Characterization and Control of Subsurface Damage in Grinding Titanium Aluminide (γ)

Precision Machining Research Consortium

Industrial Advisory Board

Georgia Institute of Technology

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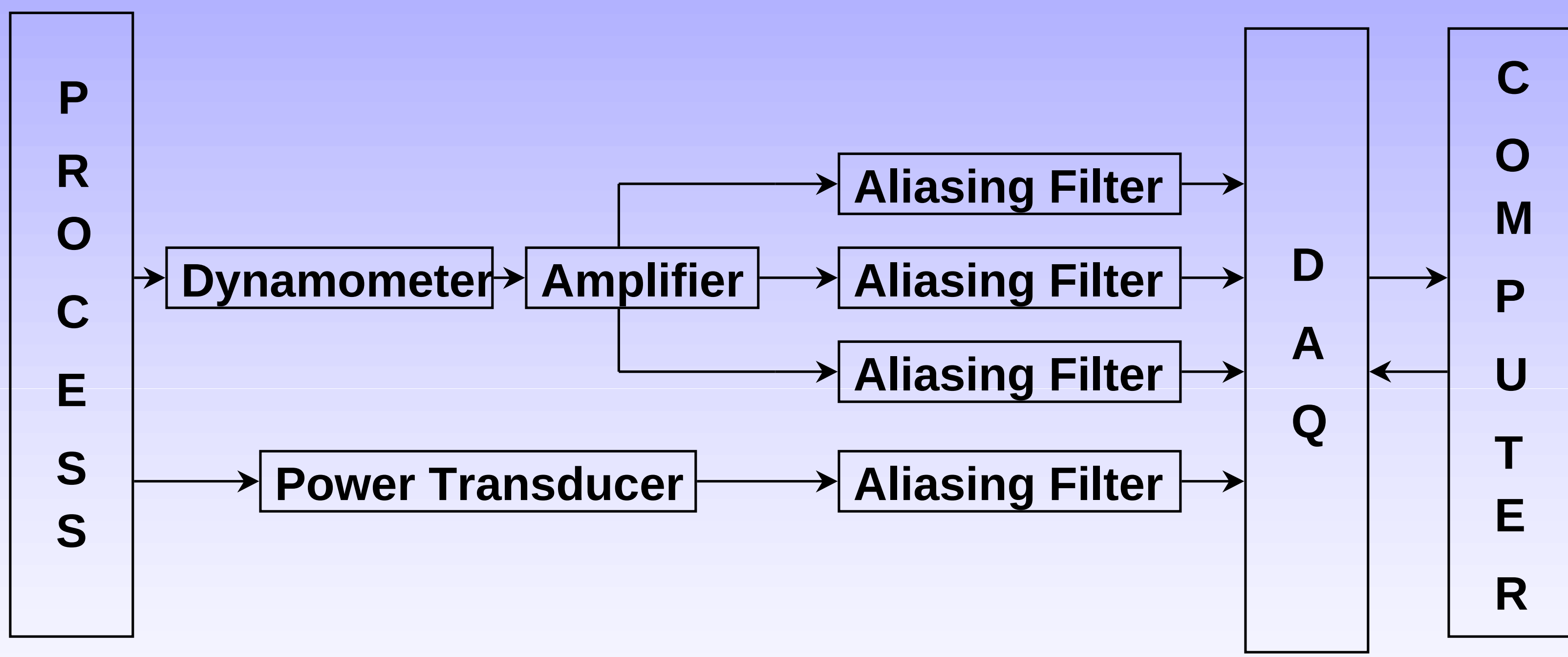
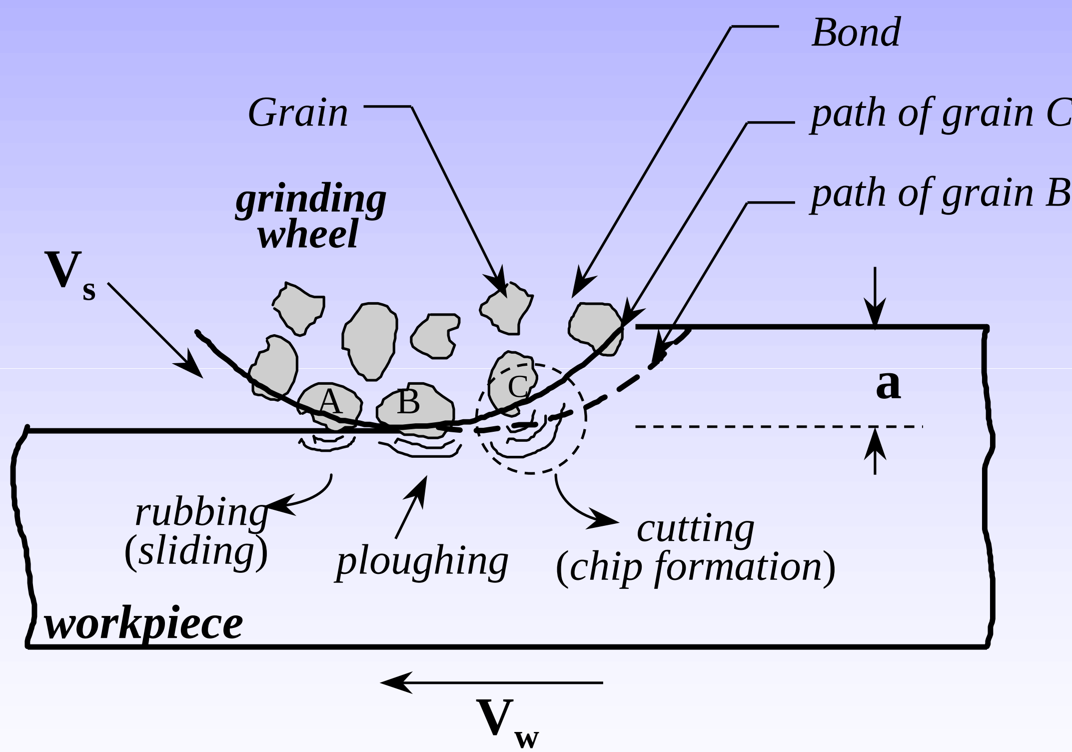
Methodology

