HIGH SPEED MACHINING

BY
RAVIVARMAN R
I-YEAR M.Tech PDM
DEPARTMENT OF MECHANICAL ENGINEERING

Content

Introduction

- Machining with high speeds (HSM) is one of the modern technologies, which in comparison with conventional cutting enables to increase efficiency, accuracy and quality of work pieces and at the same time to decrease costs and machining time.
- Even though High Speed Machining is known for a long time (first tries were made in early twenties of the past century) there are still a lot of questions and less or more complicated definitions of HSM.

Definition

The first definition of HSM was proposed by Carl Salomon in 1931. He has assumed that at a certain cutting speed which is 5 –10 times higher then in conventional machining.

Definition

- High cutting speed machining
- High rotational speed machining
- High feed machining
- High speed and feed machining
- High productive machining

Finally,

"HSM is a powerful machining method that combines high feed rates with high spindle speeds, specific tools and specific tool motion."

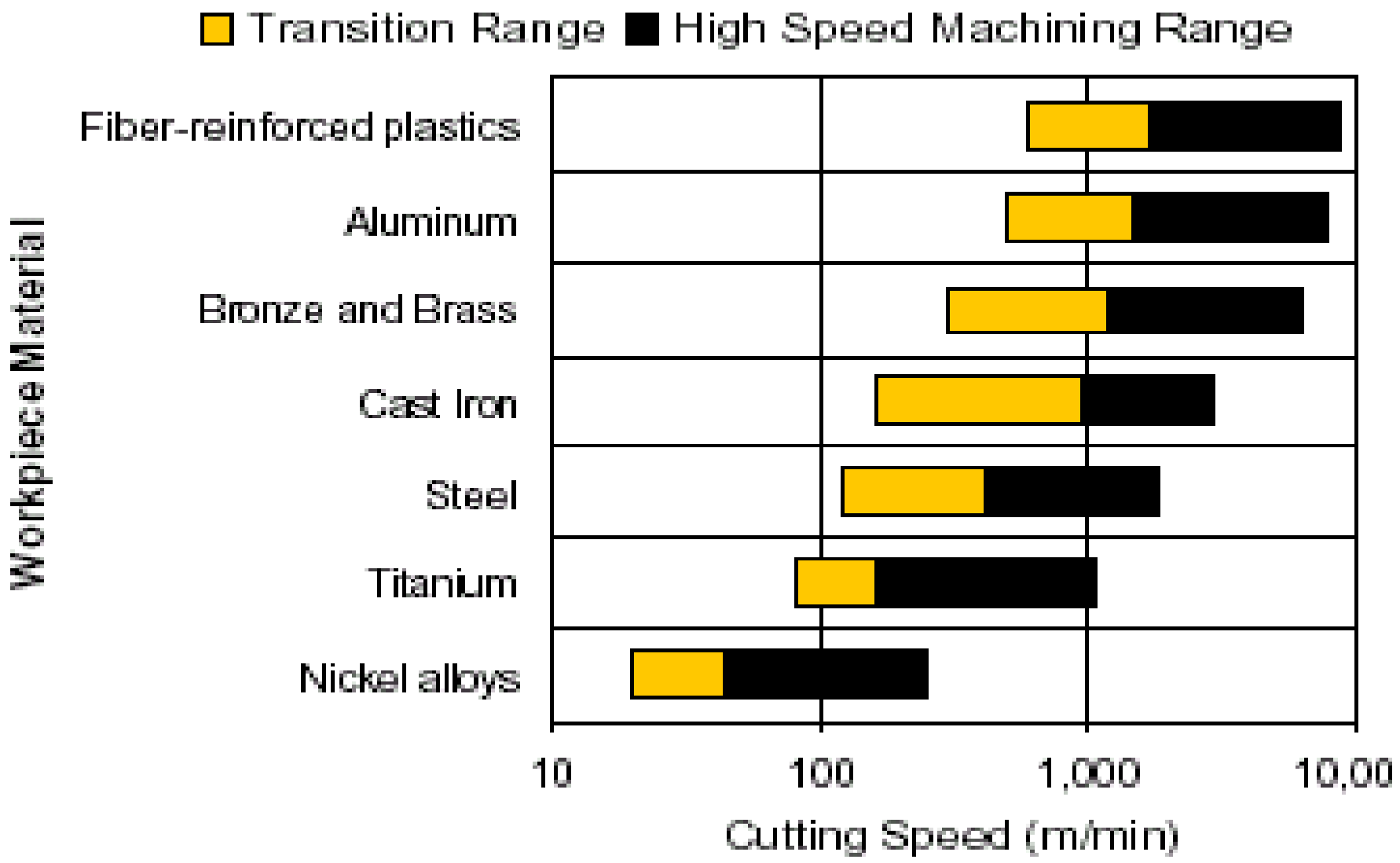
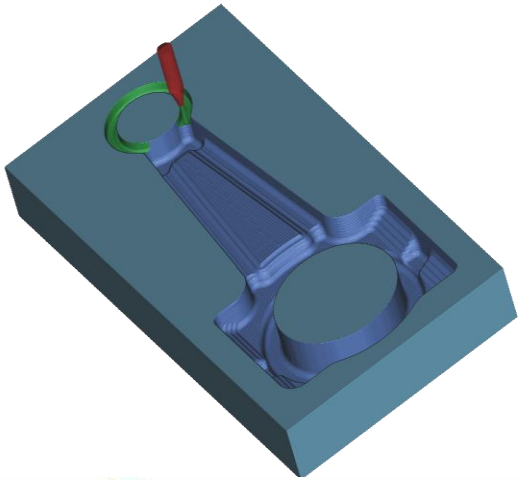


