Recent Developments in Ultrasonic Machining

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Outline

- Range of US machining
- Prior work: ‘60s and ’70s
- Current work
- Recent developments at EWI
- Future work to be done
- Summary
- Questions
Machining Processes
Range of US Machining Processes

Prior Work on US Machining

- Work at Aeroprojects on US twist drilling and US turning – 1970s
- Machine tools (drill press, lathe, mill) fitted with ultrasonic transducers
- Benefits noted: lower forces, faster feeds, longer burrs, less chatter, deeper drill depths, better tool life, less lubricant
Work at Cincinnati Milacron – 1960s
Work at Grumman – 1970s

[Images of machinery and tools]
Ohio State – 1970s

Macrosonics in industry
5. Ultrasonic machining

K. F. GRAFF

Ultrasonics, May 1975

EWI
THE MATERIALS JOINING EXPERTS
Work at Loughborough ~ 2006
Work on Twist Drilling
EWI concept for US TD System

- Basic concept …
- US unit …

4.5kW US Transducer

US TD Unit
US Drilling – Allowing for Support, Rotation, Force, and Electrical Connections

US Stack

US Transducer

Booster

Drill Head

Drive Belt
Stationary US Drilling Test Bed

- Permits development of US components and tooling for drilling, milling, turning
Current Work at EWI

Test bed (configured for drilling in this photo)

Comprehensive literature search

Drill designs
Current Status

Drill head design: Mounts on standard “knee” mill

Motor mount
Linear actuator
US stack
Current Status

Dukane 20kHz, 5kW power supply
Laptop for control of drives, US, and data collection
Drill head
Knee mill
Drilling with Vertical Mill

- ½” drill bit into ¾” steel plate
  - without sonics: 45s
  - with sonics: 15s
  - Power draw up to 2kW

- 1/8” drill bit into ¼” steel plate
  - without sonics: 15s
  - with sonics: 1.2s
  - Power draw up to 600W

- ¾” drill in development

- Video to follow…

½” holes in steel plate
Drilling with Vertical Mill

- Video of ultrasonic twist drilling with ½- and ⅛-in. bits
Next Steps

- Investment of resources to evaluate and enhance the technology (process/product) originally developed by EWI
- Continuing applications development
  - With input from industry
- Considering future portable systems
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Questions

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