- Choose a broad range of grinding conditions
- Monitor force and power consumption in real time
- Quantify the generated palstic deformation
- Correlate the depth of damage with process inputs
- Correlate the process inputs with machine inputs
- Validate the model
- Implement the controller to minimize damage

Experimental Setup

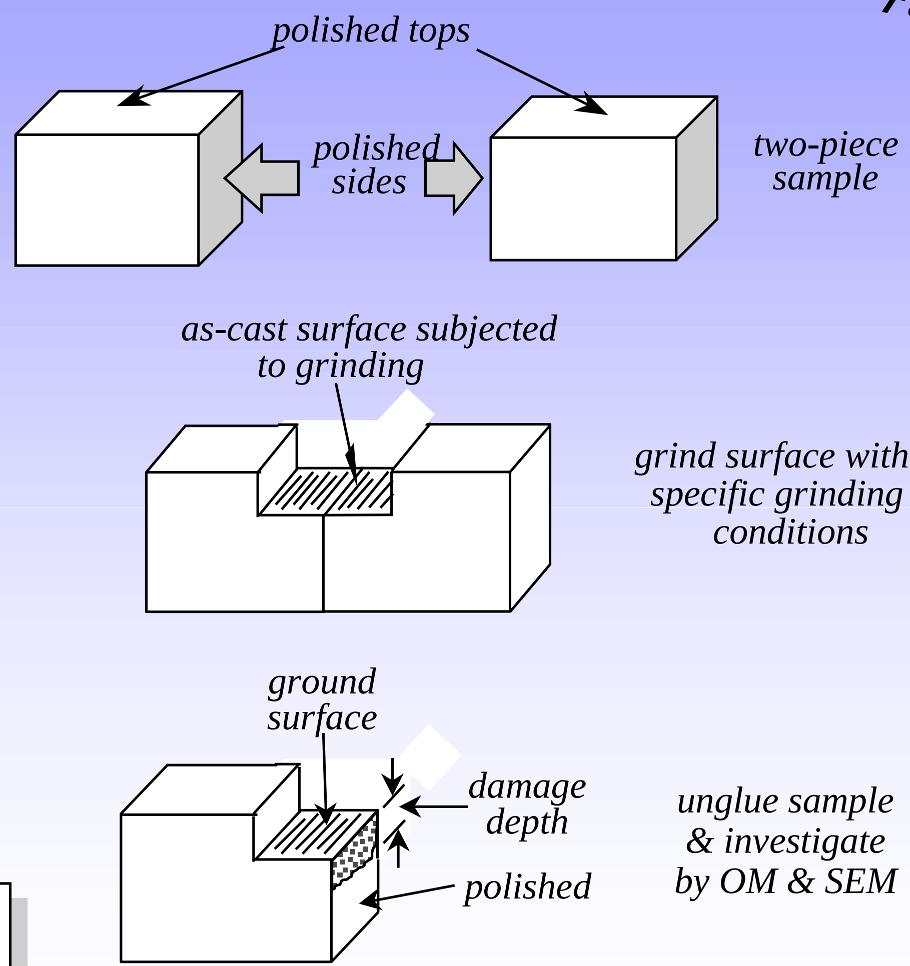


Grinding Process

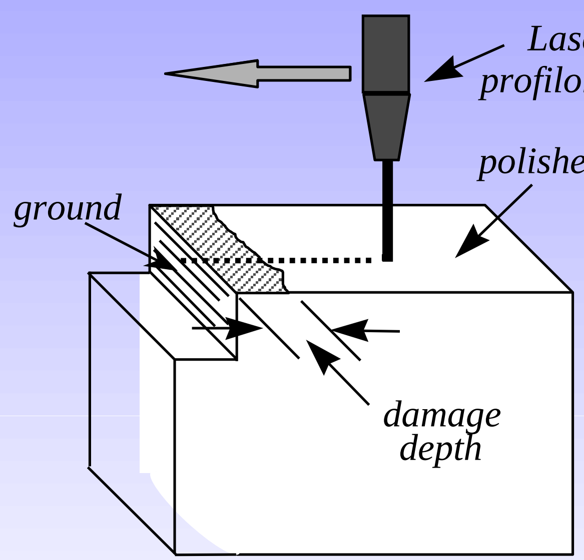


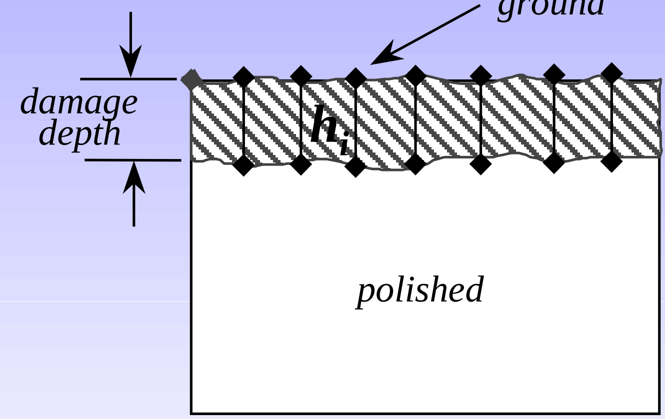
Generation of Subsurface Damage:

Section → Polish Sides → Glue & Clamp → Grind → Separate → Microscopy and Laser → Type/Depth of Damage



Estimation of Average Depth of Damage: (by Profilometer)





