AbstractID: 8251 Title: Uncertainty of Artificial Neural Network Output

We are developing computer-aided diagnosis (CAD) methods that often require a statistical classifier and often use artificial neural networks (ANNs) for that purpose. Conventionally, one trains an ANN based on a set of training cases and effectively assumes that the ANN output has zero uncertainty when applied to test cases. The purpose of this work was to investigate the magnitude of the uncertainty in ANN outputs. To measure this uncertainty, we trained multiple ANNs based on a single set of training cases and then calculated the standard deviation in the ANNs outputs on each test case. Simulated training and test data were used and were drawn from multivariate normal distributions. Each of the multiple ANNs was trained using a different random seed value that regulates the ANN training, and each of the ANNs was optimized individually. The standard deviation in the A_z values of these multiple ANNs was less than 0.001. However, the average standard deviation in the outputs of these multiple ANNs was about two orders of magnitude higher. The standard deviation in ANN outputs was inversely related to the number of training cases. It varied at least one order of magnitude, being largest for output values between 0.4 and 0.6 and smallest for output values near 0 or 1. This variation cannot be explained by the fact that the outputs are bounded by 0 and 1. These preliminary results indicate that the uncertainty in ANN output needs to be considered in designing CAD techniques.