Fig. 1 High-speed cutting ranges in machining of various materials [3]

High Speed Machining

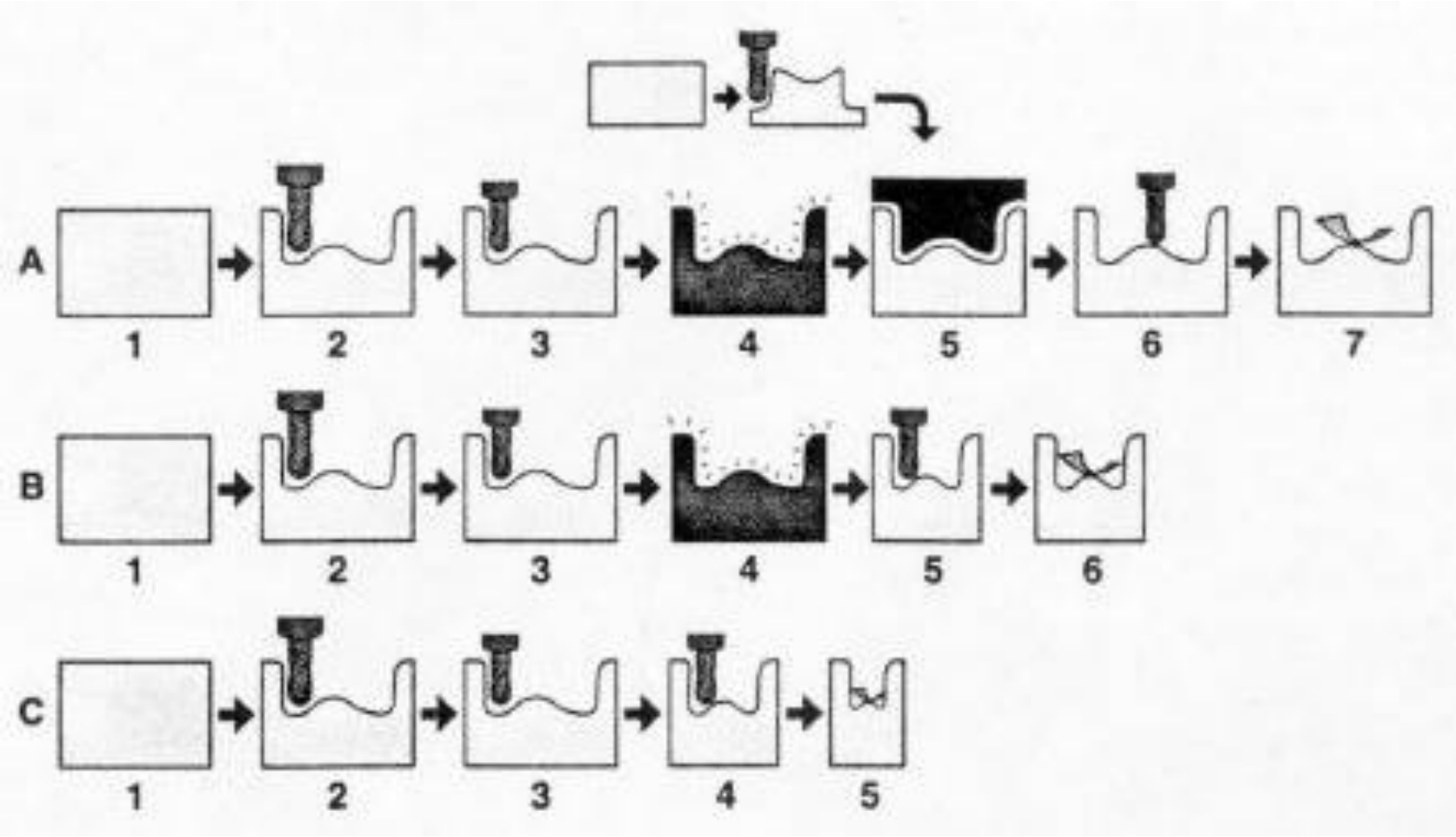
- What is it?
  - Very high tool rpm, small depths of cut and high feed rates
  - Mostly used in milling hard mold and die steels (hence term “hard milling”)



