NX CAM Update and future directions
The latest technology advances
Dr. Tom van 't Erve
NX for manufacturing
Key capabilities overview

Mold and die machining
- Adaptive milling
- Advanced, smooth finishing strategies

Production machining
- Automated NC programming
- Seamless mill-turn programming

Complex part machining
- Tube machining

Additive manufacturing
- Powder bed fusion
- HP Multi Jet Fusion

Productivity enhancements
- Intelligent in-process workpiece
- Performance improvements
- Enhanced program validation
Selected items…

- Referenced GMC & Feature-based GMC
- Inprocess workpiece
- Pinch turning
- Roughing
- Adaptive Milling
- Tube Milling
- Load IPW from operation
Selected items (continued)...

- Hole Making
- Feature based Machining
- Turning tool holder definition
Referenced GMC - Prototype

**What is it?**

Enhancing GMC in such a way that the user can more easily describe a motion sequence and reapply it from a template without going into each sub-operation for redefining input.

Framework for providing better ootb coverage for on-machine probing, in particular cycle based probing.

Not limited to probing, can also be used for other motion sequences like complex hole machining or specific milling that our current processors do not support.

- Referenced GMC & Feature-based GMC
- Inprocess workpiece
- Pinch turning
- Roughing
- Adaptive Milling
- Tube Milling
- Load IPW from operation
Referenced GMC

**Capabilities**

**Front End for Key Input:** The motion sequences are described by using regular sub-operations that have been extended. The sub-operations now allow input to come from the operation level & the tool.

Allows to define a set of key input parameters such as points, vectors, values and so on that can be put on the main dialog.

**Reference:** Once defined, they can be referenced and reused within the sub-operations.
Referenced GMC with Feature Input

Capabilities

**Feature Input:** Brings the concept of referenced GMC to feature based operations

The motion sequences are described by using parametric sub-operations. The sub-operations allow input to come from the feature level and are applied per feature.
Referenced GMC & Feature-based GMC

Inprocess workpiece
Pinch turning
Roughing Adaptive Milling
Tube Milling
Load IPW from operation

Improved usability and productivity. Create templatized motion sequences for probing, complex drilling, etc.
Next Generation IPW

New technology
- Multi-purpose
  - Tool Path Generate; Simulate & Verify
- Multi-Machining
  - Milling; Drilling & Turning
- Multi-version step-by-step project since NX9
- Finally released with NX11.0.2

New features
- Improved performance through Multi-Threading
- Simplified Geometry definition for Mill-turn (support for all Blank Types)
- Show Thickness Support for Turning
- 3D Collision Checking for Holders in Turning
- Local Resolution Refinement
- Consolidated Analyze/Show Thickness By Color
Next Generation IPW
Improved performance through Multi-Threading

<table>
<thead>
<tr>
<th>Selected Actions</th>
<th>NX11.0.1</th>
<th>NX11.0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare IPW for last operation</td>
<td>57 sec.</td>
<td>35 sec.</td>
</tr>
<tr>
<td>Show Thickness by Color</td>
<td>30 sec.</td>
<td>13 sec.</td>
</tr>
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</table>
Next Generation IPW
Simplified Geometry definition for Mill-turn

Capabilities
- Mill turn support for standard milling workpiece types
- Mill turn support of IPW flow
- Simplified Geometry definition

More details on the new Geometry Structure in this afternoon’s NX CAM Programming of Complex machine tools (Mill-Turn) 16:00 session (this same room)
Next Generation IPW
3D Collision Checking for Holders in Turning

Capabilities
- In addition to 2D Sketch on Layer 3…
- Now use 3D tool assembly for collision checking in:
  - Simulation
  - Verify
Next Generation IPW
Show Thickness and color by tool in Turning

For turning and mill-turn
- Coloring of material removal
- Show Thickness by Color

Referenced GMC & Feature-based GMC
Inprocess workpiece
Pinch turning
Roughing Adaptive Milling
Tube Milling
Load IPW from operation
Next Generation IPW
Enhance IPW Resolution

New feature in Verify 3D and Simulation

- Referenced GMC & Feature-based GMC
- Inprocess workpiece
- Pinch turning
- Roughing Adaptive Milling
- Tube Milling
- Load IPW from operation
Next Generation IPW
Merged Analyze/Show Thickness By Color

Referenced GMC & Feature-based GMC
Inprocess workpiece
Pinch turning
Roughing Adaptive Milling
Tube Milling
Load IPW from operation
### Next Generation IPW

