Identification and Control of Grinding Processes for Intermetallic Compounds

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Introduction

Intoduction

High performance systems

Advanced Materials

Advanced Processing

Intermetallic Compounds

Ti-Al Ni-Al

Previous Work: Modeling

Advanced Control

Grinding Process

Current work: Validation, Control

Future work: Extending the model/result
Background and Problem Statement

Fundamental parameter to characterize *surface texture*: - Undeformed chip length

Taken from Nelson 1997

- Undeformed chip length
Fundamental parameter to characterize surface integrity:
- Depth of plastic deformation
Background and Problem Statement

\[ h = a F_n^{1/2} \]

\[ a = \sqrt{\frac{\beta^2}{\pi \delta H_v}} \]

\( \beta \): Geometry Constant (exp.)

\( \delta \): Indenter Geometry (diamond Vickers pyramid indenters)

\( H_v \): Vickers Hardness of material:

\( h \): Depth of plastic deformation

\( F_n \): Normal Force

Problem Statement:

- Validation
- Control
- Other parameters
Approach and Methodology

- Development of an experimental platform:
  - Different grinding conditions (CNC grinder)
  - Real-time implementation of different control algorithm (major modification)

- Real-time gap elimination
  - New approach: High pass filtering/signal processing

- Real-time force control
  - New approach: Unfalsification and learning control

- Experiment design
  - Bonded interface method
Approach and Methodology

Section

Polish Sides

Glue & Clamp

Grind

Separate

White Light Interferometery

Type/Depth of Damage

polished tops

two-piece sample

polished sides

as-cast surface subjected to grinding

ground surface

damage depth

polished

unglue sample & investigate by OM & SEM

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Experiments

INDEPENDENCE: 95.4% confidence interval in grinding Ti-Al using Diamond abrasives

μ = 57 ± 2 J/mm³
η = 0.73 ± 0.03

δ = 36.4650 x Fª.5
δ = 48.2691 x Fª.4209
Summary

- Development of experimental platform
- Introducing a new method for gap elimination
- Introducing unfalsification and learning control
- Indentation model validation
- Damage control
- Comparison of CBN, Diamond, and $\text{Al}_2\text{O}_3$
- Evaluating bonded interface method
- Database generation
- Motivation for future research
- ....
DISCUSSION