Supervised deep learning for monitoring and online feedback control of FCAW process

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Flux Cored Arc Wedling (FCAW) is widely used in shipbuilding because of its fast welding speed. The formation of uniform back beads in the thick plate butt welding process is an important factor in determining the mechanical properties and product quality. However, there are non-uniform gaps caused by molding errors during machining of the base metal or thermal deformation due to high heat input during welding. Conventional back plate first layer welding is conducted by manual welding, which has limitations on productivity improvement because it depends on the skill of the operator. In order to compensate for this, there is a method of monitoring the changing gap using equipment such as a vision camera and a laser sensor, but there are many difficulties in field application due to disadvantages such as variables of various working environments and additional cost. Therefore, the study uses artificial intelligence techniques without additional equipment to monitor the changing gap during the welding process and propose a process automation system in which welding conditions are actively controlled. The proposed system is not required to use additional equipment such as vision cameras and laser sensors, so it can be applied more easily to industrial sites. The feature importance was analyzed by using Randomforest technique in the patterns of current and voltage signals, and the learning was conducted through DNN-based Keras model. The learning accuracy of the proposed DNN algorithm is 83.3%, and the welding experiment through the actual online feedback control using the proposed modularization system is confirmed to be 68.45% accuracy. After comparing the weld results without controlling the welding conditions and real-time control using the proposed modular system to verify the uniform formation of back bead.