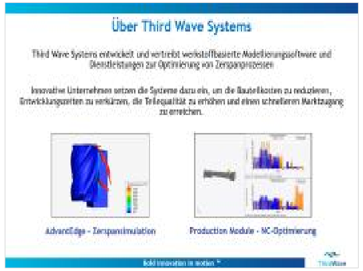
Von der Schneidkante zum NC-Code

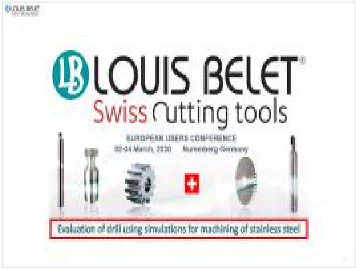
WIE ZERSPANSIMULATIONEN MODERNE PRODUKTIONSPROZESSE GESTALTEN

Referent: Dr.-Ing. Benedikt Thimm
Anwendungsexperte FE-Simulation und Materialmodellierung

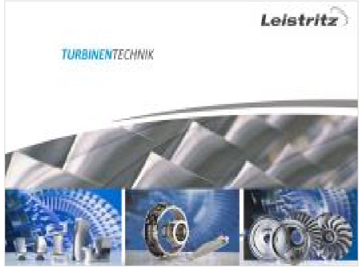
Agenda



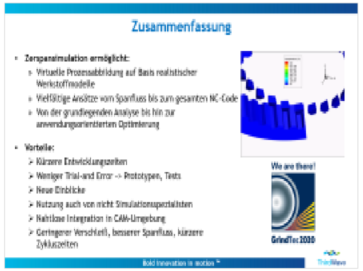
- Simulation in der Zerspanung



- Spanfluss und Belastungen an der Schneidkante



- Belastungsorientierte Optimierung von NC-Codes

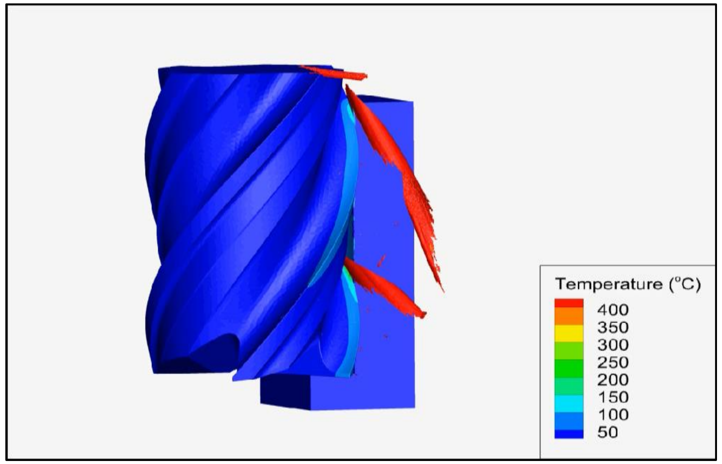


- Zusammenfassung

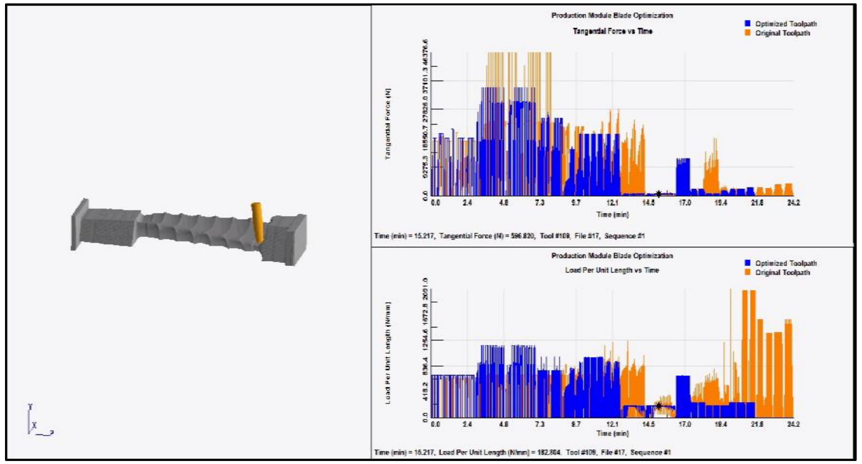
Über Third Wave Systems

Third Wave Systems entwickelt und vertreibt werkstoffbasierte Modellierungssoftware und Dienstleistungen zur Optimierung von Zerspanprozessen

Innovative Unternehmen setzen die Systeme dazu ein, um die Bauteilkosten zu reduzieren, Entwicklungszeiten zu verkürzen, die Teilequalität zu erhöhen und einen schnelleren Marktzugang zu erreichen.



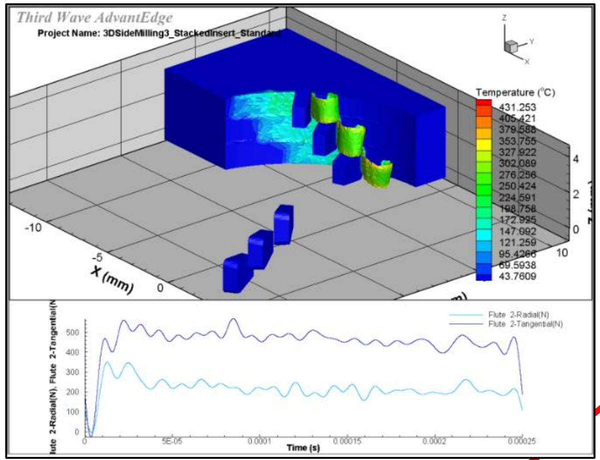
AdvantEdge – Zerspansimulation



Production Module – NC-Optimierung

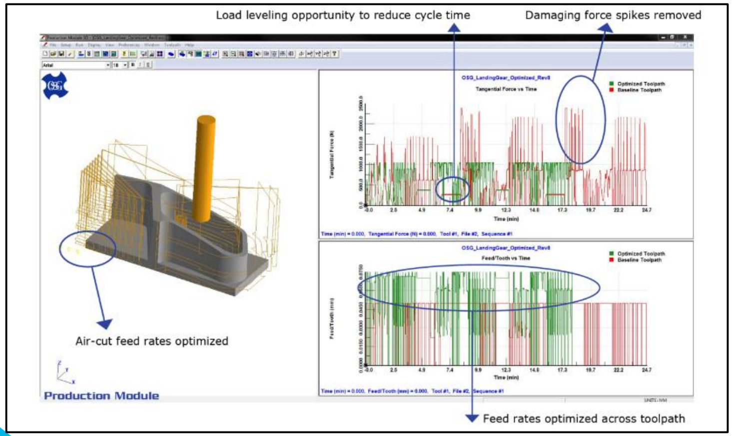
Third Wave

Ein konsequenter Schritt in Richtung moderner Entwicklungsumgebungen!

