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Unsupervised weld defect classification in radiographic images using multivariate generalized Gaussian mixture model with exact computation of mean and shape parameters

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Abstract: In industry, the welding inspection is considered as a mandatory stage in the process of quality assurance/quality control. This inspection should satisfy the requirements of the standards and codes governing the manufacturing process in order to prevent unfair harm to the industrial plant in construction. For this purpose, in this paper, a software specially conceived for computer-aided diagnosis in weld radiographic testing is presented, where a succession of operations of preprocessing, image segmentation, feature extraction and finally defects classification is carried out on radiographic images. The last operation which is the main contribution in this paper consists in an unsupervised classifier based on a finite mixture model using the multivariate generalized Gaussian distribution (MGGD). This classifier is newly applied on a dataset of weld defect radiographic images. The parameters of the nonzero-mean MGGD-based mixture model are estimated using the Expectation-Maximization algorithm where, exact computations of mean and shape parameters are originally provided. The weld defect database represent four weld defect types (crack, lack of penetration, porosity and solid inclusion) which are indexed by a shape geometric descriptor composed of geometric measures. An outstanding performance of the proposed mixture model, compared to the one using the multivariate Gaussian distribution, is shown, where the classification rate is improved by 3.2% for the whole database, to reach more than 96%. The efficiency of the proposed classifier is mainly due to the flexible fitting of the input data, thanks to the MGGD shape parameter.

Keywords : Mixture model, Multivariate GGD, radiography, weld defect, classification