Identification and Control of Grinding Processes for Intermetallic Compounds

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Correlation between Force and Plastic Deformation

Part 1: Set Reduction
(model fitting or parameter estimation)

$$h = aF_n^{1/2}, \quad a = \sqrt{\frac{\beta^2}{\pi \delta H_v}}$$

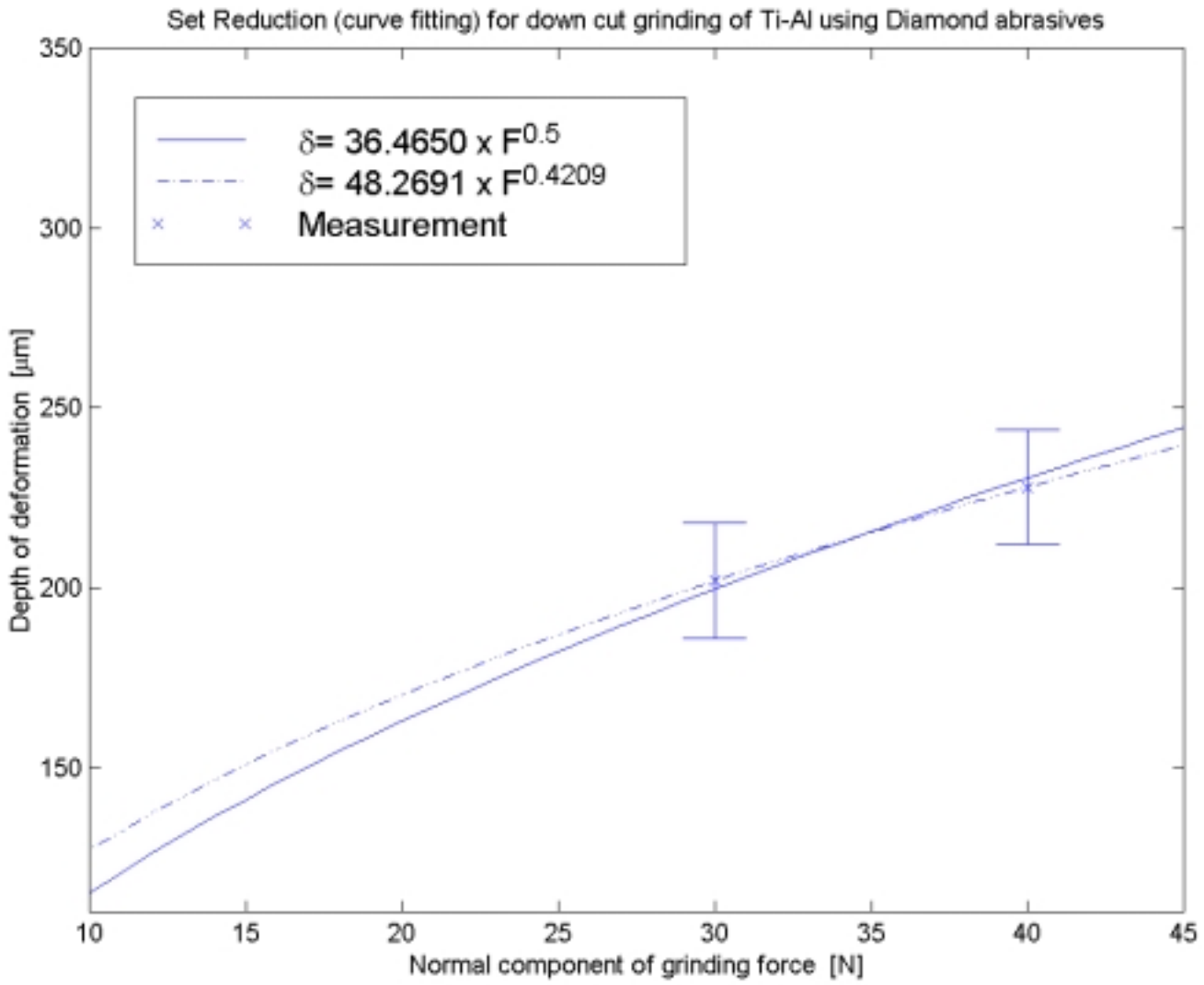
Creating Plot for:

- Diamond
- TiAl
- 20um
- 25m/sec
- 30N, 40N
- Wet
- Down cut

Correlation between Force and Plastic Deformation

Part 1: Set Reduction

1.C) Model Estimation (least square)



Correlation between Force and Plastic Deformation

Part 2: Model Validation
(Extrapolation)

$$h = aF_n^{1/2}, \quad a = \sqrt{\frac{\beta^2}{\pi \delta H_v}}$$

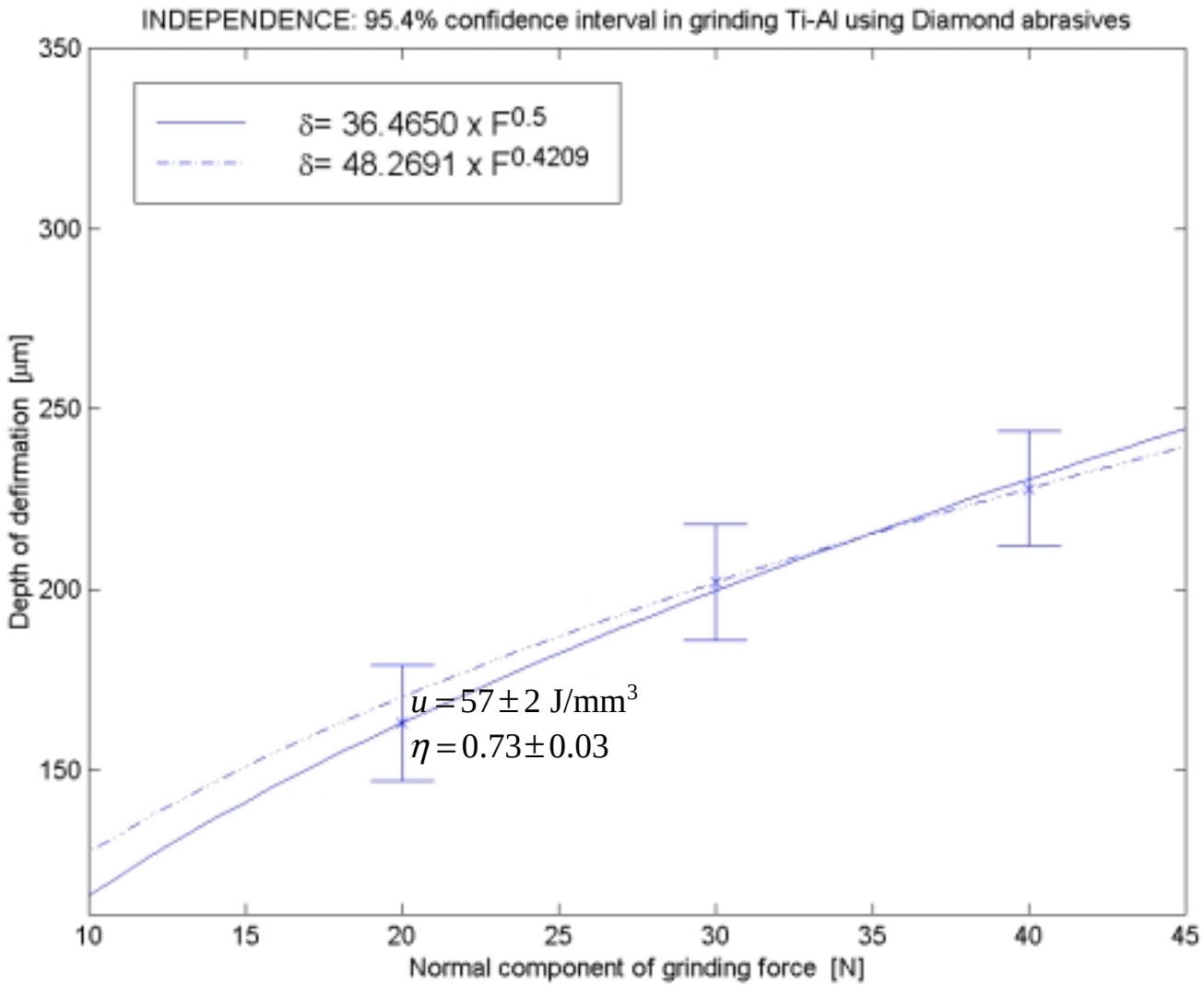
Creating Plot for:

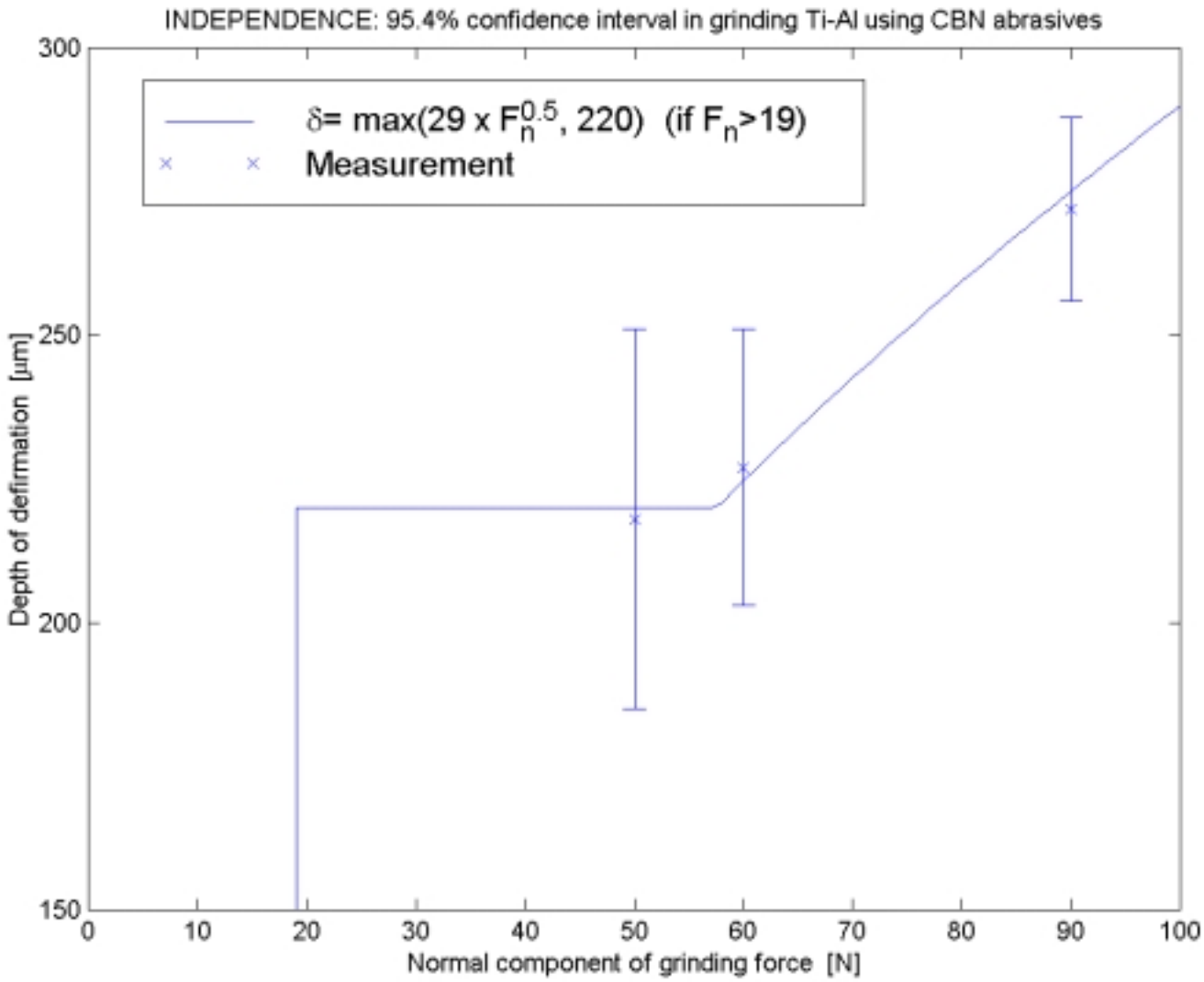
- Diamond
- TiAl
- 20um
- 25m/sec
- 20N
- Wet
- Down cut