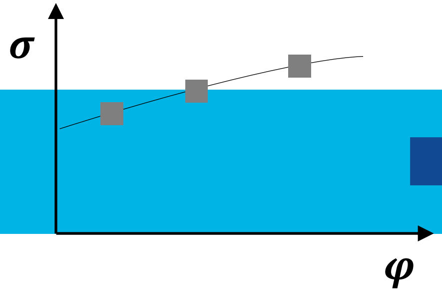


Optimaler Produktionsschritt

Anwendung: Werkzeugweg und Strategie abgestimmt auf das Bauteil



Basis -> Zerspanwerkzeug abgestimmt auf Werkstoff- und Prozessparameter (Fokus: Spanfluss, Verschleiß, Bauteilqualität)

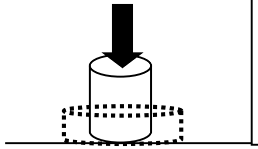


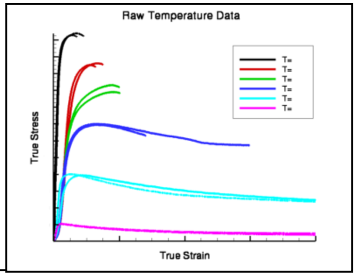
$$\sigma_f(\varphi^p, \dot{\varphi}, T) = g(\varphi^p) \cdot \Gamma(\dot{\varphi}) \cdot \Theta(T)$$

Third Wave Systems

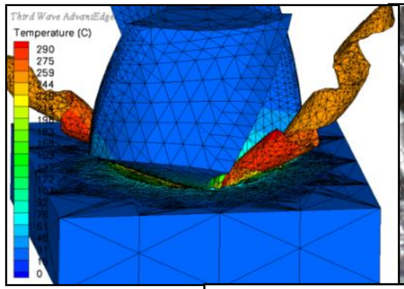
Werkstoffbasierte Modellierungstechnologien

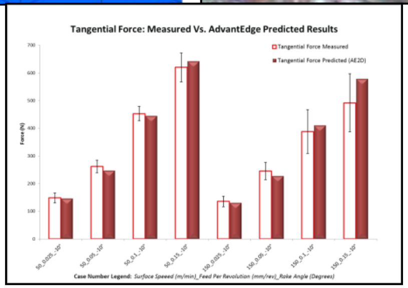
Materialtests





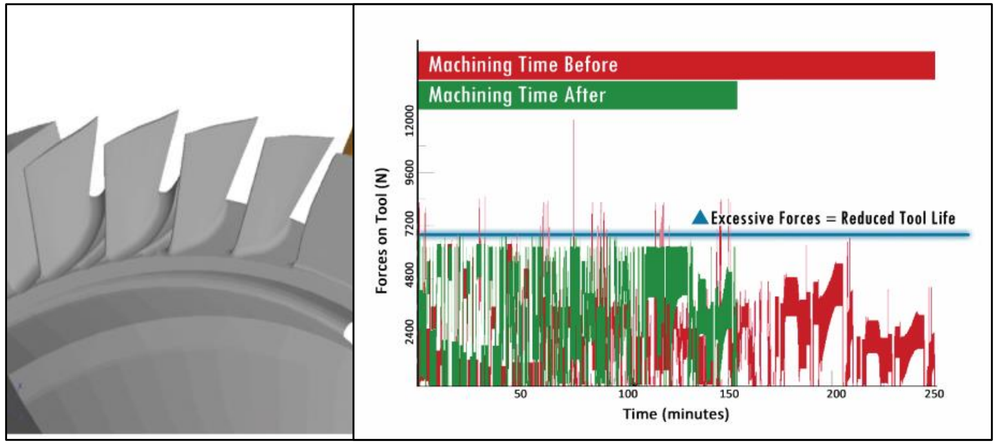
AdvantEdge





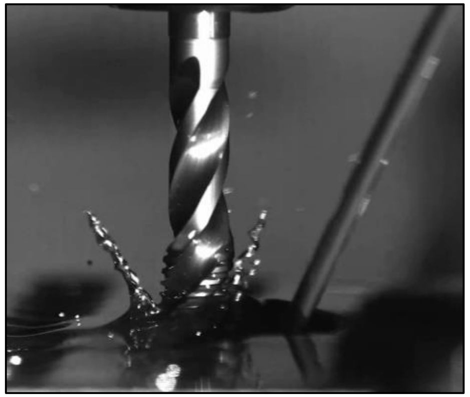
- Werkstoffdatenbank umfasst ca. 150 Werkstoffmodelle
- Entwickelt durch eine innovative Test- und Modellierungstechnologie
- Experimentell getestet und in Zerspanversuchen validiert

