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Modelling surface roughness in finish turning as a function of cutting tool geometry using the response surface method, Gaussian process regression and decision tree regression

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ABSTRACT

In this study, the modelling of arithmetical mean roughness after turning of C45 steel was performed. Four parameters of cutting tool geometry were varied, i.e.: corner radius *r*, approach angle *κ*, rake angle *γ* and inclination angle *λ*. After turning, the arithmetical mean roughness *Ra* was measured. The obtained values of *Ra* ranged from 0.13 μm to 4.39 μm. The results of the experiments showed that surface roughness improves with increasing corner radius, increasing approach angle, increasing rake angle, and decreasing inclination angle. Based on the experimental results, models were developed to predict the distribution of the arithmetical mean roughness using the response surface method (RSM), Gaussian process regression with two kernel functions, the sequential exponential function (GPR-SE) and Mattern (GPR-Mat), and decision tree regression (DTR). The maximum percentage errors of the developed models were 3.898 %, 1.192 %, 1.364 %, and 0.960 % for DTR, GPR-SE, GPR-Mat, and RSM, respectively. In the worst case, the maximum absolute errors were 0.106 μm, 0.017 μm, 0.019 μm, and 0.011 μm for DTR, GPR-SE, GPR-Mat, and RSM, respectively. The results and the obtained errors show that the developed models can be successfully used for surface roughness prediction.

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