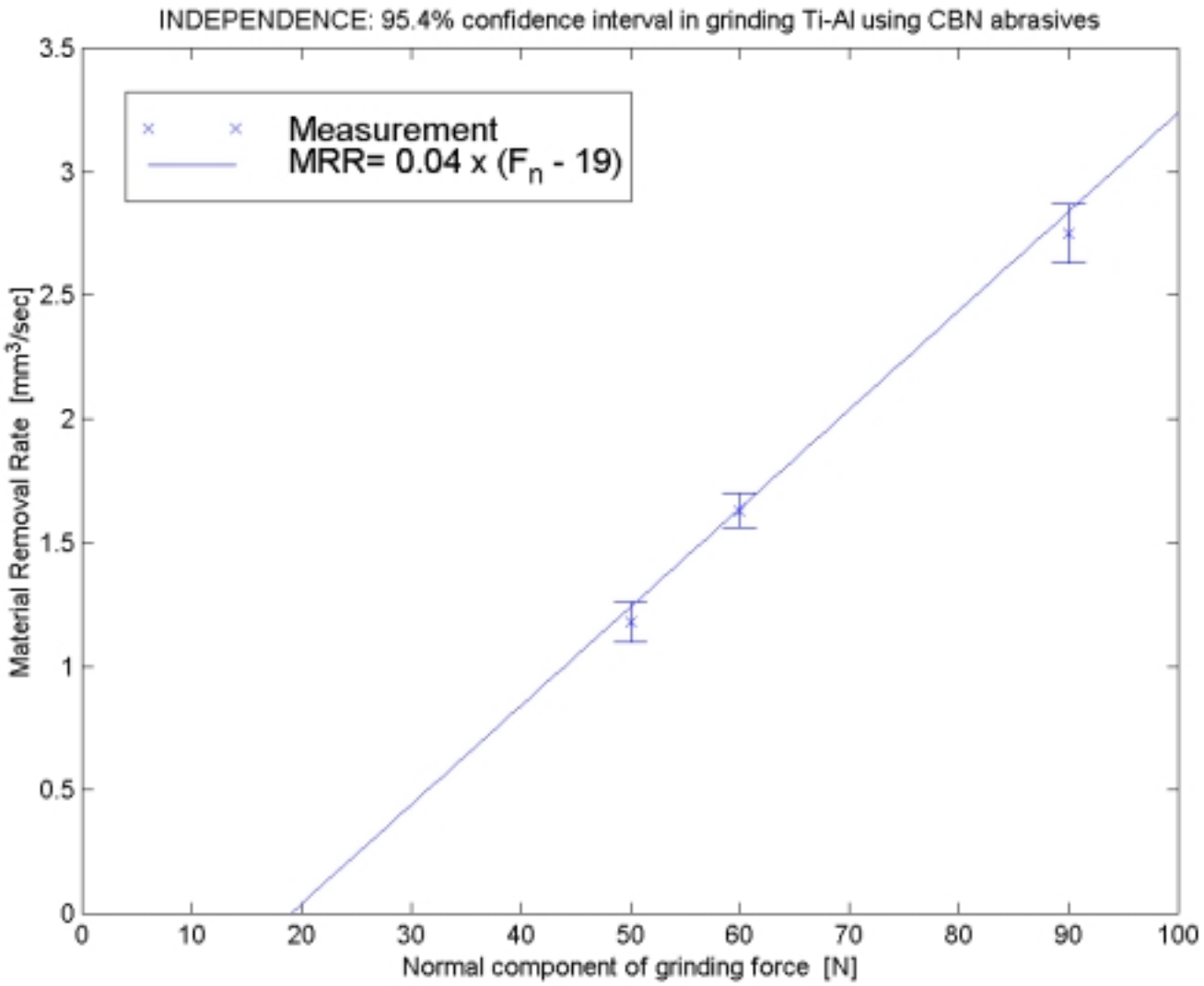
Correlation between Force and Plastic Deformation

