Manufacturing process modeling and metrology

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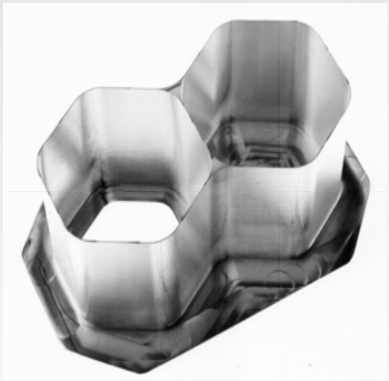
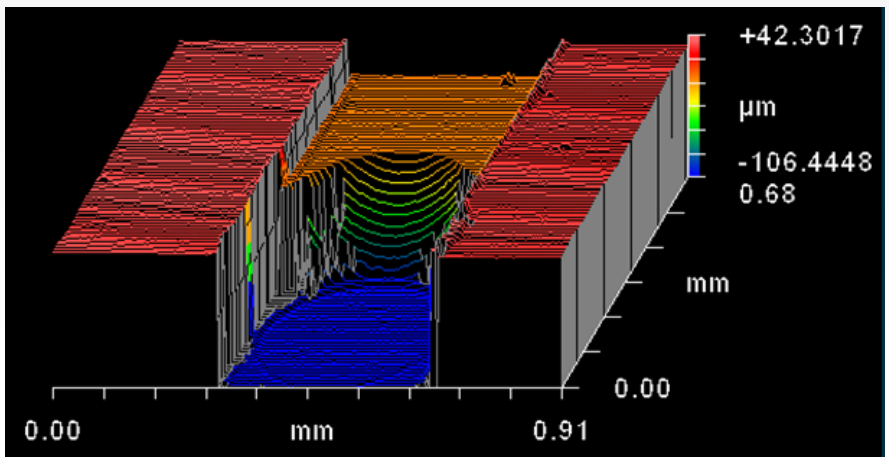
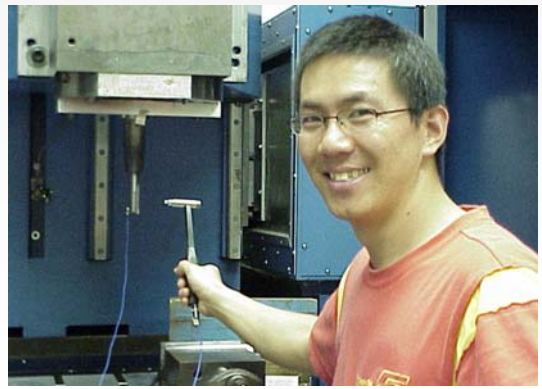


