Simulating Non Cutting CNC Processes

CNC Simulation of Non-Cutting CNC Processes

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Who uses CNC Simulation and Why?

- **End users**
  - To verify and optimise the CNC machining process
  - To evaluate possible new machine purchases

- **Machine Tool Builders and Distributors**
  - To make proposals, Time studies and benchmarks for both existing machines or new or modified machines

- **Universities and Colleges**
  - To provide students with a Virtual machining environment to learn about different types of machine tools
Simulating Non Cutting CNC Processes

The World leader in CNC Simulation

Simulating Non Cutting CNC Processes

VERICUT

CNC Simulation, Verification, Optimization and Analysis

CNC Simulation for the World’s Aerospace Manufacturers

Seamless Integration with VERICUT!

Click on a CAD/CAM logo for a simulation

VERICUT is the world’s leading INDEPENDENT CNC simulation software, used in nearly every industry by users of ALL leading PLM and CAM systems!

CGTech’s Interfaces for VERICUT provide an easy & convenient way to verify CNC programs directly from your CAM system! The interfaces can verify individual CNC programs, a series of selected CNC programs, or a complete sequence of operations.
Simulating Non Cutting CNC Processes
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Parallel Kinematics

Automated Fixtures - Pogos

- **Pogo simulation**
  - A “Pogo” is a programmable stock support with a self-orienting suction cup (or other device) on the end
  - When the suction cup contacts the stock it orients normal to the surface
Pogo Simulation, cont.

- **Pogo macro**
  - Sets pogo motion type for `ProcessCompNameValue`
  - Orient the last component on the branch
  - Component is oriented about its origin and normal to the stock surface
Simulating Non Cutting CNC Processes
Waterjet Cutting

WaterJet

Macros, Tools, Components
- WaterJetOnOff
- WaterJet Tool
- Deflector Component

Simulating Non Cutting CNC Processes
Waterjet Cutting

- Water Jet tool type in Tool Manager
  - Parametric water jet cutter
    - Diameter
    - Length
    - Min/max cutting zone
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Waterjet Cutting

Riveting/Fastener System Support
Simulating Non Cutting CNC Processes
Riveting Assembly

- **Rivet/Fastener Simulation**
  - Created for “proof-of-concept” trial for Airbus France
  - Trial project adds rivet models to a skin/structure via NC program command

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Riveting Assembly

- **Rivet/Fastener Simulation, cont.**
  - Long term project to provide specific simulation features
    - Fastener features
    - Statistics
    - Specific error checks
    - Integration in VERICUT
Simulating Non Cutting CNC Processes
Riveting Assembly

Project History
- Proof-of-concept study completed end of 2004
- Fiber-placement programming and simulation prototype delivered end of 2005
- Initial customer order end of 2006
- First beta delivery completed mid-2007
- First production delivery scheduled for mid-2008
Simulating Non Cutting CNC Processes
Composite Software Goal

- Provide machine-independent off-line programming and simulation software for CNC composite fabrication machinery
  - Similar to the historical example of CNC machines in the metal-cutting industry

Simulating Non Cutting CNC Processes
Fibre Placement Programming

- Read CAD file and ply definitions
  - Read tool surface and ply geometry and attributes
    - CATIA V5
    - SAT
    - XML
  - Geometry definition and accuracy is maintained
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Fibre Placement Programming

- **Setup Material and Paths**
  - Tow quantity, width, material thickness
  - Tow direction tolerance, minimum length, extension direction
  - Maximum overlap
  - Splice minimum length and separation
  - Course spread adjustment

- **Link courses**
  - Set lead-on, lead-off, retract distance and start location
  - Link manually or automatically
  - Choose direction, painting, spinning and head reversal options
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Fibre Placement Programming

- **Post-processing**
  - Specify output point spacing
  - Motion smoothing via head pitch rate limits and "grader" adjustments
  - Output ISO (G-Code) NC programs via user-configurable post processor
  - Output CATIA V5 path and material curves for analysis
Simulating Non Cutting CNC Processes
Composite Machine Simulation

Overview
- Based on industry leading VERICUT Software
- User-configurable machine kinematics and control emulation
- Simulate directly from ISO (G-Code) NC program file

Continuous sweep collision detection
- Not a static interference check

Accurate reverse kinematics
- From “roller” to joint positions

Simulate concurrent motion of multiple machines
- Painting & Rotating
- Up to 32 machines
Fiber placement integrated in machine simulation
- Applies material per NC program commands
  - Follows roller path
  - Tow add/cut
  - Material data stored by tow, path, ply and layer
- Simulates physical placement behavior
  - Apply material to the tool or previous material
  - Monitor roller conformance to tool/material surface
  - Detect steering and roller orientation errors in the NC program file

Measure material thickness, gap and overlap
- Individually
- Automatically by region

Detect invalid roller/path orientations

View material application statistics by
- Length of each tow
- Total material required
- Number of cuts for each tow
- Reset statistics based on planned maintenance events