

Contents

Preface — V

About the editor — VI

List of contributing authors — XI

Viktor P. Astakhov and Xinran Xiao

1 The Principle of Minimum Strain Energy to Fracture of the Work Material and Its Application in Modern Cutting Technologies — 1

- 1.1 Introduction — 1
- 1.2 General structure of the proposed approach — 4
 - 1.2.1 Block 1: Definition of the metal cutting process — 4
 - 1.2.2 Block 2: Energy partition in the cutting system — 6
 - 1.2.3 Block 3: Principle of minimum strain energy to fracture of the work material — 10
- 1.3 Realization — 12
 - 1.3.1 Assessment of the range of variation — 12
 - 1.3.2 Measurability — 18
- 1.4 PMSEF and tool geometry — 21
 - 1.4.1 General — 21
 - 1.4.2 Rake angle and PMSEF — 22
- 1.5 PMSEF and machinability — 32
 - References — 34

Wit Grzesik

2 Energy Consumption Optimization in Machining Processes — 36

- 2.1 Introduction — 36
- 2.2 Reduction of energy consumption by machine tools — 37
- 2.3 Modeling and optimization of energy-conscious machining processes — 42
- 2.4 Determination of machining conditions based on minimum energy consumption — 48
- 2.5 Investigation and modeling of machining processes using eco-efficiency criterion — 52
- 2.6 Summary — 56
 - References — 58

Witold F. Habrat, Piotr Laskowski and Angelos P. Markopoulos

3 Machining with High-Pressure Cooling — 60

- 3.1 Introduction — 60
- 3.2 Characteristics of high-pressure cooling — 62
- 3.3 High-pressure coolant supply system and types of tooling systems — 65

- 3.4 The benefits of the application of HPC — 68
- 3.5 Modeling of machining with HPC — 71
- 3.6 Conclusion — 73
- References — 74

F. Hakami, A. Pramanik and A. Basak

- 4 Effect of Machining on the Fatigue Life of Steels — 76**
- 4.1 Introduction — 76
- 4.2 Effect of machining processes on fatigue life — 79
- 4.3 Effect of machining conditions — 84
- 4.4 Conclusion — 91
- References — 92

N.M. Vaxevanidis, N.A. Fountas, J.D. Kechagias and D.E. Manolakos

- 5 FEM Analysis and ANN Modeling for Optimizing Machinability Indicators during Dry Longitudinal Turning of Ti-6Al-4V ELI Alloy — 95**
- 5.1 Introduction — 95
- 5.2 Materials and methods for robust experimental parameter design — 97
- 5.2.1 Test material and general properties — 97
- 5.2.2 Machine tool, cutting insert type, and measuring equipment — 97
- 5.2.3 Experimental design — 99
- 5.2.4 Machining results and observations — 101
- 5.3 Statistical analysis and interpretation — 105
- 5.3.1 ANOVA for main effects, interactions, and power fitting models — 105
- 5.4 Nonlinear regression and FEM for F_z — 108
- 5.4.1 Nonlinear regression model for F_z — 108
- 5.4.2 Three-dimensional Lagrangian turning FEM model for F_z — 109
- 5.5 Nonlinear regression and ANN models for R_a — 112
- 5.5.1 Nonlinear regression model for R_a — 112
- 5.5.2 ANN model for R_a — 113
- 5.5.3 ANN topology — 114
- 5.5.4 ANN correlation — 114
- 5.6 Conclusions — 117
- References — 117

R. Kalidasan, S. Senthilvelan and U.S. Dixit

- 6 Double-Tool Turning — 119**
- 6.1 Introduction — 119
- 6.2 Cutting forces and temperature in double-tool turning — 121

- 6.2.1 Experimental results — **122**
- 6.2.2 Theoretical explanation of the experimental results — **124**
- 6.3 Surface roughness and dimensional deviation in double-tool turning — **130**
- 6.3.1 Observations on surface roughness in double-tool turning — **130**
- 6.3.2 Study of dimensional deviation in double-tool turning — **132**
- 6.4 Cutting tool wear in double-tool turning — **136**
- 6.5 Optimization of the double-tool turning process — **139**
- 6.6 Directions for future research — **139**
- 6.7 Conclusion — **139**
- References — **140**

J.D. Marafona, J. Fonseca, I.M.F. Bragança, L.L. Alves and P.A.R. Rosa

7 Effect of Electrical Resistivity on the Electrical Discharge Machining Process — 143

- 7.1 Introduction — **143**
- 7.2 Theoretical modeling — **146**
- 7.2.1 Governing equation — **147**
- 7.2.2 Constitutive behavior — **148**
- 7.2.3 Thermal energy balance — **148**
- 7.2.4 Surface conditions — **148**
- 7.2.5 Characteristics of plasma channel — **149**
- 7.3 Single discharge testing methods and equipment — **151**
- 7.3.1 Design and fabrication of the testing machine — **151**
- 7.3.2 Topographical survey of the eroded craters — **153**
- 7.4 Plasma resistivity — **155**
- 7.4.1 Discharge channel — **155**
- 7.4.2 Electrical resistivity — **157**
- 7.4.3 Materials and experimental procedures — **158**
- 7.5 Results and discussion — **159**
- 7.5.1 Plasma characteristics of the spark discharge — **160**
- 7.5.2 Morphology of the eroded craters — **164**
- 7.6 Conclusions — **167**
- References — **168**

Index — 171

