Genetic Based Experimental Investigation on Finishing Characteristics of $AlSiC_p$-MMC by Abrasive Flow Machining

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Abstract

Implementing non-conventional finishing methods in the aircraft industry by the abrasive flow machining (AFM) process depends on the production quality at optimal conditions. The optimal set of the process variables in metal-matrix-composite (MMC) for a varying reinforcement percentage removes the obstructions and errors in the AFM process. In order to achieve this objective, the resultant output functions of the overall process using every clustering level of variables in a model are configured by using genetic programming (GP). These functions forecast the data to vary the percent of silicon carbide particles (SiCp) particles without experimentation obtaining the output functions for material removing rates and surface roughness changes of Al-MMCs machined with the AFM process by using GP. The obtained genetic optimal global models are simulated and, the results show a higher degree of accuracy up to 99.97% as compared to the other modeling techniques.

Keywords: abrasive flow machining, mmc, polishing, genetic models, forecasting

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Appendix A (Coefficients of equation of Material Removal Rate, MRR)

$$A = \left\{ 0.14 - \frac{0.00154}{V_4} + \frac{0.14}{V_3} + 0.00208\left(\frac{V_4}{V_3}\right)^2 \right\} \tag{A1}$$

$$B = \left\{ \frac{0.0011V_4^2}{V_3} - 0.14 + \frac{0.00154}{V_4} - \frac{0.14}{V_3} + \frac{0.00208V_4^2}{V_3} \right\} \tag{A2}$$

$$C = 2A + \frac{16384V_0}{A^3}\left(\frac{B}{V_5}\right)^8 \tag{A3}$$

$$D = A + \frac{4096}{A^3}\left(\frac{B}{V_5}\right)^8 - \frac{16\left\{ \frac{8(C^2+1.25)}{V_5} + A + \frac{4096}{A^3}\left(\frac{B}{V_5}\right)^8 \right\}}{\frac{4096V_0B^8}{A^3(V_5)^4}} \tag{A4}$$

Appendix B (Coefficients of equation of Surface Roughness, ∆Ra)

$$A = \left(\frac{0.26}{V_5} - 1.91\right)^2 \tag{A5}$$

$$B = \left\{ \left(\frac{0.033A+V3}{V1} + 1.643\right) - A \right\}^2 - V0 \tag{A6}$$

$$C = \frac{1}{\left\{ A + (B+0.67)V_0 \right\}^2} - A \tag{A7}$$

$$D = \frac{\left[\frac{\{A+1.06\}^2 + V_1}{CV_0} + C \right]}{V_4} \tag{A8}$$

$$E = \frac{\left[2V_4 - \frac{(C+D^2)}{V_0} - 10.23 \right]}{\frac{(C+D^2)}{V_0} + 12.93} \tag{A9}$$

$$F = \frac{-3.82E}{\frac{\left(C+D^2\right)}{V_0} + 12.93} \tag{A10}$$

$$G=\frac{\left(C+D^{2}\right)}{V_{0}}+12.93-\frac{3.82E}{\frac{\left(C+D^{2}\right)}{V_{0}}+12.93} \tag{A11}$$

$$H=\frac{\frac{G}{(F+V_{0})}+\frac{4}{(F+V_{0})G^{3}V_{1}}-V_{2}}{\frac{4}{(F+V0)G^{3}V_{1}}-V_{2}} \tag{A12}$$

$$I=4\left[V_{0}{}^{2}+\frac{(\frac{3.34+1.928H}{V_{5}})^{2}}{V_{2}}\right]-V_{2}-1.78 \tag{A13}$$

$$J=\left\{2.928H+3.34+1.38I-(\frac{1.38IV}{V_{5}}+V_{0})^{2}\right\}*\left(\frac{(\frac{1.38IV}{V_{5}}+V_{0})^{4}}{V_{2}}-0.22\right) \tag{A14}$$

$$K=2V_{0}V_{1}\frac{\left(\frac{(\frac{1.38V_{0}}{V_{5}}+V_{0})^{4}}{V_{2}}-0.22\right)^{2}}{V_{1}}-V_{2} \tag{A15}$$