look Up Table transformation. Second they extract the defect by applying the morphological operations which eliminate small holes, spots and connect the closely regions.

Authors in [3] and [6] proposed a fuzzy $k$-nearest neighbor method based on multilayer perceptron neural network and a fuzzy expert system for the classification of welding defect types. The features used for the classification are distance from centre, circularities, compactness, major axis width and length, elongation, Heywood diameter, the intensity average and its standard deviation.

A typical method for automated recognition of welding defects was presented in [2]. The detection algorithm follows a pattern recognition methodology steps as follows:

Step 1: Segmentation: different regions are found and isolated from the rest of the X-ray image using a watershed algorithm and morphological operations (erosion and dilation).

Step 2: Feature extraction: regions are measured and shape characteristics are quantified such as diameter variation and main direction of inertia based on invariant moments.

Step 3: Classification: the extracted features of each region are analyzed and classified using a $k$-nearest neighbor classifier. According to the literature, the method is robust and achieves good detection rate.

In [5], a welding defect classification method is proposed. In a first step, called image pre-processing, the quality of the image is improved using a median filter and a contrast enhancement technique. After that the evaluation of the characteristic parameters following a relevance criterion in discriminating welding defect classes by using a linear correlation coefficient matrix is

![Figure 1: Type of defects in welded joints: (a) Burn thru, (b) Porosity, (c) Lack of penetration, (d) Internal Undercut, (e) Lack of Fusion, (f) External Undercut](image-url)