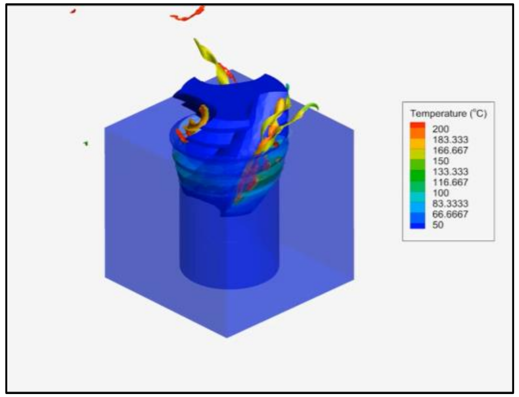
Production Module

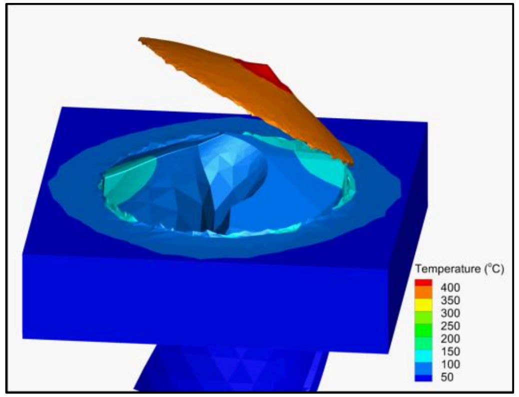


AdvantEdge

Finite Element-Analyse





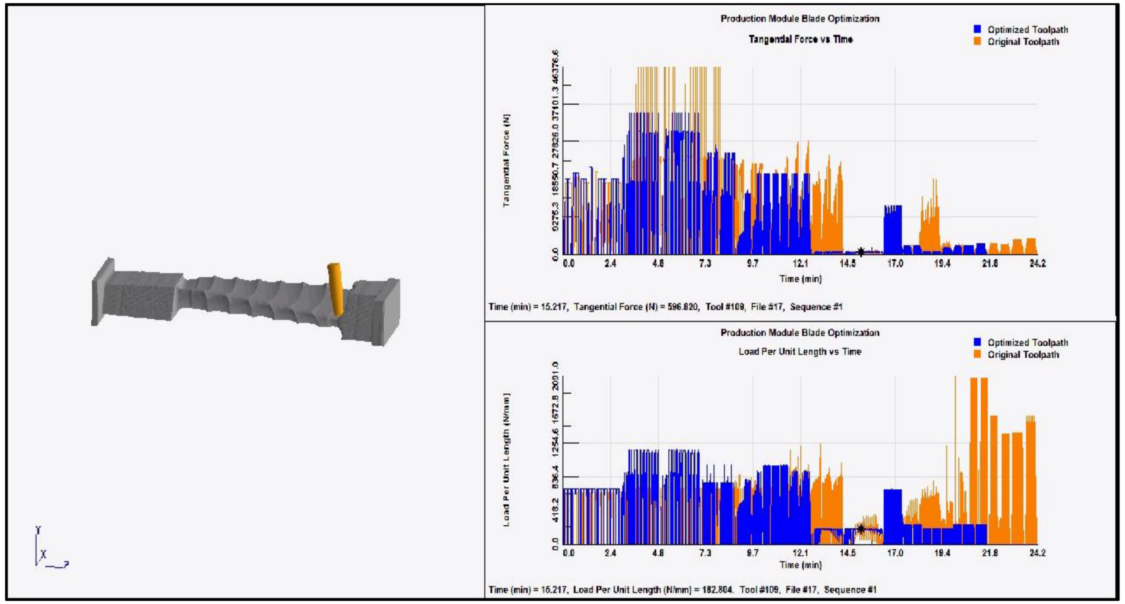


- Anwendung in Design und/oder Optimierung
- Kundenprobleme effizient erkennen und beheben
- Prozessverbesserungen verifizieren
- Vielversprechende Prototypen erkennen
- Design-Iterationen sowie Trial-and-Error-Tests reduzieren

Production Module

Optimierung von NC Werkzeugwegen

Production Module ist eine NC Werkzeugwegoptimierungssoftware, die physikalische Materialdaten, CAD/CAM-Daten, Werkzeug- und Werkstückgeometrien integriert, um komplexe Zerspanoperationen zu analysieren und zu optimieren!



