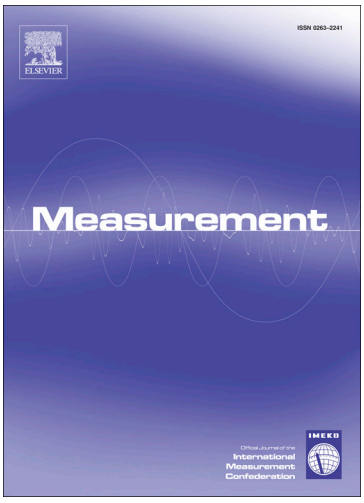

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Compensation of friction and force ripples in the estimation of cutting forces by neural networks

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Abstract

Estimated cutting forces are usually mixed up with disturbing forces such as friction and need to be compensated. In common compensation methods, such forces are firstly recorded along machining contours under air-cutting conditions. Then, recorded disturbing forces are recalled for the compensation during the main machining process. This method doubles the process time and needs a precise synchronization. This problem is addressed in this paper. A novel method based on neural networks is introduced to compensate of friction and force ripples during cutting force estimations when signals of permanent magnet linear motors (PMLMs) are used. To this end, a Kalman filter observer was designed and experimentally verified for measuring of friction and force ripples. It was then used to provide target series required for training a neural network. Time series of the translator position along some sinusoidal trajectories were selected as training inputs. Taguchi experimental design method was used to determine the structure of the network (number of layers, nodes, and delays). It can be seen that increasing the complexity of the network does not necessarily lead to a more precise network, and a neural network with a hidden layer,16 nodes in the hidden layer and two time-delays can well model such forces. Experiments showed that the results of both methods are very similar and therefore, the proposed method can be used as well as the recording meth

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