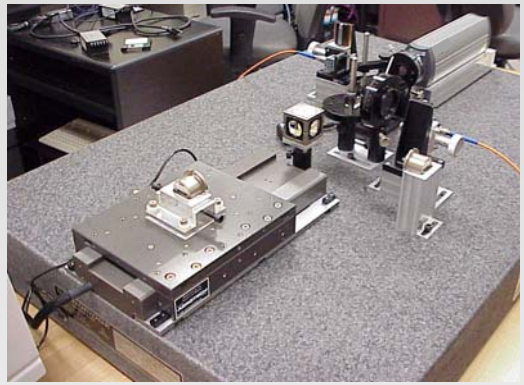


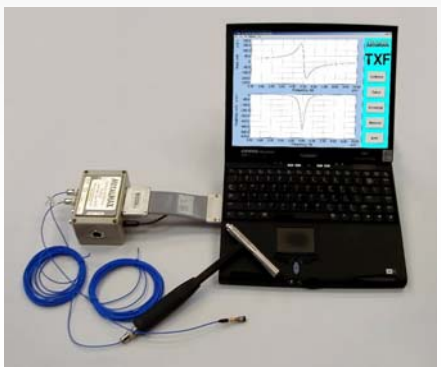


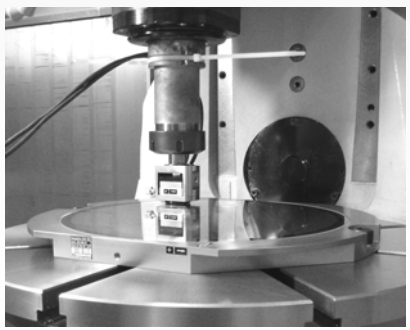
Machine Tool Research Center

Machine Tool Research Center

- Founded in 1984 by Dr. George Tlusty
- 26 PhDs graduated
- 60 MS degrees awarded
- Over $12M in externally sponsored research from government and private industry
- Over 2300 ft^2 lab space
- State of the art machine tools, metrology equipment, instrumentation







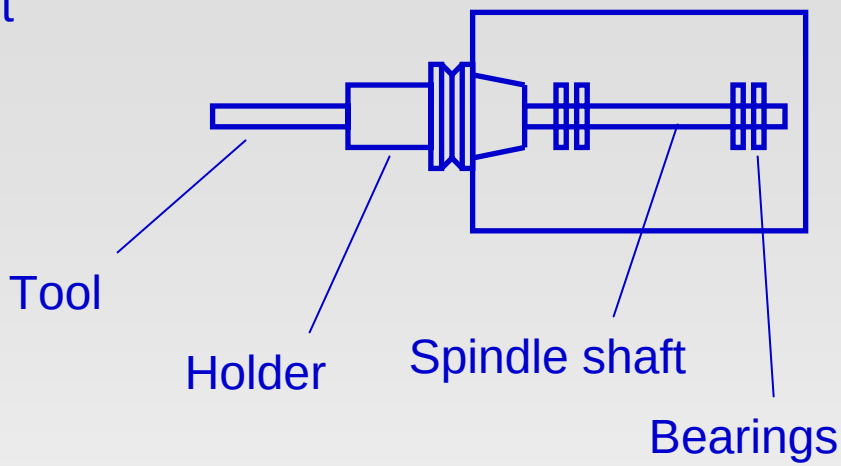
High-speed machining research

Stability lobe diagrams can be used to select cutting conditions to avoid chatter.

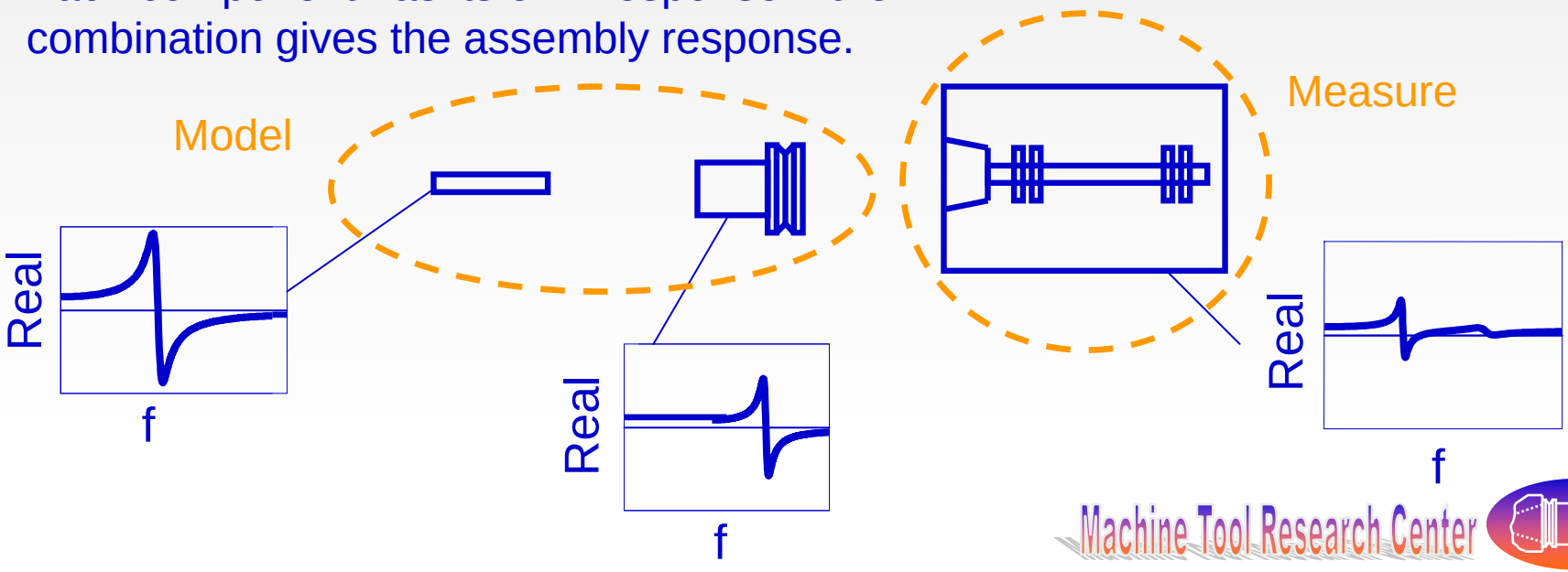
This requires knowledge of the tool point dynamic response.

