. It is particularly in the serial inspection of castings, that radioscopy constitutes state-of-the-art when applied in conjunction with systems for image intensification, digital image processing and automatic image evaluation. This paper discusses different applications and new requirements placed on radioscopic image processing.

2 Radioscopy - State of the Art

In general, radioscopic X-ray inspection systems are used in the serial examination of industrial workpieces since they enable a flexible adjustment of the beam direction and of the inspection perspective as well as on-line viewing of the radioscopic image. In the past few years this economic and reliable technique has become of essential significance for different applications. The configuration of such radioscopic systems is schematically represented in Fig.1.

![Schematic set-up of a radioscopic system](image)

**Fig.1: Schematic set-up** of a radioscopic system

The creation of the X-ray image can be divided in two components:

- **X-ray image generation** and subsequently
- **transformation to a visible radioscopic image** with image transfer
The X-ray tube generates an X-ray image of the workpiece via central projection. The geometrical resolution in the radioscopic image is adjusted by the workpiece-detector distance. The relation between the focus-detector distance (FDA) and the focus-workpiece distance (FOA) determines the geometrical magnification of the image. An image converter such as an X-ray image intensifier converts the X-ray image to a visible radioscopic image.

The adjoining image transfer system, consisting of the lens part, the camera and the monitor, simply has the task of making the output image of the X-ray image intensifier visible on a monitor to the inspection personnel. Digitizing makes it possible to transfer the image to an image processing computer. Digital image processing can be used to improve and evaluate the radioscopic image.

3 Automated Unattended Inspection of Castings

Light alloy castings are widely used, especially in automotive manufacturing. Due to imperfections of the casting process, these components are prone to material defects (e.g. shrinkage cavities, inclusions). These parts are frequently used in safety relevant applications, like steering gears, wheels and, more and more wheel suspension components. These parts require a 100% radioscopic inspection. Only a fully automated X-ray inspection system for unattended inspection can guarantee objective and reproducible defect detection (Fig.2). The decision about the specimen is done according to the user’s acceptance specification.

![Fig.2: Defect detection with SABA 2000](image)

The basic requirements placed on automated unattended inspection systems, like high reliability of defect detection combined with a very low false detection rate and an inspection at least as fast as visual inspection have not changed. Nowadays, especially for wheel suspension components, the inspection speed has to be increased significantly, due to the large number of caste parts. An inspection of some hundred thousand parts per month is possible only with automated X-ray inspection.
But in addition to this speed requirement such a system has to be able to detect defects which are very low in contrast and size. These requirements are very often contradictory and demand extreme performance of all parts of an X-ray inspection system.

4 Check of Completeness and Function

Nowadays automated X-ray inspection is also used for a very new field of application: the check of completeness and function. Figure 3 shows an example of an electrical protection switch with spring contacts.

For example, deformation of the springs and the presence of the springs have to be detected. Furthermore distances between the contacts and dimensions have to be examined.

5 Measurement

The measurement of distances and dimensions is a new application in automated X-ray inspection. Figure 4 shows an example of the above mentioned protection switches.