Real-time monitoring of root gap change based on electrical signals of FCAW using machine learning

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This study proposes a real-time monitoring technique based on machine learning for detecting changes in the root gap of butt joints during the flux-cored arc welding (FCAW) process using electrical signals. During the FCAW process, an excessive amount of weld fume is generated, which makes it difficult to use a vision sensor for monitoring the welding process. Therefore, instead of using the vision sensor, current and voltage signals were measured to monitor the gap changes during the FCAW process. The FCAW welding experiments were conducted with increasing and decreasing root gaps to simulate the real field conditions with the varying root gaps on a lab scale. The current and voltage signals measured from the welding machine are used as input data for training the random convolution kernel transform (ROCKET) algorithm, which can effectively minimize the time delay in real-time monitoring due to the low computational complexity. In comparing the univariate model using current and voltage signals respectively and the multivariate model using both signals, the multivariate model classified the gap during the FCAW process with the highest accuracy at 96.2%. Moreover, the classification errors were investigated by correlating the geometry of the root bead and electrical signals measured during the welding process.