<table>
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<tr>
<th>Feature-Based GM&amp;</th>
<th>Improved usability and productivity. Create templatized motion sequences for probing, complex drilling, etc.</th>
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Pinch Turning (Prototype)

Terminology

- Pinch turning, aka merging lathe or dual roughing, is a common option for multi-channel multi-function production machines. In pinch turning, two (or more) tools are simultaneously machining the same IPW.
Pinch Turning (Prototype)

Reduced Programming Time because of
- Standard Operation
- Automatic and Manually Synchronization
- Automatic Tool suggestion
- One click generate for two Operation
- Simple to use also for new users
- Automatic and correct IPW generation
- Integration into Verification
- Linked Operation to share Parameters
- Standard example Post available
Pinch Turning (Prototype)

Capabilities
- Merging Lathe; second Tool follows the leading Tool by a distance
- Dual Facing
- Balanced Mode; both Tools cut at the same time (double feed rate)
- Automatic Synchronization
- Automatic assignment of correct avoidance
<table>
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<th>Description</th>
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More details on Pinch turning in this afternoon’s NX CAM Programming of Complex machine tools (Mill-Turn) 16:00 session (this same room)
Adaptive Milling

Capabilities
- Accomplishes a high speed tool path that maintains a consistent chip thickness
- Higher productivity
- Longer tool life
- Good choice for milling hard materials
- Available with any license that includes Cavity Mill
- Preview NX 11.0.x
- To test, you need a special mill-contour template
- Production release with NX12.0
Adaptive Milling - Roughing
- High Feeds & Speeds

Capabilities
- Deep cuts at high feed rates
- Smooth-flowing toolpath
- Consistent tool load
- Cutting tools can be used to their maximum

Customer benefits
- Reduce machining time; up to 60%
- Ideal for hard materials
- Extend tool life by up to 4x
Advanced finishing methods

Enhanced finishing capabilities
- Spiral finishing strategy
- Machining across gaps
- Consistent step over

Customer benefits
- Superior quality of machined surface
- Eliminate prep work
- Reduced rework
**Advanced toolpath smoothing**

**Optimized toolpaths**
- Smooth engages into material
- Smooth retract moves
- Smooth transitions
- Eliminates sudden stops and change of directions

**Customer benefits**
- Reduced machining time
- Minimized machine tool wear
- Improved accuracy
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Tube Milling

- Referenced GMC & Feature-based GMC
- Inprocess workpiece
- Pinch turning
- Roughing Adaptive Milling
- Tube Milling
- Load IPW from operation
Tube Milling

Capabilities
- Efficient rough and finish cutting strategies
- Automated tool orientation
- Precise control of cutting parameters

Customer benefits
- Streamlined, error-free programming
- Shorter machining time
- Improved machined quality
**Tube Milling**

**Shapes with closed cross-section**
- Ports of combustion chambers
- Sculptured/undercutting holes
- Housings
- Shrouded blisk
- ‘Additive’ parts
- …
**Tube Milling**

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**Finishing operation added in NX 11.0.1**
- Helix
- Along

**Roughing operation added in NX 11.0.2**
- Follow Periphery
- Adaptive
  - Optimized material removal after any pre-machining (IPW aware)
  - Smooth tool path – especially in sharp edges
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Use IPW from preceding Operation in Simulation & Verification

Ability to use IPW from preceding operation
- Use saved IPW or calculate on the fly

Referenced GMC & Feature-based GMC
Inprocess workpiece
Pinch turning
Roughing
Adaptive Milling
Tube Milling
Load IPW from operation
Load IPW from preceding Operation in Simulate
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<td>Save time during simulation and verification</td>
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Selected items (continued)…

- Hole Making
- Feature based Machining
- Turning tool holder definition
New Cutting Tool Types
Boring Bars & Chamfer Boring Bar

Capabilities

• New parametric tool types for boring & countersinking
• Replacing existing Boring Bar
• Detailed description of cutting and non-cutting sections
• Corner Radius fits Diameter
• Lead Angle; Insert Angle & Insert Lengths to describe insert
• Relief and Pilot parameters to define areas surrounding the insert for verification and collision check purposes

Customer Benefit

• Better process reliability due to exact definition of the tool
Hole making: predefined depth

Capabilities
- Overrule inferred operation depth
  - Fixed value; % tool diameter; % flute length
  - E.g. Pilot hole depth as factor of tool diameter