Can measure using impact testing, but requires hardware and expertise.

Alternative: model the tool-holder-spindle assembly.



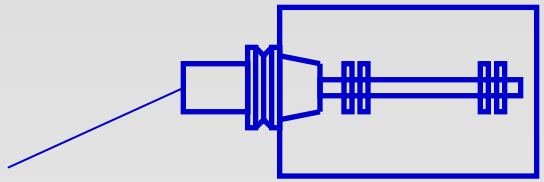
Each component has its own response – the combination gives the assembly response.



High-speed machining research

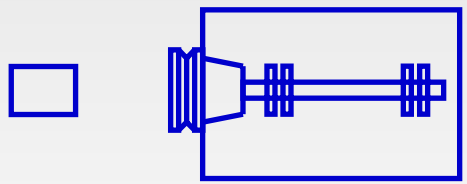
Our approach

- insert standard holder in spindle under test

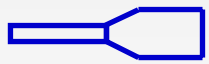


- measure response of standard holder-spindle by impact testing (service provider, archive, include as part of maintenance program)

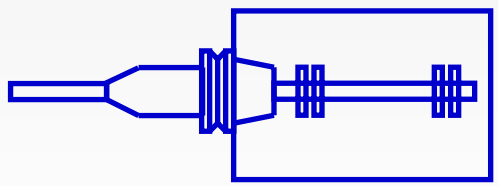
- remove portion of standard holder beyond flange (in simulation) to isolate spindle



- model desired tool-holder



- couple tool-holder receptance (FRF) to spindle response



- predict tool point FRF (virtual impact test)

High-speed machining research

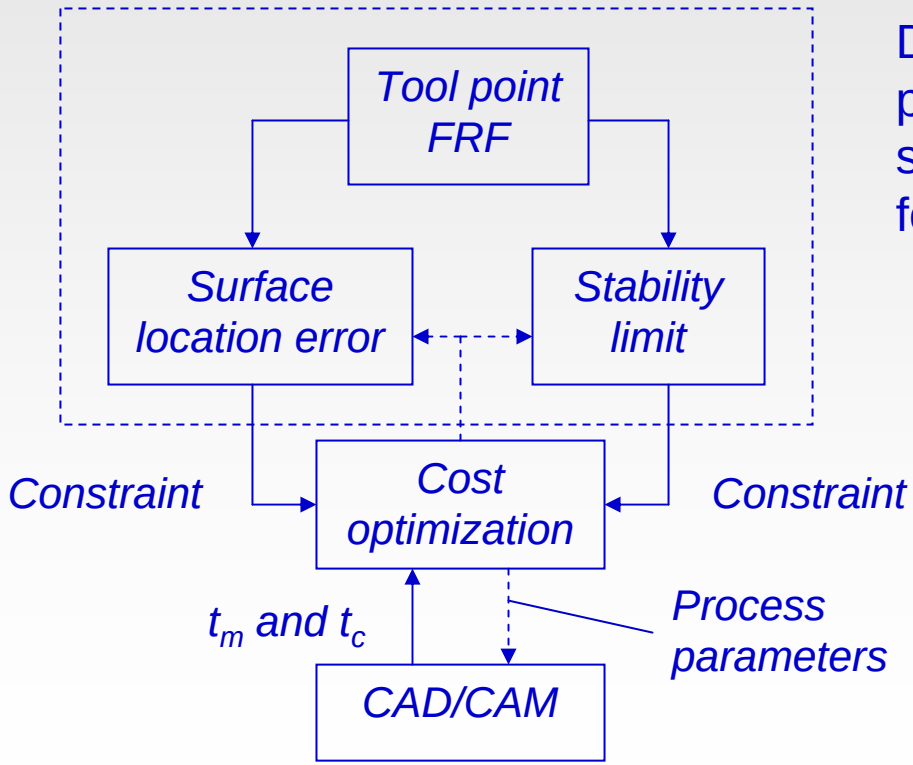
Single objective function, cost-based optimization formulation. Consider both process dynamics and tool wear.

