

# UGPost with Non Standard Motion

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# UGPost with Non Standard Motion

- Agenda:
  - Define non-standard motion
  - How to setup machines with these types of non-standard motion
  - (Feel free to interrupt with questions)
  - Demo
  - Suggestions from others who have done non-standard motion

# What's Non-standard motion

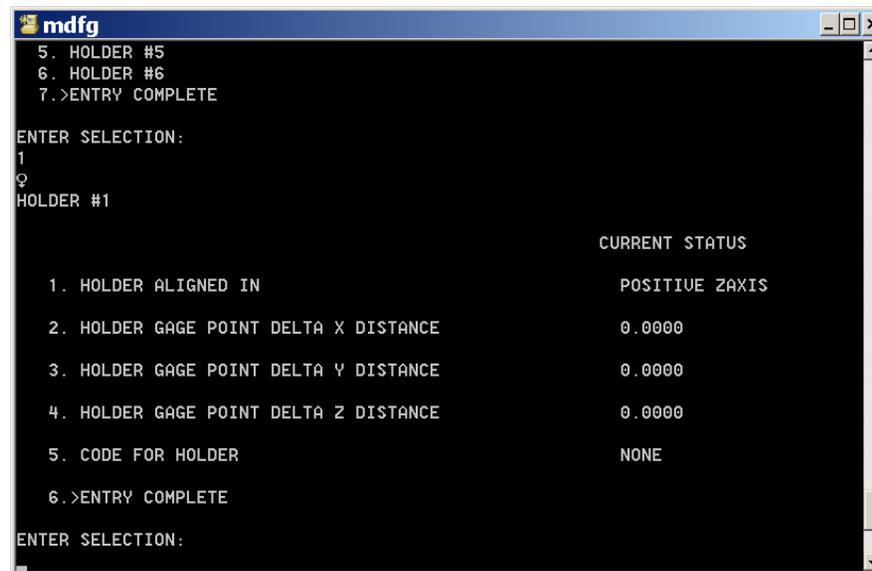
- Motion that UGPost does not handle as standard “out of the box.”
- Right angle head (standard?)
- Non-orthogonal axes
- Non-standard 5 axis machine  
(2 linear and 3 rotary axes – 5 axis machine?)
- Merging Lathes?
- Mill-Turns are standard by using linked posts.

# Right angle head

- In pre-NX3 this was done with holders assigned with the load command.
- This was not reliable for multi-axis motion.
- Hence, not very useful.

# Right Angle Head

- In pre-NX3 we used the Holder with the Load tool command.
- In MDFG you had this menu



```
mdfg
5. HOLDER #5
6. HOLDER #6
7.>ENTRY COMPLETE

ENTER SELECTION:
1
♀
HOLDER #1

CURRENT STATUS

1. HOLDER ALIGNED IN          POSITIVE ZAXIS
2. HOLDER GAGE POINT DELTA X DISTANCE    0.0000
3. HOLDER GAGE POINT DELTA Y DISTANCE    0.0000
4. HOLDER GAGE POINT DELTA Z DISTANCE    0.0000
5. CODE FOR HOLDER            NONE
6.>ENTRY COMPLETE

ENTER SELECTION:
```

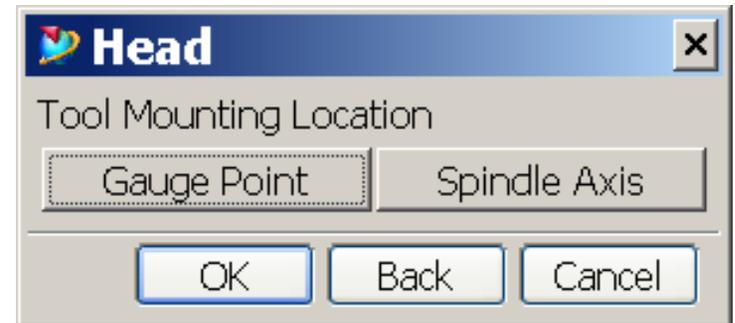
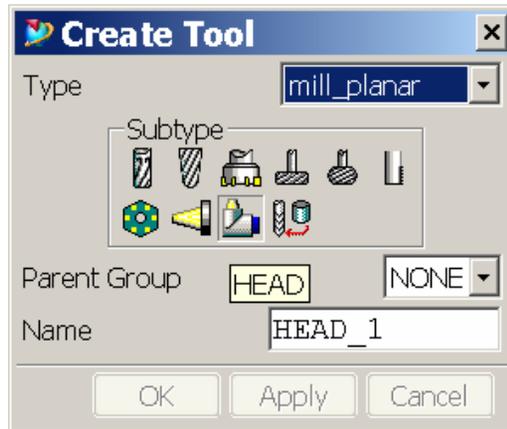
# Right angle head

- In UGPost you must set these mom variables.

```
▪ #=====
▪ proc PB_CMD_init_kinematics { } {
▪ #=====
▪ uplevel #0 {

▪ ###    set mom_kin_read_ahead_next_motion "1"
▪       set mom_kin_holder0_offset_x 0.0
▪       set mom_kin_holder0_offset_y 0.0
▪       set mom_kin_holder0_offset_z 0.0
▪       set mom_kin_holder0_orientation NEGZ
▪       set mom_kin_holder2_offset_x 0.0
▪       set mom_kin_holder2_offset_y 0.0
▪       set mom_kin_holder2_offset_z 0.0
▪       set mom_kin_holder2_orientation NEGX
▪       set mom_tool_holder 0
▪       MOM_reload_kinematics
▪       if {[hiset mom_fixture_offset_value]} {set mom_fixture_offset_value 1}
▪ } ;# uplevel
▪ }
```

# Right angle head



- In NX3 there is a head object under tools.
- Set the tool mounting position by setting the gauge point and the spindle axis.
- The use of the head object makes the right angle head trivial and now STANDARD.