Customer Benefit
- Associative control of operation depth
- No longer need in-process feature definition in the MKE via Add-On
Thread Milling: Multiple starts

Capabilities
- Allows recognition and user definition of number of starts for threads

Customer Benefits
- Additional capability; previously only a single start was supported
- Multiple starts give the thread more strength
Feed Adjustment on Arcs

Capabilities
- Definition of Feed Adjustment on Arcs
- Aligned to Planar Milling operations

Availability
- Hole Milling
- Chamfer Milling
- Boss Milling
- Thread Milling
- Radial Groove Milling
<table>
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<tr>
<th>Hole Making</th>
<th>Easier and more accurate operation &amp; tool definition</th>
</tr>
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Feature groups

Capabilities
- Unifies feature groups created by “Group Features…” and “Create Feature Process…”
- Adds Classification criteria to all feature groups

Customer Benefit
- Improved support for design change workflows
- Drag & drop of features into feature groups checks the acceptance criteria
- Consistent behavior for: “Show Valid Feature Groups…”
Delay update of machining features
E.g. after design change or move component

Capabilities
- Automatic delay of manufacturing feature updates outside of CAM
- Optional delay of manufacturing feature updates inside of CAM
- General update feature recognition performance improvements

Customer Benefit
- Improved performance in handling of feature updates
- Ability to delay updates until all modifications have been finished

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move component</td>
<td>Move component</td>
<td>Move component</td>
</tr>
<tr>
<td>Stay in CAM</td>
<td>Stay in CAM</td>
<td>Switch to Modeling</td>
</tr>
<tr>
<td>42 minutes</td>
<td>8 minutes</td>
<td>6.5 minutes</td>
</tr>
</tbody>
</table>
General Performance Improvements

Capabilities
- Performance improvements on parts with large number (4000) of features

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<tr>
<td>Feature Recognition</td>
<td>60 minutes</td>
<td>3:25 minutes</td>
</tr>
<tr>
<td>Specify Feature Geometry in operation</td>
<td>24 minutes</td>
<td>0:46 minutes</td>
</tr>
<tr>
<td>Set User defined Depth in operation</td>
<td>51 minutes</td>
<td>2:40 minutes</td>
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<td>Hole Making</td>
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User defined Holder Style

Hole Making

Feature based Machining

Turning tool holder definition

Align definition of User-defined Parametric Turning Holders with ISO standards and tool vendors catalogs

KAPR
User defined Holder Style

Existing tool holder definition:
- Current definition for Insert and Holder is on two different tab pages

- Orient Angle and Holder Angle influence each other if “Lock Insert and Holder Orientation” is on!
- Tool holder definition behavior is confusing
User defined Holder Style

Enhancements for User defined Turning Holders:
- New Cutting Edge Angle (CEA) fully determines the characteristic of shank shape
  1. Legacy workflow: Tool definition via Orient- and Holder Angle with “Lock Insert and Holder Orientation”
  2. New definition via easy to use Cutting Edge Angle
- All on Holder tab page, “Lock” no more needed
  ❧ more easy to use
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<td><strong>Turning tool holder definition</strong></td>
<td>More realistic Turning Tool Shank shapes will reduce the need for 3D Tool assemblies</td>
</tr>
</tbody>
</table>
Additive manufacturing

3D print production-quality parts
Additive manufacturing
Powder bed fusion

3D print complex metal parts for real production

- Position the parts on the build tray
- Create support structures
- Define the build process settings
- Generate printer-specific output

Customer benefits

- Leverage the most widely utilized metal additive manufacturing technology
- Print fine internal details and complex features
- Near forged part material properties
Additive manufacturing
HP Multi Jet Fusion

Print functional plastic parts using a process similar to inkjet printing

- Automated 3D nesting of parts on the build tray
- Define printing parameters
- Drive the latest HP multi jet fusion 3D printers

Customer benefits

- Make parts with high dimensional accuracy and improved properties
- Build parts 10 times faster
- Reduce costs
NX CAM Additive manufacturing @this event

Today
9:00 – This room: Helmut Zeyn:
• Multi-Axis/Hybrid Additive Manufacturing

13:30 – This room: Helmut Zeyn:
• Fixed Plane Additive Manufacturing

Tomorrow
10:30 – Lyon: Elisa Birr:
• Industrialization of Additive Manufacturing – challenges and opportunities (round table)
As such, presentations help define the company's reputation and provide both internal and external orientation.
Contact page

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