High Speed Machining

- Value
  - Maximizes overall productivity – fewer process steps, faster machining
  - Machining Mold and Dies made of very hard materials , deep cavities and fine details typically require time consuming EDM processes.
  - HSM produces high quality finish on milling machine – reduces need for EDM electrodes and hand finishing
- Challenges
  - How to drive HSM machines to capacity without breaking tools
  - Tool makers cutting data ranges are highly optimistic

High Speed Machining



HSM - Truth and Myths

"You do not need NURBS anymore."

"The controller runs better with more data."

"When the machine chokes and jerks, reduce the number of points by lowering the tolerance"

"Increase the amount of stock being cut if the finish is dull"

"The tool path must be tangential everywhere."

"Tool must be constantly engaged with blank"

"Always use ball end mill."

"Never cut with the bottom of the ball end mill"

Demands On The Machine

- Spindle speed range <=40000 rpm
- Spindle power >22 KW
- Programmable feed rate 40-60 m/min
- Rapid travels <90 m/min
- High thermal stability and rigidity in spindle
- Coolant through spindle
- Advanced look ahead function in the CNC

Conventional	HSM
The contact time between tool and work is large	Contact time is short
Less accurate work piece	More accurate work piece
Cutting force is large	Cutting force is low
Low surface finish	High surface finish
Material removal rate is low	Material removal rate is high
Cutting fluid is required	Cutting fluid is not required

HSM	EDM
Material removal rate high	Material removal rate is low
Dimensional tolerance 0.02 mm	Dim tolerance 0.1- 0.2 mm
There is no need of making cutting tool according to the contour to be machined	Cutting tool has to be made according to the contour to be machined

Advantages

- High material removal rate
- High surface finish
- Increased productivity
- Possibility of machining of very thin walls
- Reduction in lead times
- Low cutting force
- Cutting tool and work piece temperature are kept low
- Connection time between the cutting edge and work piece is short
- It eliminates the need of coolant
- Reduction of production process

Disadvantages

- High speed machines are more expensive as than manually operated machines.
- Tools used for high speed machines are quite costly.
- A part of machine which includes machine and tooling are expensive and requires extensive justifications.
- Repairing is expensive too.
- High speed machines do not eliminate all the error.
- Internal shapes cannot be machined in High speed machining.
- Size limitations depend on the size of machine.

Applications

- Industry which deals with the machining of Al to produce automotive components, small computer parts or medical devices
- Used to machine such parts as die casting dies, forging dies, injection moulds and blow moulds, milling of electrodes in graphite and copper, modeling and prototyping of dies and moulds.
- Die mould industry which requires dealing with finishing of hard materials.