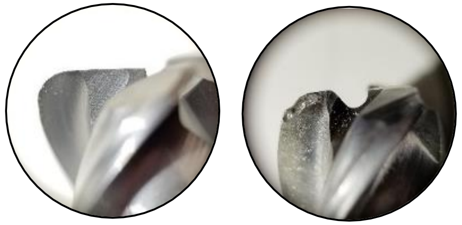
Production Module

Ein Engineering-Tool mit vielfältigen Anwendungsmöglichkeiten

Werkstückqualität

Spanabnahme

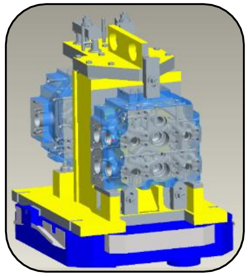
Werkzeugverschleiß

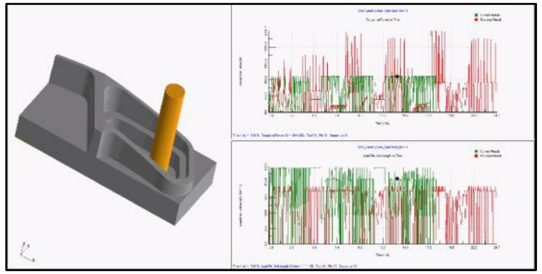


Zykluszeit / MRR

Reduzierung der Zykluszeit um 30 % bei Beibehaltung der Standzeit

Spindelverschleiß





Belastungsanalyse für Spannmittelentwicklung

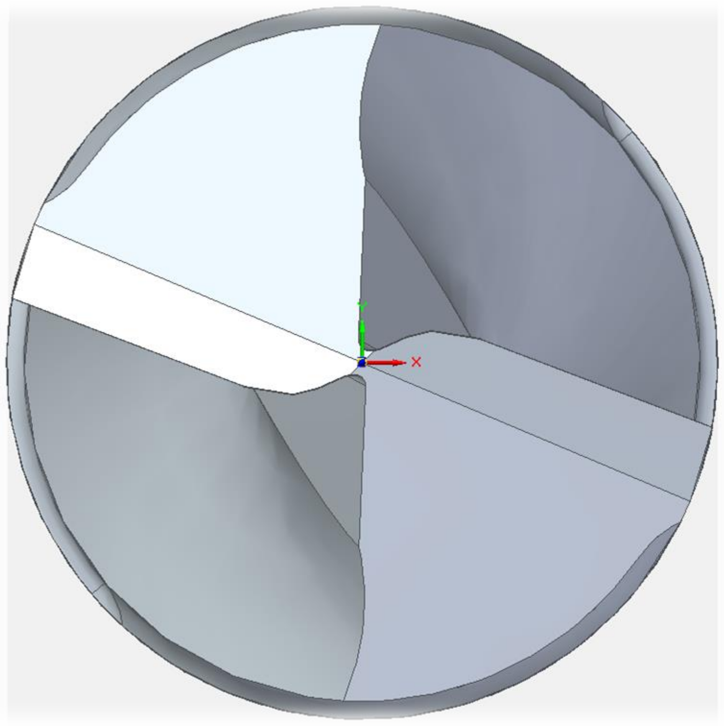
Fragen der Bediener

Drehmoment- und Belastungsanalyse

LOUIS BELET®
Swiss Cutting tools

Evaluation of drill using simulations for machining of stainless steel

Ref 370 - Drill for stainless steel



Drill Diameter : 0.50 to 3.00 step 0.01 mm

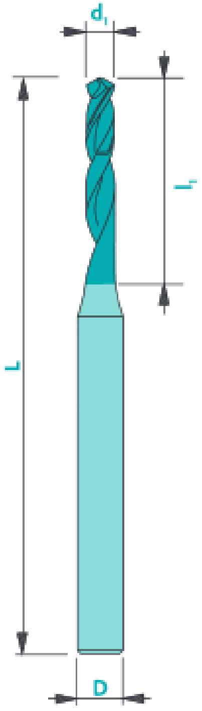
Flute Length : 4.0 to 12.0 mm

Point Angle : 135°

Helix Angle : Variable 34°/12°

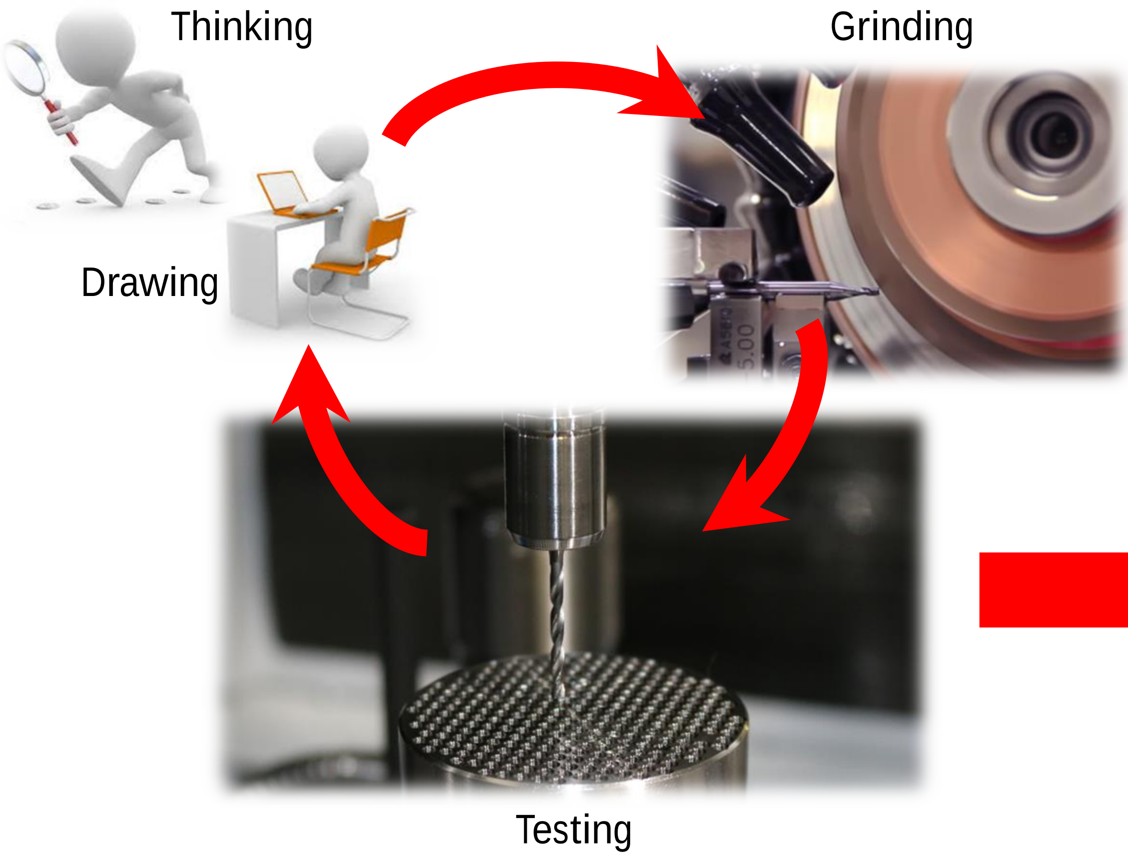
Tool Material : MG10

Coating : Nemo (AlCrN)



Tool presentation - Development period

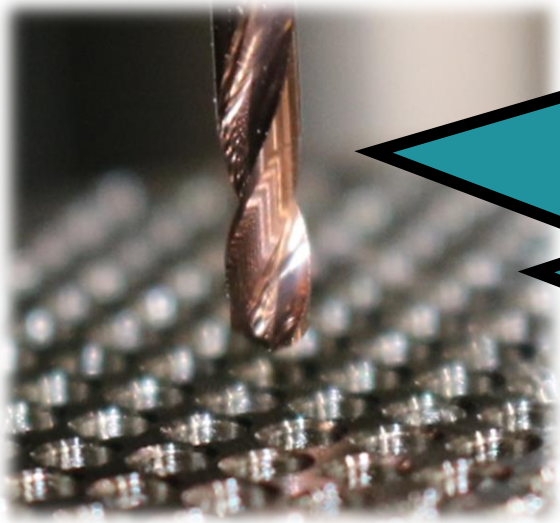
How we created a tool before using AdvantEdge ?



- After 6 months
- 31 versions of drill
- 60 hours of production
- Lot of carbide and coating

