High-accuracy CNC algorithms for high-precision manufacturing

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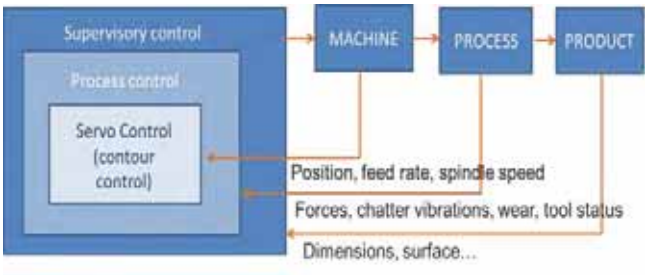
Objectives

Precision manufacturing is becoming increasingly important due to the rapidly increased demand for high precision micro products and components in a wide range of industries, such as biomedical, electro-optics, automotive, aerospace and information technology. Currently, these highly accurate miniaturized 3D complex parts are made via a variety of separate high precision machining processes, such as milling, grinding and laser machining.
Every process, which takes part in high-precision manufacturing, is conducted by computer numerical control (CNC). Nowadays, commercial CNCs provides PID controllers and no sophisticated interpolators. Moreover, the position control is intended to be combined with the control of forces in order to get a more accurate approach building an hybrid position-force controller. Finally, an intelligent system presents a support system to combine these aspects and others of the process, such as selection of milling tools, cutting parameters, etc.

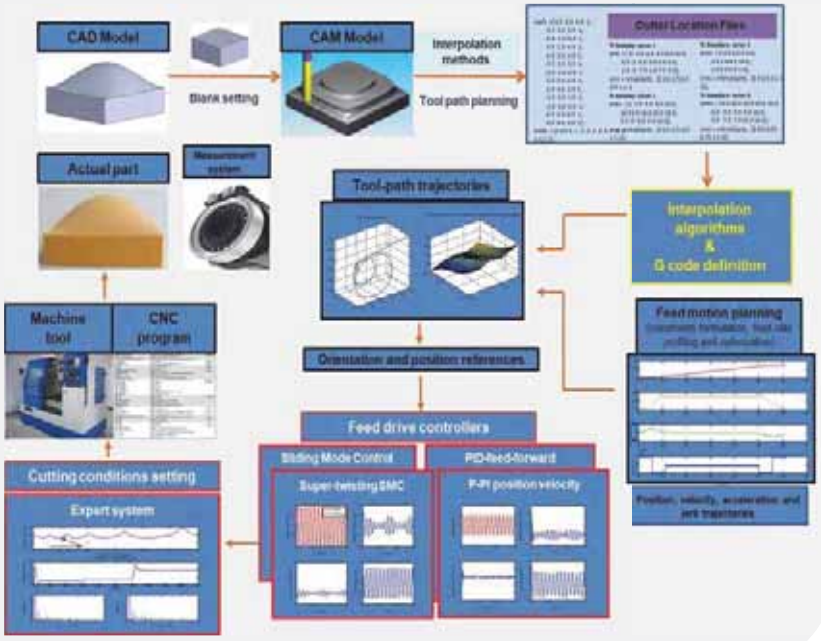
Methodology

The manufacturing system is separated into machine, process and product and separated controllers are dedicated. Furthermore, later, they will be put together in hybrid controllers position-force or real time solutions.

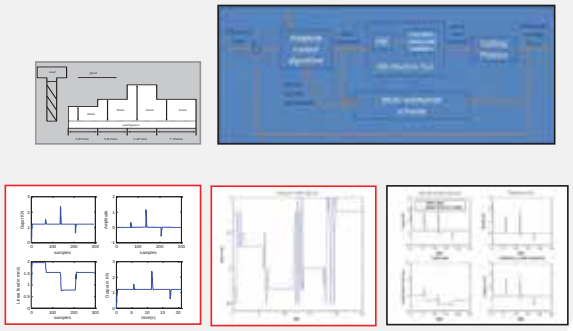


Results & Work in progress

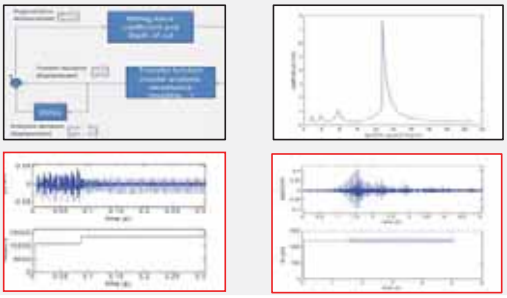
I. Feed drive controller and cutting conditions setting



II. Adaptive force control



III. Vibrations avoidance



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2. L. Rubio, M. de la Sen, A.P. Longstaff and S. Fletcher (2013), “Analysis of discrete time schemes for milling forces control under fractional order holds”, International Journal of Precision Engineering and Manufacturing, 14(5), pp. 735-744, May 2013.
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