Performance analysis of an automatic green pellet nuclear fuel quality classification using modified radial basis function neural networks

Benyamin Kusumoputro, author

Abstrak

Cylindrical uranium dioxide pellets, which are the main components for nuclear fuel elements in light water reactors, should have a high density profile, a uniform shape, and a minimum standard quality for their safe use as a reactor fuel component. The quality of green pellets is conventionally monitored by laboratory measurement of the physical pellet characteristics; however, this conventional classification method shows some drawbacks, such as difficult usage, low accuracy, and high time consumption. In addition, the method does not address the non-linearity and complexity of the relationship between pellet quality variables and pellet quality. This paper presents the development and application of a modified Radial Basis Function neural network (RBF NN) as an automatic classification system for green pellet quality. The weight initialization of the neural networks in this modified RBF NN is calculated through an orthogonal least squared method, and in conjunction with the use of a sigmoid activation function on its output neurons. Experimental data confirm that the developed modified RBF NN shows higher recognition capability when compared with that of the conventional RBF NNs. Further experimental results show that optimizing the quality classification problem space through eigen decomposition method provides a higher recognition rate with up to 98% accuracy.