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CPS: Synergy: CNC Process Plan Simulation, Automation and Optimization (1646013 - CPS/CM)

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Challenge

Computer-aided manufacturing (CAM) tools are critical for supporting functional manufacturing by machining

Conventional automated CAM methods are sub-optimal due to:

1. Constraining tool paths along simple paths
2. Restricting of tooling orientation
3. Single-feature part processing

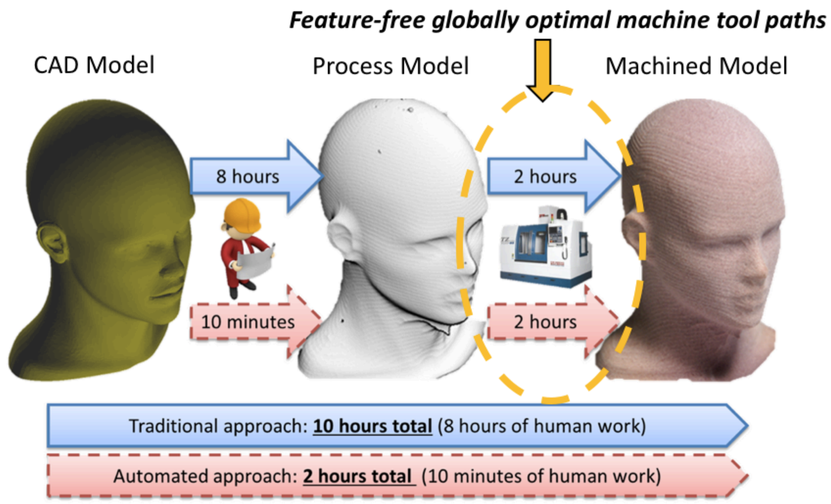
Conventional semi-automated CAM methods are difficult to use and require significant expert user input and control.

Solution

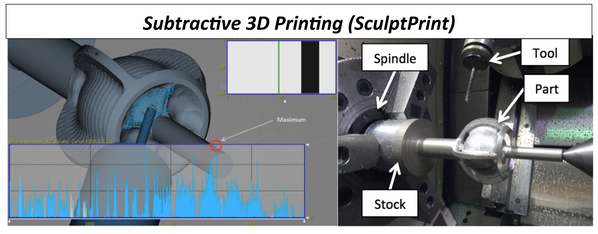
Integrated approach based on rethinking the way tool motion unit elements are designed and implemented in machine controllers. Integration with ubiquitous sensing (big data approach) for enabling predictive physics on the machine tool.

1. New sophisticated voxel-based tool motions for optimizing speed.
2. New controller architectures for dynamic machine control.
3. Sensor integration for predictive physics.
4. Validation.

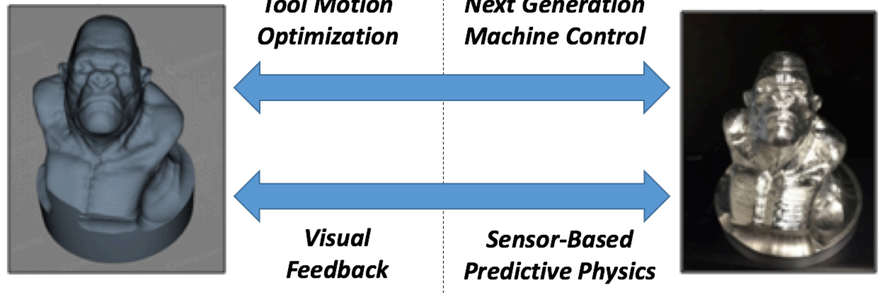
Challenge



Method



Plan



Scientific Impact

The new mathematical algorithms for manufacturing process planning will drive:

1. Dynamic reprogramming capability for machines using native adaptive planning for machine controllers.
2. Real-time process control/optimization.
3. Multi-fold increases in machine productivity.
4. High-performance GPU-based computing in manufacturing analyses.

Broader Impact

Implementation of new path planning and control architectures for machine tools will:

1. Drive improvements in effectiveness for CNC machining, an industrial activity used in production of 82% of products.
2. Enable multi-fold improvement of production time compared to currently available automatic CNC planners. Potential savings of $1T per year.
3. Lead to order of magnitude reduction in expert labor needed using semi-manual process planners and time required to teach this expertise to students.

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