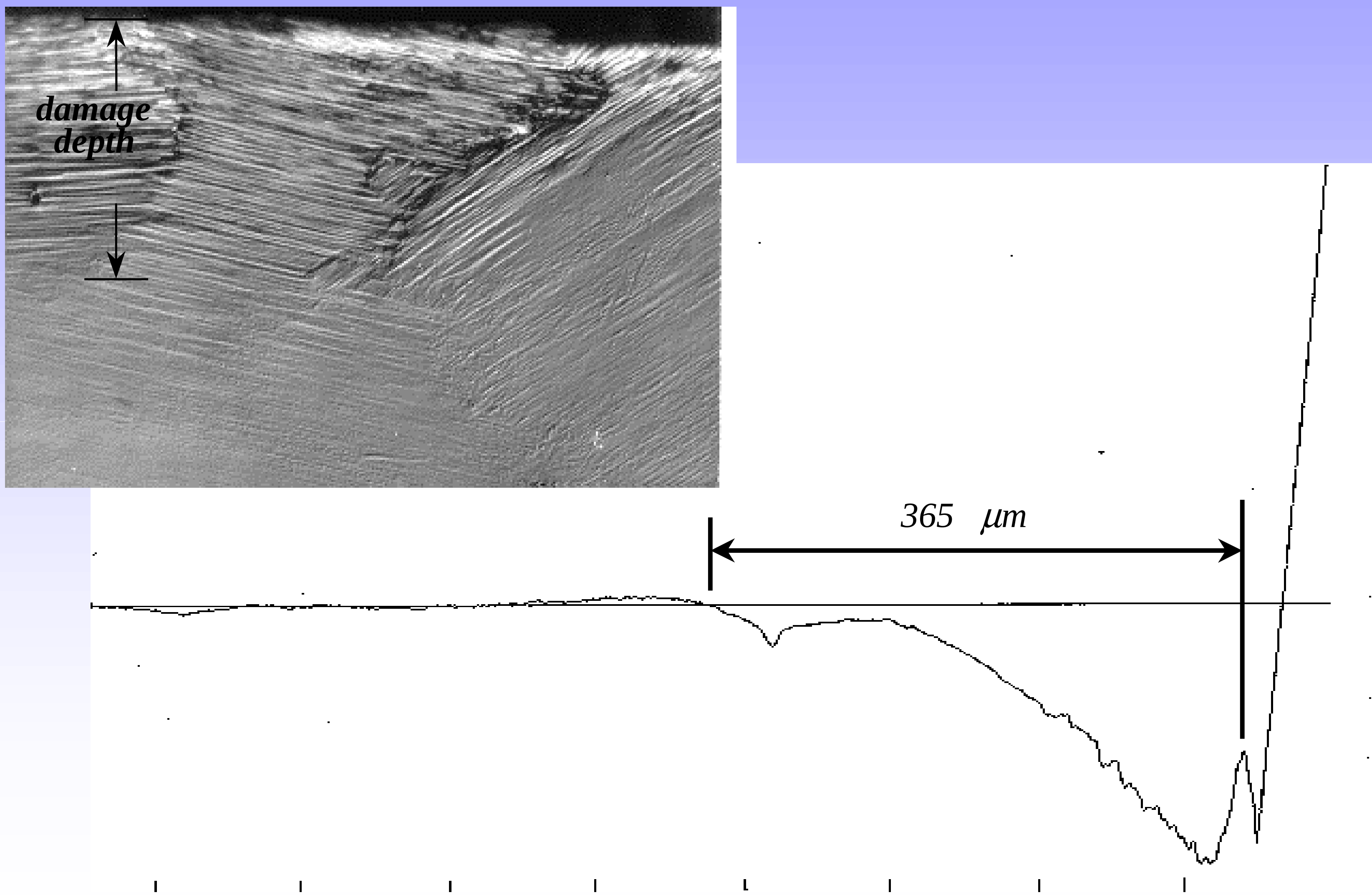
Measurement of: Depth of Damage

Average Depth of Damage

