Experimental Modeling of the Sanding Process -
The Relationship Between Input and Output Parameters

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Project Sponsors

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Introduction

- Abrasive finishing processes (sanding)
  - Production time
  - Cost
- Impact perceived and actual quality of product
- Relationships between key input and responses have not been properly established
- Automation of process has been limited by lack of published information
Objectives

- Identify key **inputs** and **outputs**
- Model of process
- Optimization
- Automation
Modeling Scheme

SANDING PROCESS

- Abrasive
- Pressure
- Species
- Grit Size
- Orientation
- MRR
- Surface Roughness
Assessment of Surface Quality

- Monitoring the Machining Process
- Monitoring Product Quality
- Machining Research

Objectives:
- Measure and define surface topography
- Quantify surface defects
- Identify specific machining problems
- Provide on-line surface quality monitoring
Experimental Setup and Methods

- Statistical Design of Experiments
  - Split Plot Fractional Factorial
  - Full Factorial design
  - Response Surface
- Stroke Sander
- CNC Router
Material Removal Rate - MRR

Material Removal Rate

MATERIAL REMOVAL RATE

P-100

P-150

P-220

Pressure (psi)

MRR (cubic inch/min)

Z-Axis

Y-Axis

X-Axis

CHERRY

MAPLE

OAK

PINE

0.450

0.550

0.650

0.750

0.0

10.0

15.0

20.0

5.0

10.0

15.0
EFFECT OF GRAIN ORIENTATION IN MATERIAL REMOVAL RATE
Surface Roughness

SURFACE ROUGHNESS

P-100
P-150
P-220

Rq (microinches)

Pressure (psi)

CHERRY
MAPLE
OAK
PINE
Surface Roughness

SILICON CARBIDE Vs ALUMINUM OXIDE

Rq (microinches)

GRIT SIZE

Pressure (psi)

Al2 O3

SiC
Future of Sanding

- Micro-Replicated Abrasives
- Custom Sanding Tooling Designs
  - Minerals or combinations
  - Size and shape
  - Patterns / Directional
- Control
  - Predictable performance
  - Wear
  - Monitoring
Conclusions

- Input - Output Relationships
- Surface Quality - Surface Roughness
- Process Economics
- Model for Optimization, Visualization and Robustness
- Comments and Discussion