Real

Virtual



VS

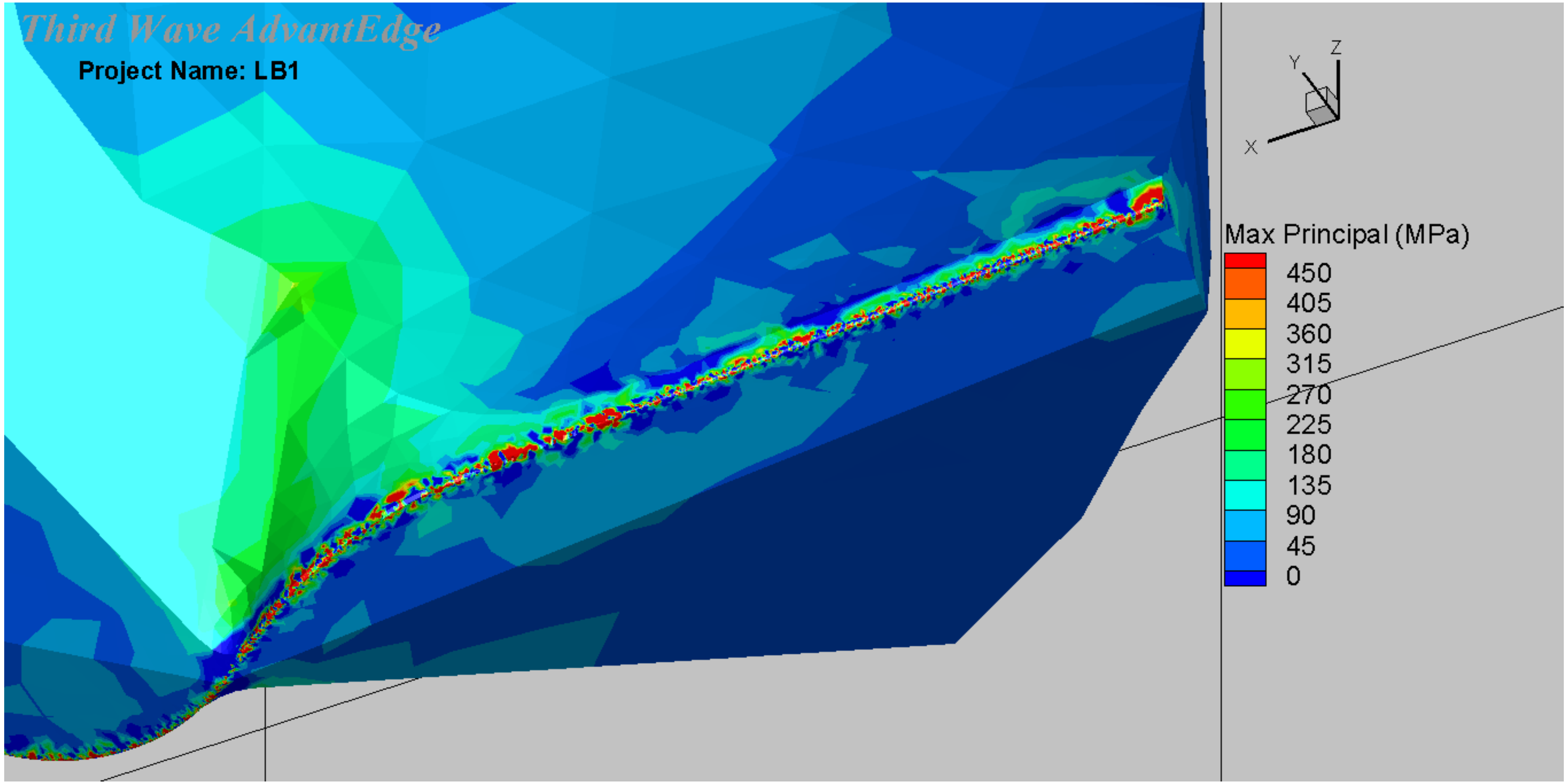
Cutting conditions :

Vc = 30 m/min
f = 0.037 mm
Peck drilling = 1/3 x Ø
Cutting oil

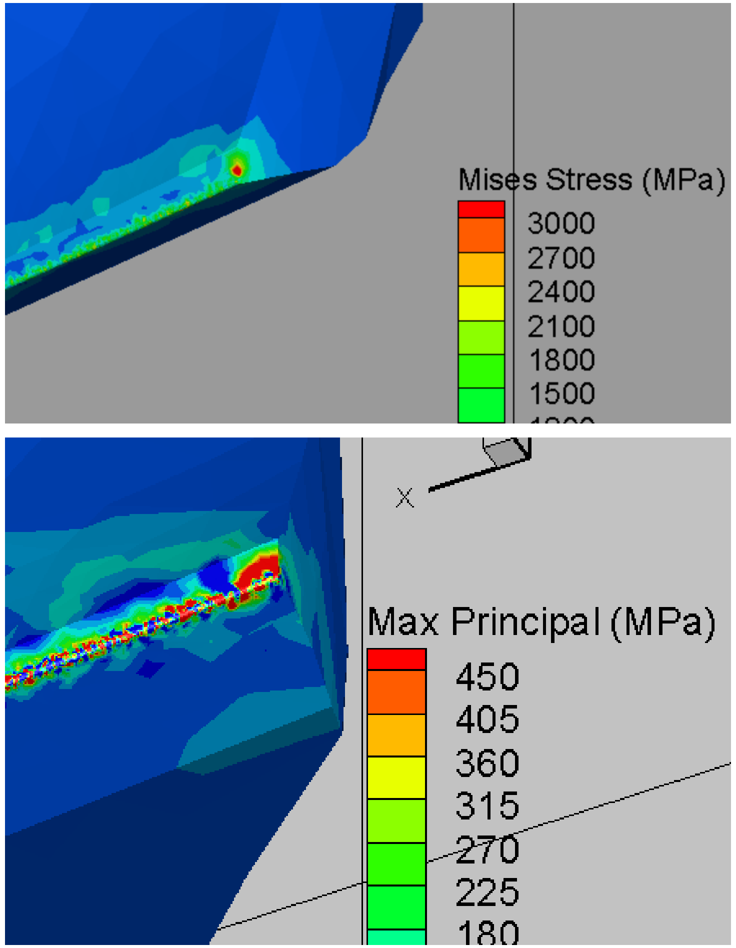
N = 5162 rpm
Vf = 191 mm/min
Q = 0.62 mm