$$C(x) = a + xC_m$$

$$C_m = t_m r_m + \left(t_{tch} r_m + C_t\right)\frac{t_c}{T}$$

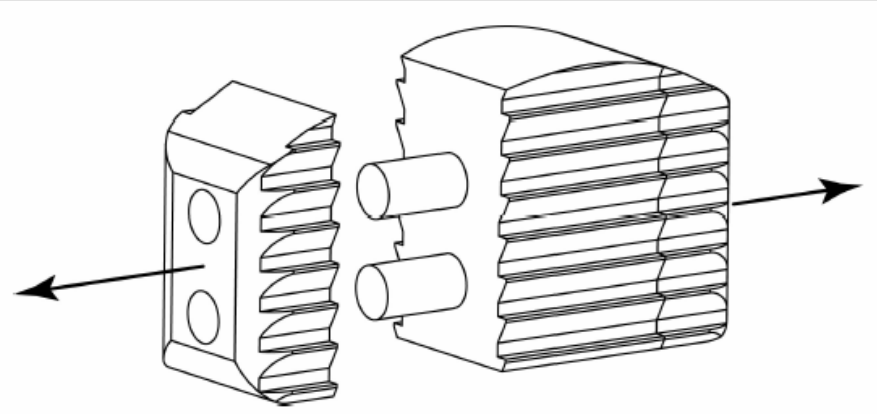
Depend on process parameters (spindle speed, depths of cut, feed/tooth)

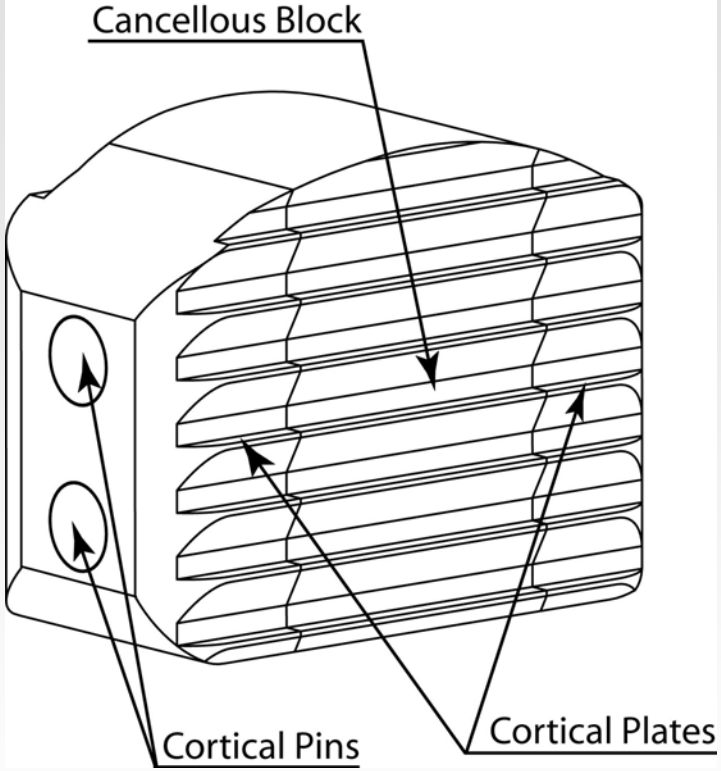
All analytical, frequency domain models.