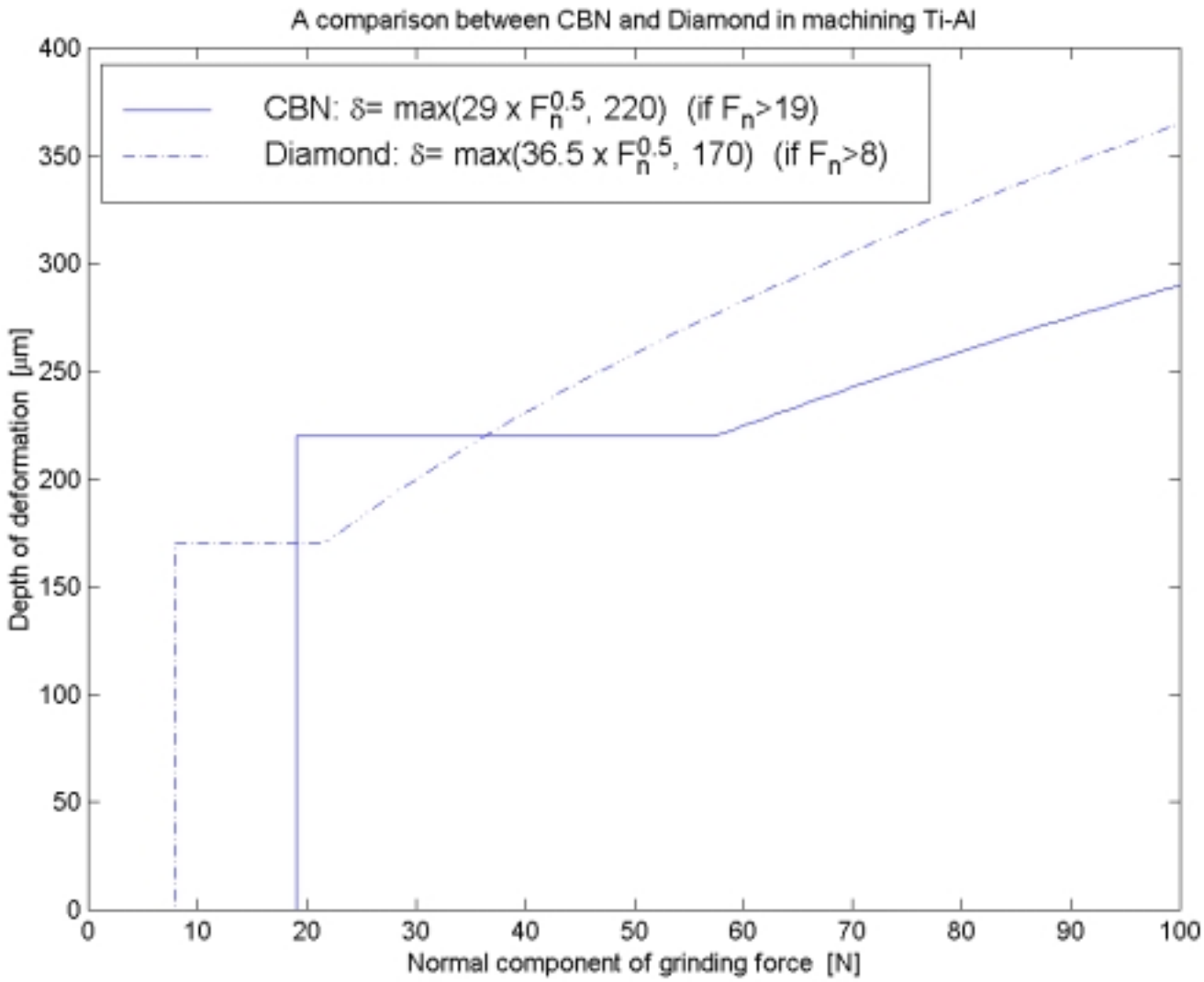
Part 2: Model Validation (Extrapolation)

