DETECTION OF DEFECTS IN WELDED PIPES USING MACHINE VISION METHODS AND RIDGE FUNCTIONS

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Let $D \subset \mathbb{R}^2$ be a set. A ridge function [1], [2] on D is a function of the form $\varphi(\mathbf{a} \cdot \mathbf{x})$, where $\mathbf{x} = (x_1, x_2) \in D$, $\mathbf{a} = (a_1, a_2) \in \mathbb{R}^2 \setminus \{\mathbf{0}\}$, $\mathbf{a} \cdot \mathbf{x} = \sum_{j=1}^{2} a_j x_j$, and φ is a real-valued function defined on $\Delta(\mathbf{a}) = \{\mathbf{a} \cdot \mathbf{x} : \mathbf{x} \in D\}$. These functions arise in some problems of tomography [3]. In this work, we use ridge functions and their orientation as features to describe the anisotropy of welded joints of pipes in digital images. These features are included in a model of a defect-free weld. Defects in the welded joints are areas of local random violation of the regularity and anisotropy of pipes.

In this study, the images of pipe sections with a welded joint obtained from a static camera, are analyzed based on the method of integral Radon projections and ridge functions. As a model of a defect-free welded joint, a function of two variables that has homogeneity or the anisotropic in the horizontal direction is used. Such functions are known as ridge functions. We obtained a criterion for the presence of welding defects in the image based on the comparison of the image and its reconstruction by the Radon integral projection. Images of various defects in welded joints were used for computational experiments. These studies have shown that the method of integral projections can be used to identify the specific type of defects of welded joints.

The proposed approach can be a possible solution for automatic visual quality control systems of welded joints to solve the problem of detection and recognition of defects in welded joints in the images [4],[5].

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