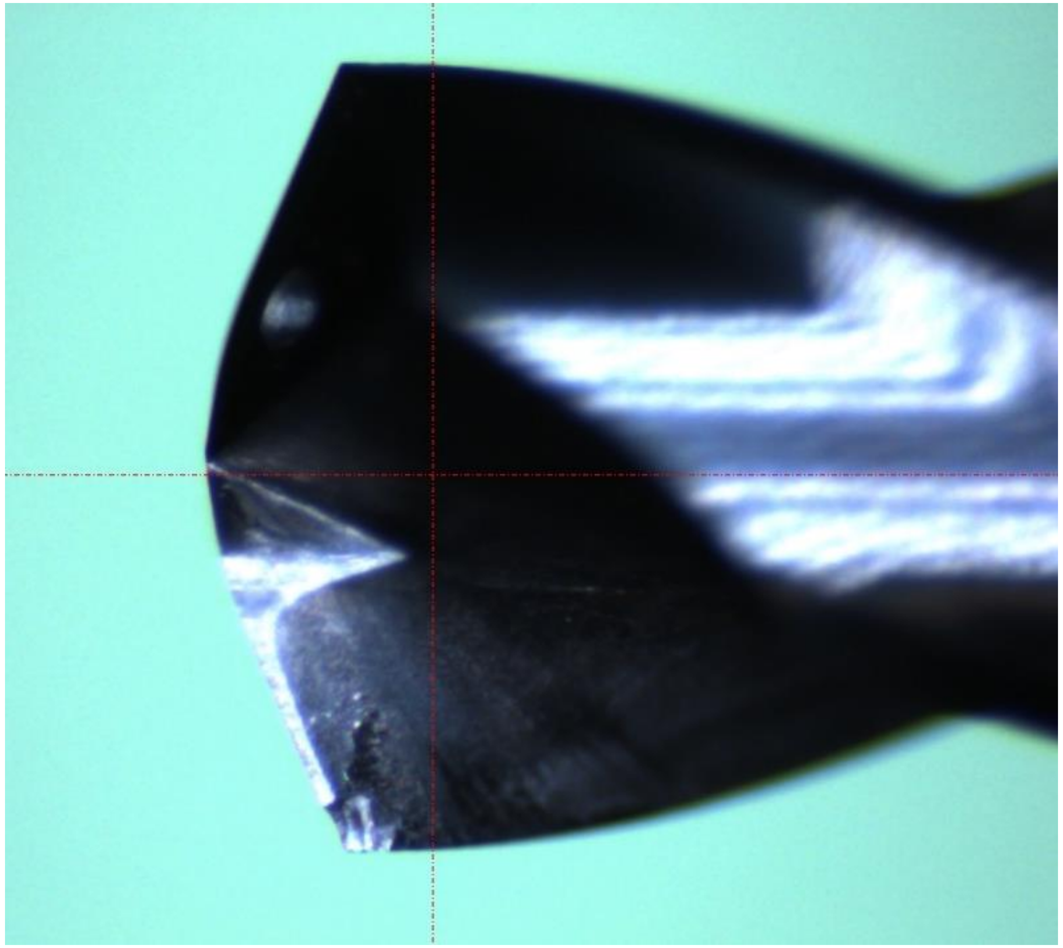
Tool material : Carbide MG 10%Co
Coating Material : TiAlN and AlCrN
Coating Thickness : 0.001 mm
Workpiece Material : 316L

Real VS Virtual – Max Principal (MPa)



Real VS Virtual – Ref.370





The real results are consistent with the virtual results

Without AdvantEdge :

- To develop a New tool -

- After 6 months
- 31 versions of drill
- 60 hours of production
- Lot of carbide and coating

Real results but we don't understand all.

With AdvantEdge :

- To develop a New tool -

- ~ 3 months
- ~ 5 to 10 reals versions of drill
- 30 hours of production

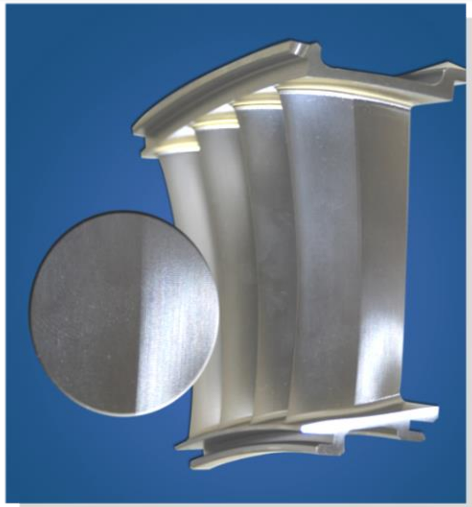
Virtual results but we understand lot of things.

For the future :

- CBN end Mills - New Drill with coolant holes - Gundrills with coolant holes - Pilot drills for deep holes

TURBINENTECHNIK

Example 1: Vane Segment - 4 Profiles



Material Ti-6Al-4V

Required surface roughness
$R_{a\ max} = 1.6$

No rework by hand allowed
in gaspath

CAM System

- Cutter Pathes generated with Siemens NX in CL Data (APT) format for roughing
- Cutter Pathes generated with ConceptNREC in CL Data (APT) format for semi- and finishing
- Optimized APT-files postprozessed in G-Code machine-files with TurboSoft+

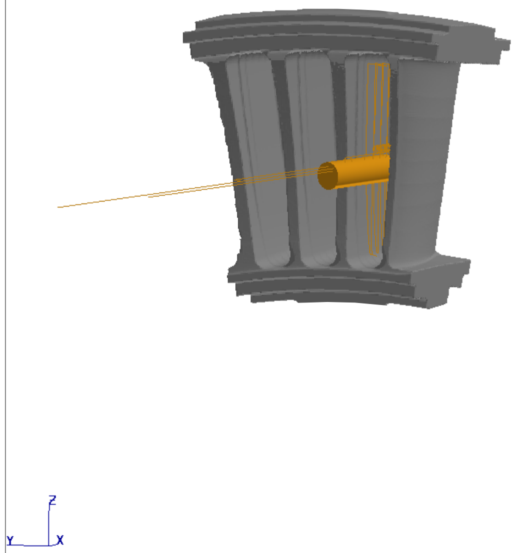
Optimization Focus

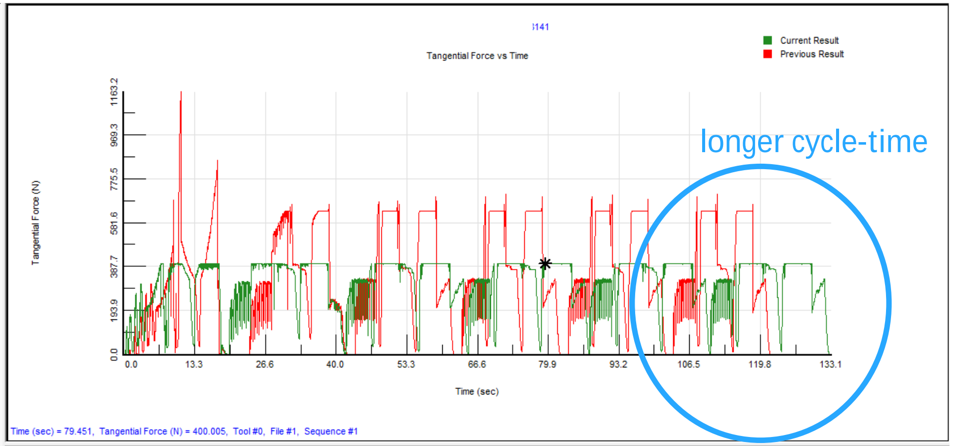
- Improve Tool Life
- Eliminate Chatter Marks
- Enhancing Surface Quality