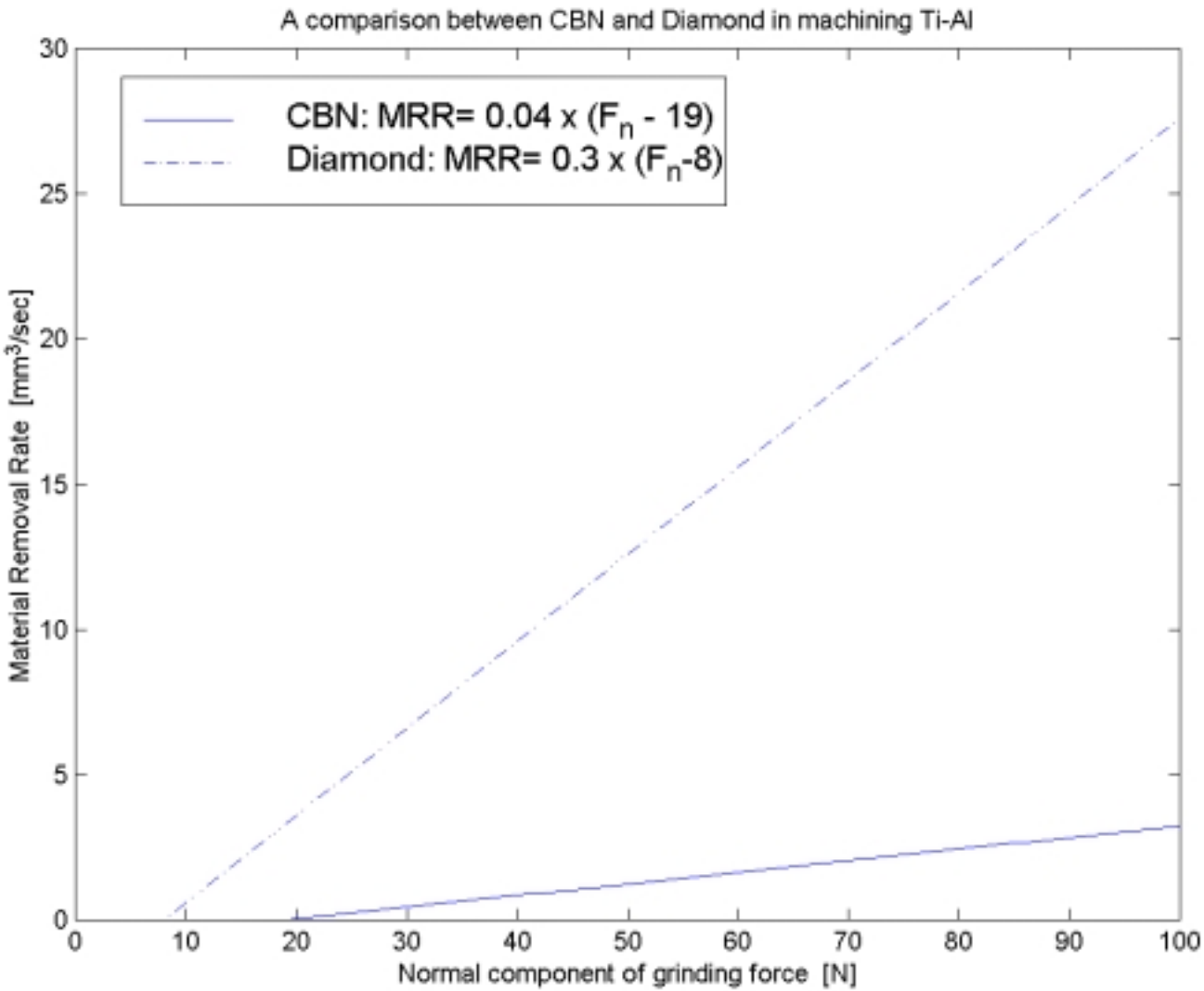
2.b) Independence of Measurements (independence of confidence intervals: 95.4%)

