Tool Wear Prediction in the Machining of Carbon Fiber Reinforced Polymers (CFRPs)

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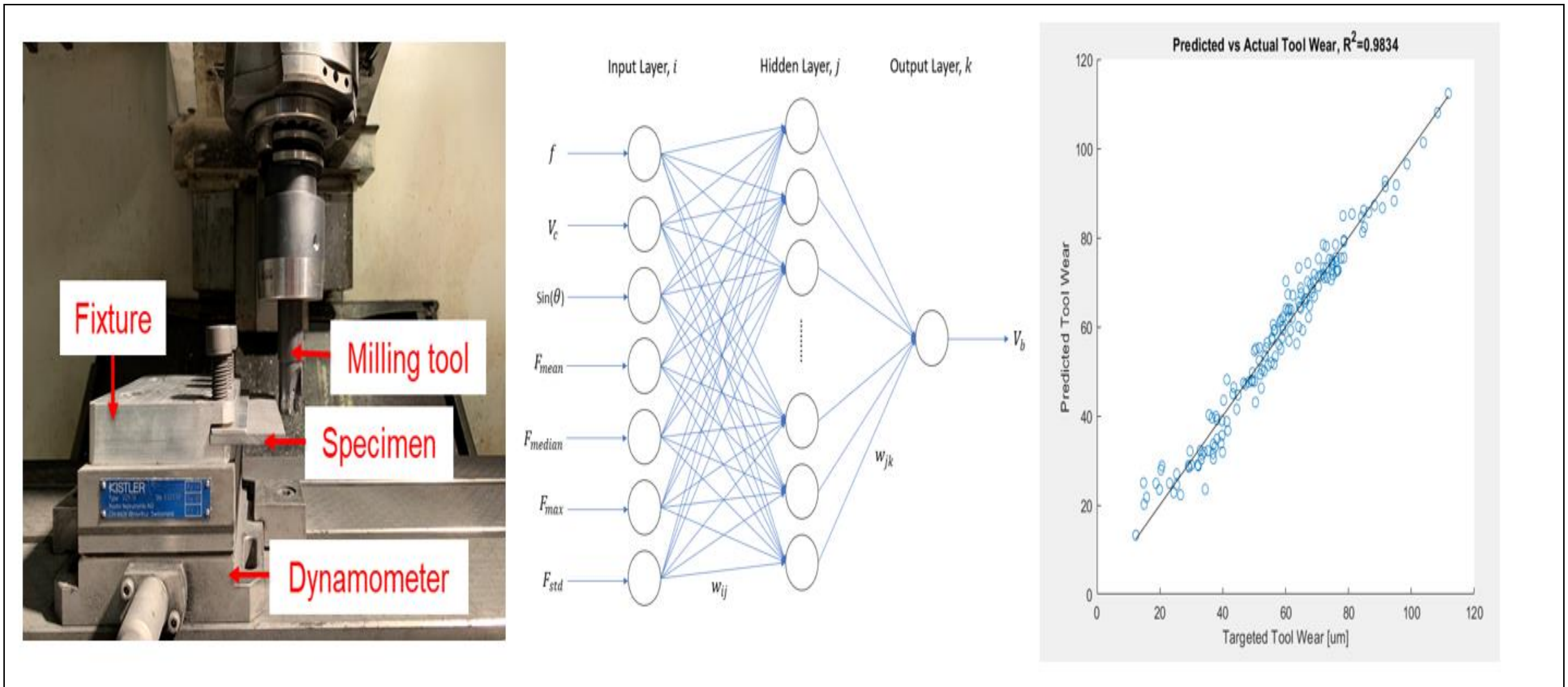

Figure 1 (a) Setup of milling experiment (b) Network architecture (c) Result: Predicted vs Actual Tool Wear

The objective of the project is to develop a predictive model that accurately predicts the tool wear value in the milling operation of CFRPs. Even though CFRPs offer superior physical properties, the abrasive nature of carbon fiber and the low thermal conductivity of the matrix causes rapid tool wear during the cutting operation. Tool wear progression during cutting operation must be monitored as it affects the surface finish quality and reduces manufacturing productivity. This model will be implemented on-line to replace the conventional method that relies on visual inspection of cutting tools. The predictive model is an artificial neural network that takes cutting forces, fiber cutting angles, feed rate, and cutting speed as inputs. The model is trained using experimental data collected through dry milling experiments. The performance of three different learning algorithms (backpropagation, Levenberg-Marquardt, Levenberg-Marquardt using Bayesian Regularization). The model trained using the Levenberg-Marquardt using Bayesian Regularization algorithm predicts the tool wear most accurately with R^2 of 0.9814.