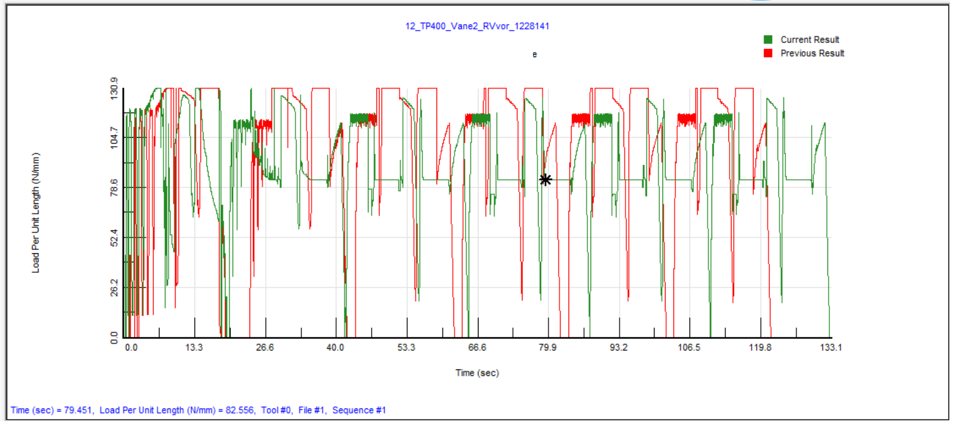
Leistritz

Extending Tool Life

Profil roughing in forged raw part





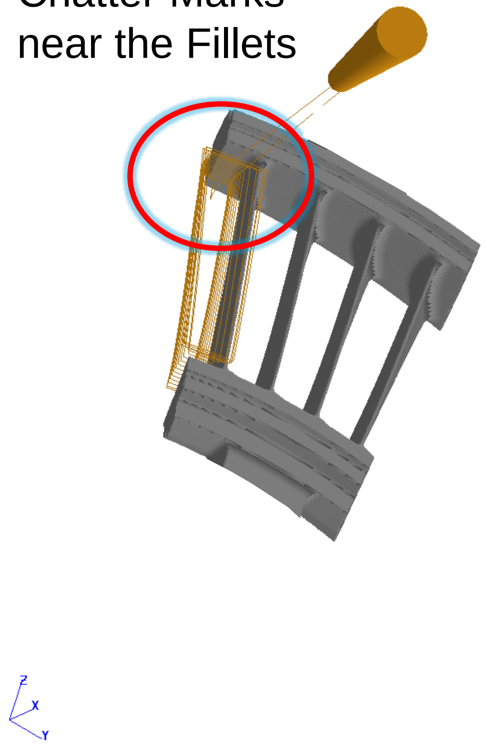


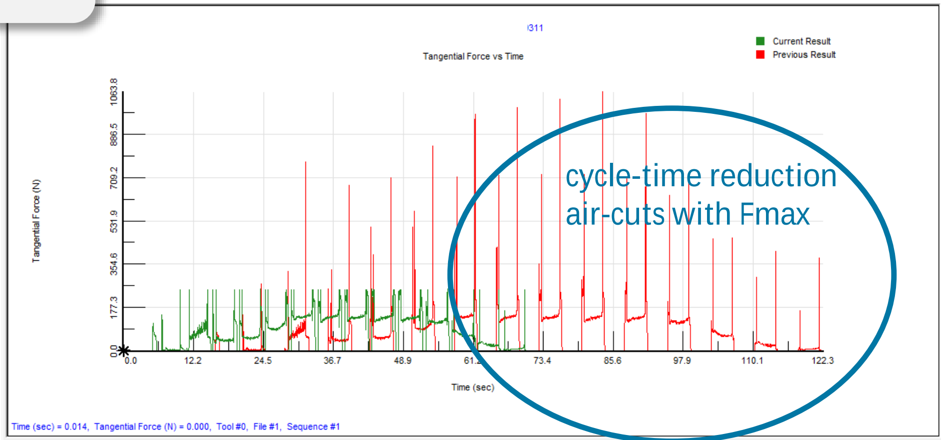
Baseline Machining Time:	42.0 min / Part
Optimized Machining Time:	37.5 min / Part
Cycle Time Savings:	10.7 % for Roughing one Part
Improved Tool Life:	from 2 Parts up to 7 Parts

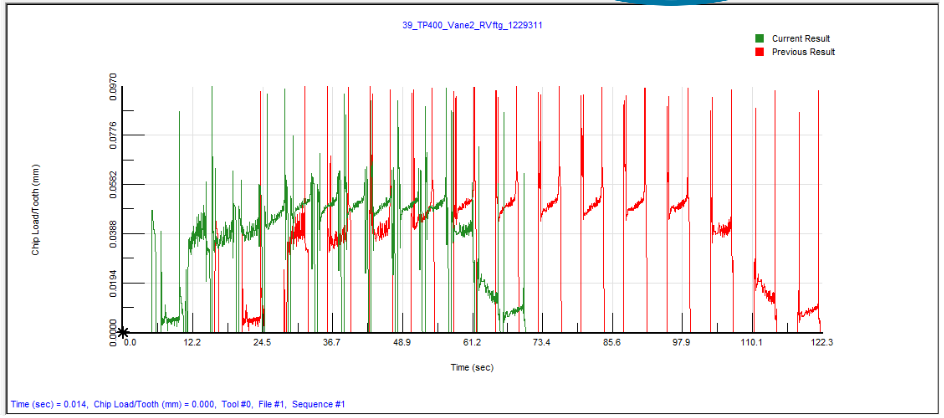
Leistritz

Enhancing Surface Quality

Chatter Marks
near the Fillets







Baseline Machining Time:	55.5 min / Part
Optimized Machining Time:	48.0 min / Part
Cycle Time Savings:	13.5 % for Semi- and Finish
Total Time Savings:	12.7 % per Part