Case Study-HSM on Connecting Rod Die

Measurement	NX2	NX3
Operations required	11	7
Rest mill path generation time	4:30	1:30
Overall Programming Time	6 hr	2 hr

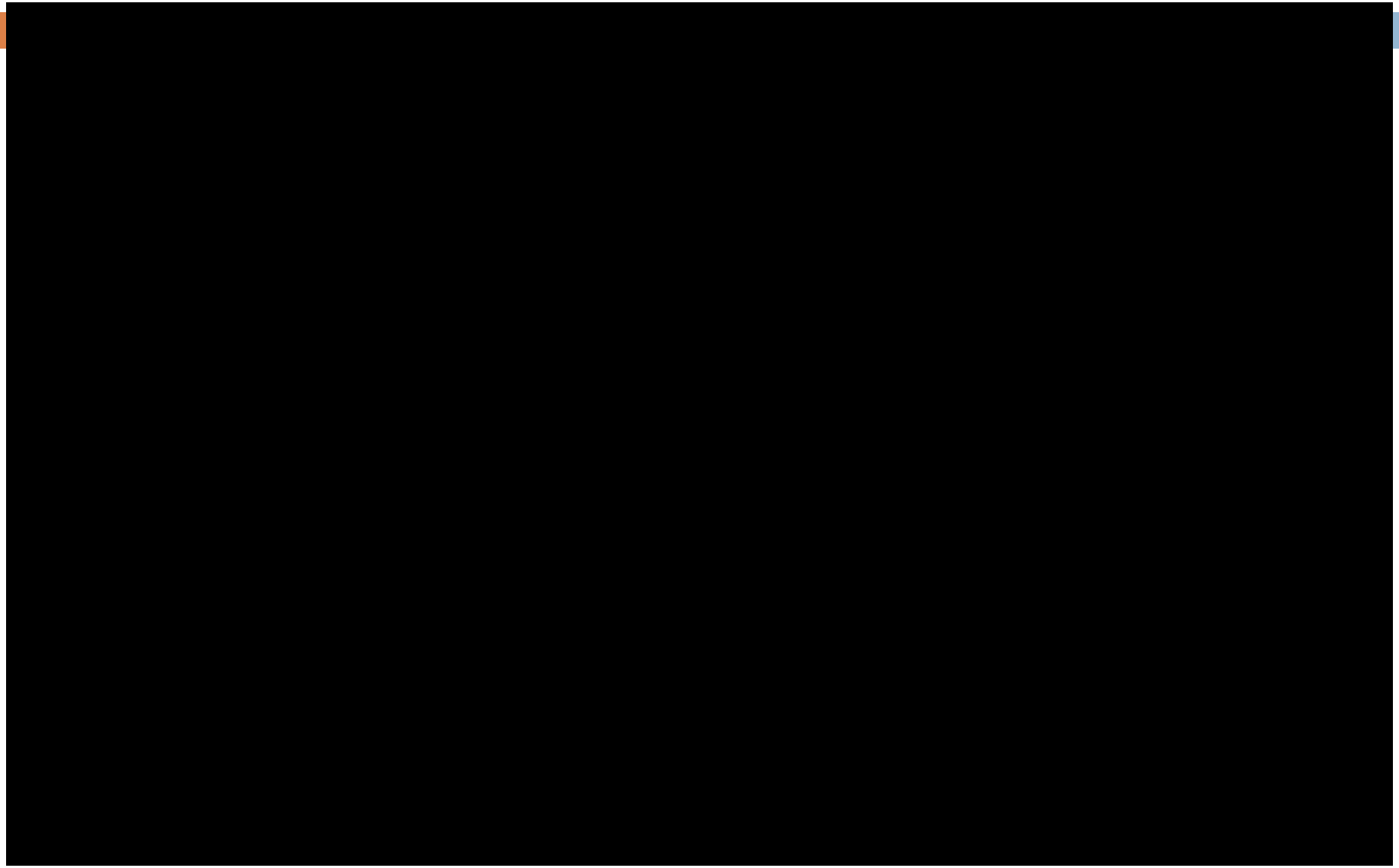
How did we do it?

- Improved In-process work-piece performance
- Automatic cut levels in cavity milling
- New Z-level Plus path to contour floors while roughing
- Trochoidal cutting to avoid over-embedding tool
- Holder checking for multiple tools

Conclusion

- HSM is not simply high cutting speed .It should be regarded as a process where the operations are performed with very specific methods and precision equipment
- HSM is performed in finishing in hardened steel with high speeds and high feeds often with 4-6 times conventional cutting speeds
- HSM is high productive machining in small sized components in roughing to finishing and in finishing to super finishing in components of all sizes.
- Improvement of quality and optimization of cost.

HSM Video



WEBSITE REFERENCE

- UGS PLM Software
http://www.plm.automation.siemens.com
- Vibrafree.com
http://www.vibrafree.com/UHSHM/UHSHM.htm

For more case studies please visit Vibrafree.com. There a lot of case studies about HSM in pdf format.

Thank you