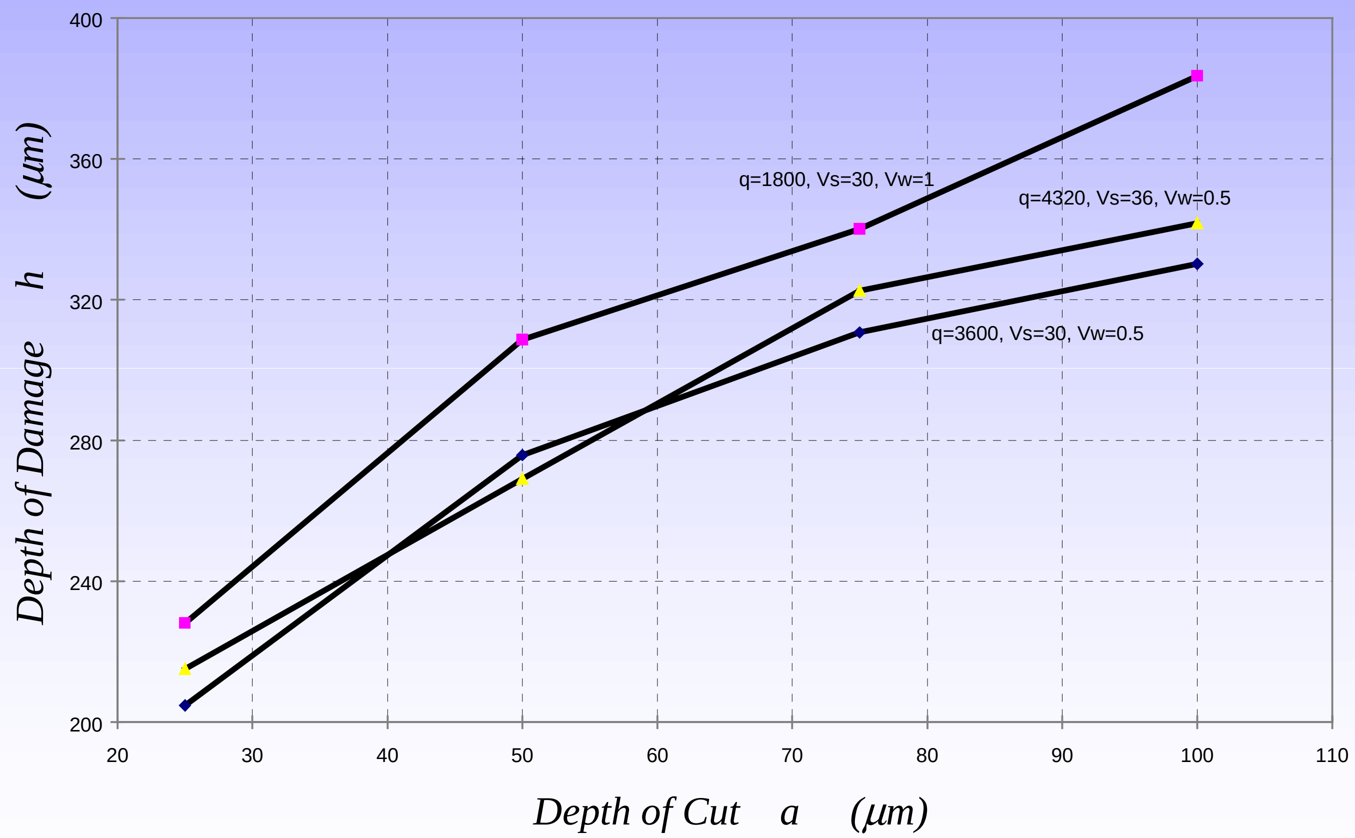
$$\bar{h} = \frac{\sum_{i=1}^{n} h_i}{n}$$