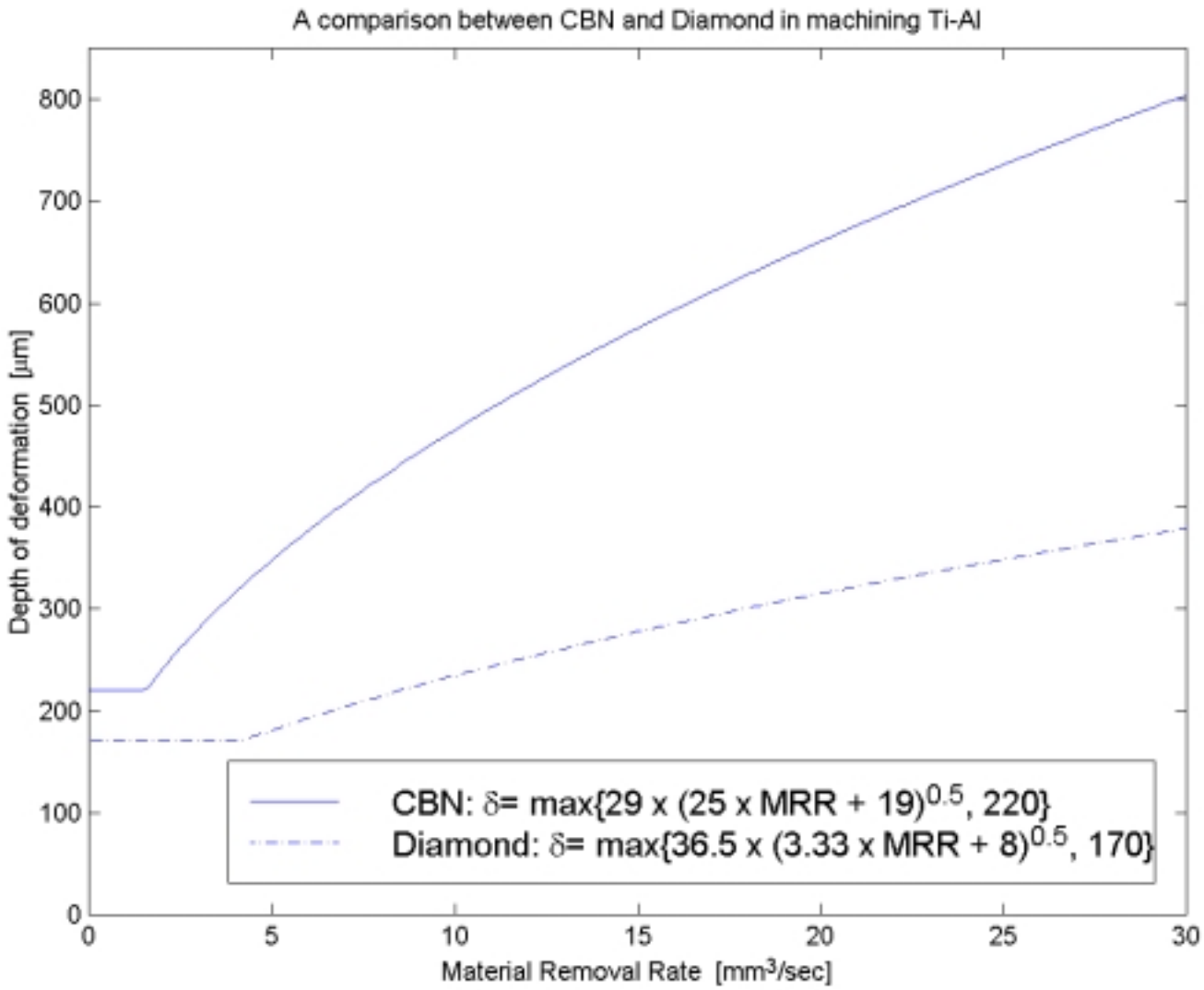



INDEPENDENCE: 95.4% confidence interval in grinding Ti-Al using CBN abrasives
δ= max(29 x F_n^0.5, 220) (if F_n>19)
Measurement
Depth of defirmation [µm]
Normal component of grinding force [N]
300
250
200
150
0
10
20
30
40
50
60
70
80
90
100


INDEPENDENCE: 95.4% confidence interval in grinding Ti-Al using CBN abrasives
Measurement
MRR= 0.04 x (F_n - 19)
Material Removal Rate [mm³/sec]
Normal component of grinding force [N]
0
0.5
1
1.5
2
2.5
3
3.5
0
10
20
30
40
50
60
70
80
90
100


A comparison between CBN and Diamond in machining Ti-Al
CBN: δ= max(29 x F_n^0.5, 220) (if F_n>19)
Diamond: δ= max(36.5 x F_n^0.5, 170) (if F_n>8)
Depth of deformation [μm]
Normal component of grinding force [N]
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
70
80
90
100


A comparison between CBN and Diamond in machining Ti-Al
CBN: MRR= 0.04 x (F_n - 19)
Diamond: MRR= 0.3 x (F_n-8)
Material Removal Rate [mm^3/sec]
Normal component of grinding force [N]
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80
90
100


A comparison between CBN and Diamond in machining Ti-Al
Depth of deformation [μm]
Material Removal Rate [mm3/sec]
CBN: δ= max{29 x (25 x MRR + 19)0.5, 220}
Diamond: δ= max{36.5 x (3.33 x MRR + 8)0.5, 170}
0
100
200
300
400
500
600
700
800
0
5
10
15
20
25
30