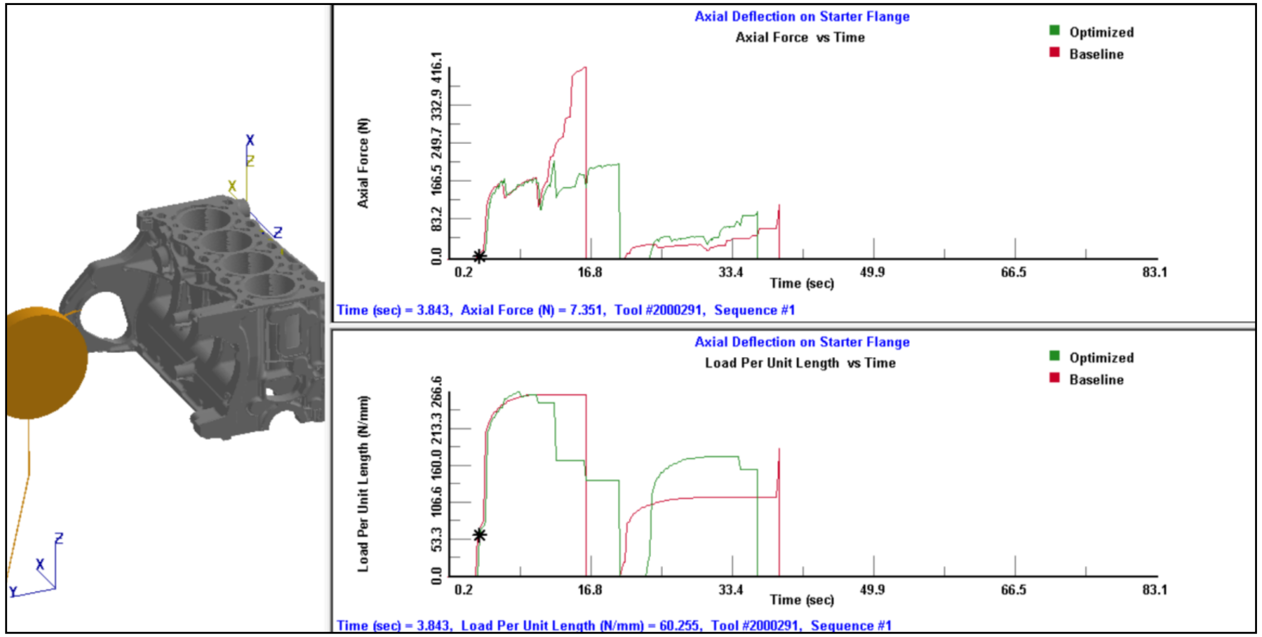
Motorblock - Axialkraft

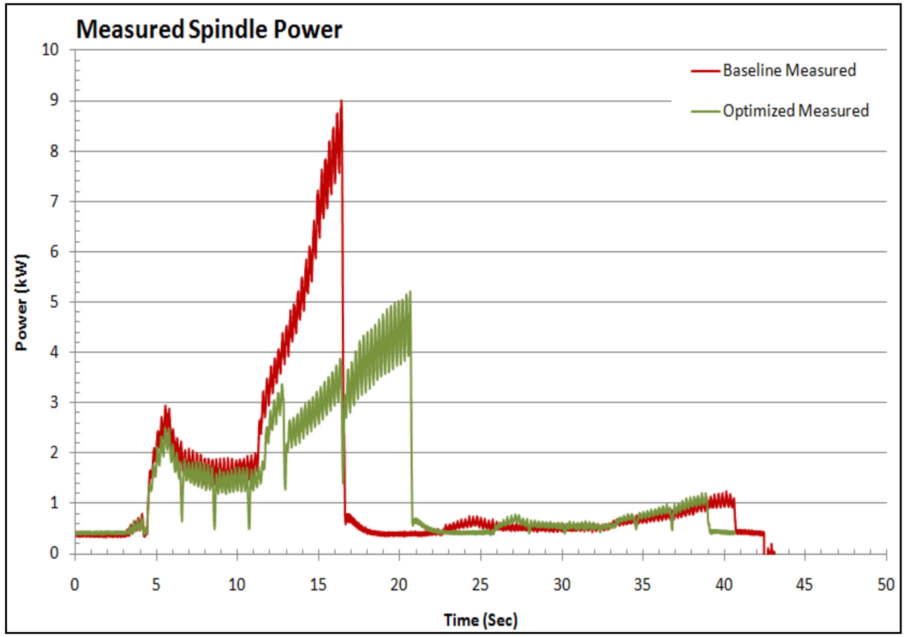
Method

Limit deflection of workpiece by optimizing axial force

Results

- Reduced peak axial force (acting normal to flange) from 416N to 213N
- Reduced peak spindle power from 9kW to 5kW
- Reduced cycle time by 4 seconds



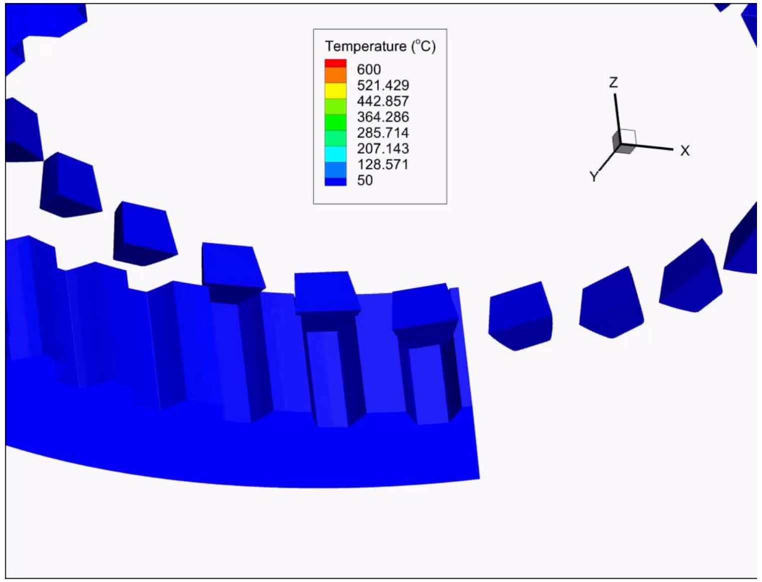


ThirdWave

Zusammenfassung

- Zerspansimulation ermöglicht:
  - » Virtuelle Prozessabbildung auf Basis realistischer Werkstoffmodelle
  - » Vielfältige Ansätze vom Spanfluss bis zum gesamten NC-Code
  - » Von der grundlegenden Analyse bis hin zur anwendungsorientierten Optimierung

- Vorteile:
  - ➢ Kürzere Entwicklungszeiten
  - ➢ Weniger Trial-and Error -> Prototypen, Tests
  - ➢ Neue Einblicke
  - ➢ Nutzung auch von nicht Simulationsspezialisten
  - ➢ Nahtlose Integration in CAM-Umgebung
  - ➢ Geringerer Verschleiß, besserer Spanfluss, kürzere Zykluszeiten



We are there!

GrindTec 2020

Vielen Dank für Ihre Aufmerksamkeit!

Third Wave Systems
6475 City West Parkway
Minneapolis, MN 55344 USA
www.thirdwavesys.com

Third Wave Systems, Inc. / Account Management Germany
+49(0)151-15206791 | julian.luedecke@thirdwavesys.com
Third Wave Systems, Inc. / German-Support
+49(0)151-20268109 | german-support@thirdwavesys.com