Correlated to Different Grinding Conditions

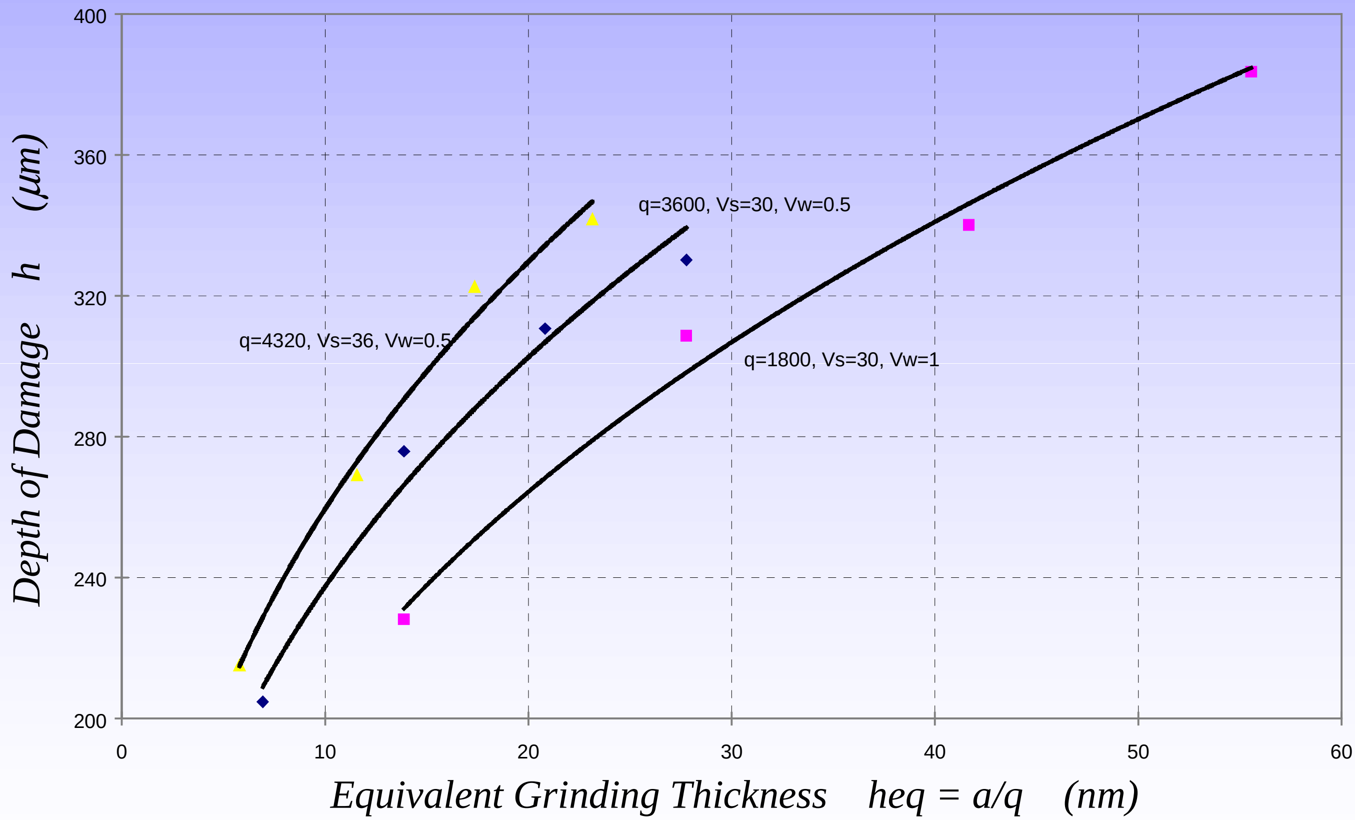
Average Depth of Damage



Damage Depth vs Depth of Cut



Relationship between h and heq



Contribution

- Identify quantities that are involved in defining workpiece quality
- Establish limits for subsurface damage and effects
- Relate subsurface damage characteristics to process variables
- Identify parameters that must be controlled to achieve desired quality
- Develop mechanistic process model for grinding operation
- Increase knowledge and understanding of the grinding operation