Manufacturing metrology research

Example: Determine error sources for interference pin connection in human bone allograft for spinal fusion.





Measured components at process stages.

Determined interference from dimensions.

Developed finite element model.

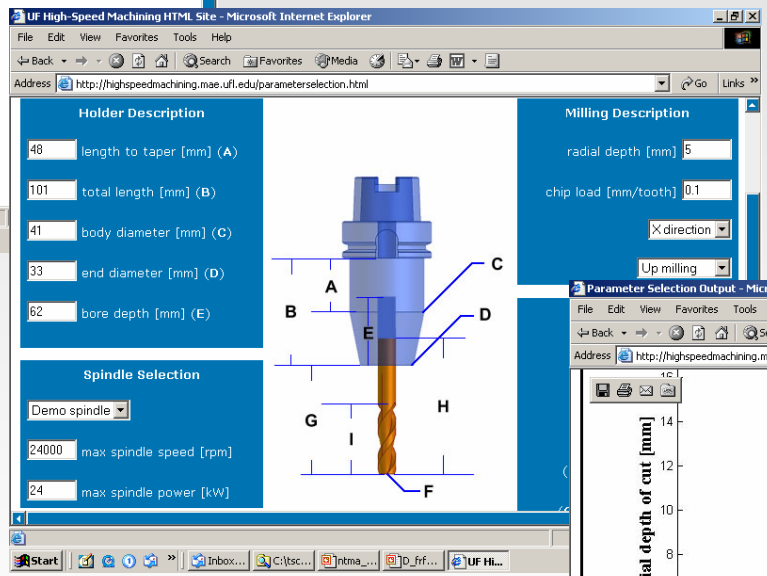
Completed Monte Carlo simulation.

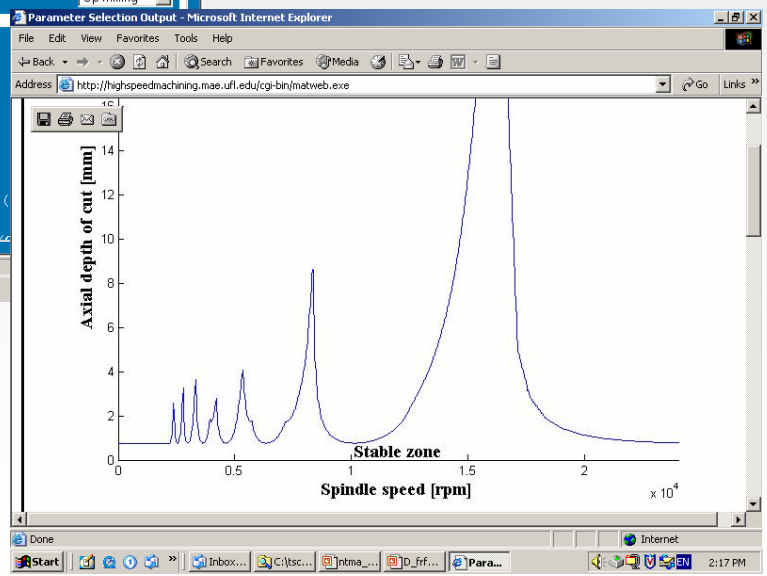
Made recommendations for process improvements.

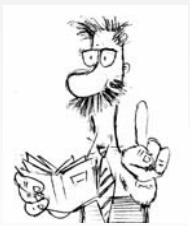
Web site for more information

http://highspeedmachining.mae.ufl.edu

- Publications
- Presentations







Pigskin Professor video series

Machine Tool Research Center