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Artificial Neural Network in Ultra-High Precision Grinding of Borosilicate-Crown Glass

Authors : Goodness Onwuka, Khaled Abou-El-Hossein

Abstract : Borosilicate-crown (BK7) glass has found broad application in the optic and automotive industries and the growing demands for nanometric surface finishes is becoming a necessity in such applications. Thus, it has become paramount to optimize the parameters influencing the surface roughness of this precision lens. The research was carried out on a 4-axes Nanoform 250 precision lathe machine with an ultra-high precision grinding spindle. The experiment varied the machining parameters of feed rate, wheel speed and depth of cut at three levels for different combinations using Box Behnken design of experiment and the resulting surface roughness values were measured using a Taylor Hobson Dimension XL optical profiler. Acoustic emission monitoring technique was applied at a high sampling rate to monitor the machining process while further signal processing and feature extraction methods were implemented to generate the input to a neural network algorithm. This paper highlights the training and development of a back propagation neural network prediction algorithm through careful selection of parameters and the result show a better classification accuracy when compared to a previously developed response surface model with very similar machining parameters. Hence artificial neural network algorithms provide better surface roughness prediction accuracy in the ultra-high precision grinding of BK7 glass.

Keywords : acoustic emission technique, artificial neural network, surface roughness, ultra-high precision grinding
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