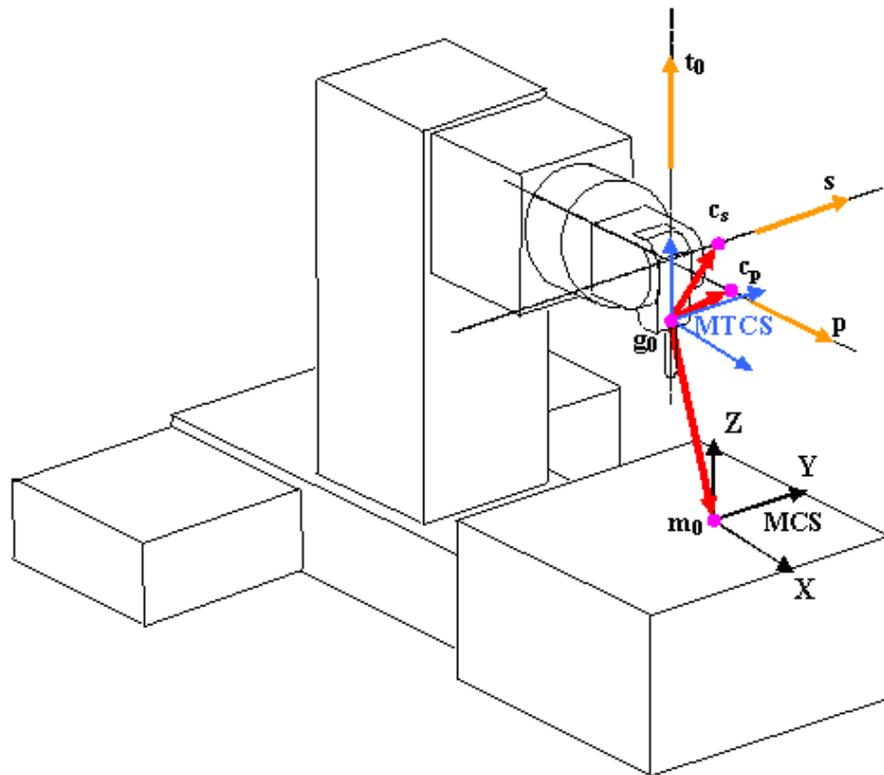
# Non-Orthogonal Axes

- Pre-NX3 there was the advanced kinematics module in UGPost.
- The advanced kinematics module was not reliable. It would usually give good output but at times it would abort.
- This meant non-orthogonal axes were possible only with the machine tool builders routine.

# Non-Orthogonal Axes

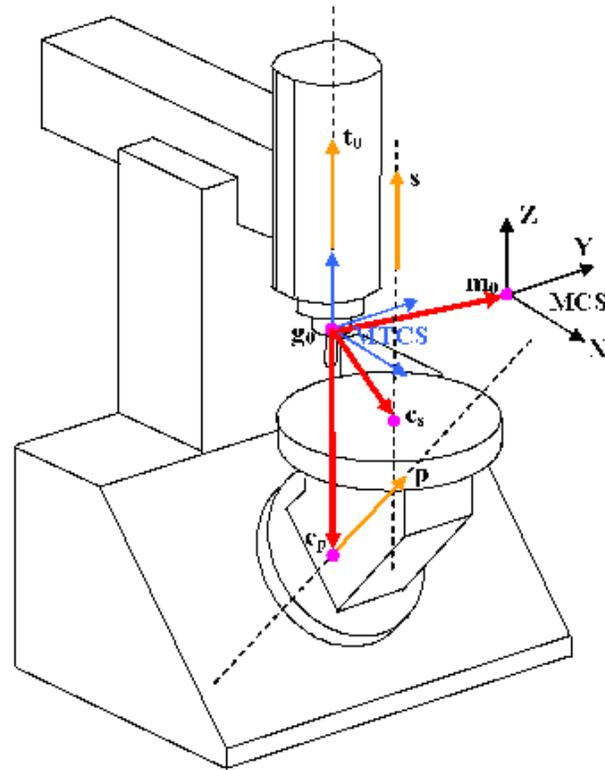
- In NX3 there is the new inverse kinematics engine.
- UGPost needs to set the rotary axis vectors, points and spindle axis

# Non-Orthogonal Axes



- Example of dual head at 45 degrees

# Non-Orthogonal Axes



- Example of dual table at 45 degrees

# Non-Orthogonal Axes

- **Parameter**    **mom Variable**
- t0            mom\_kin\_spindle\_axis (0,0,1)
- p             mom\_kin\_4th\_axis\_vector (1,0,1)
- s             mom\_kin\_5th\_axis\_vector (0,0,1)
- cp            mom\_kin\_4th\_axis\_point (2,-2,-10)
- cs            mom\_kin\_5th\_axis\_point (4,0,-4)
- m0            mom\_kin\_machine\_zero\_offset (1,10,0)

# Non-Orthogonal Axes

- Examples
- 
- #
- # This flag must be set to "1" for the new IKS to use the new mom variables.
- #
- set mom\_kin\_iks\_usage "1"
- 
- #
- # For three axis mills you should comment out mom\_kin\_4th\_axis\_vector
- # and mom\_kin\_5th\_axis\_vector.
- #
- # For four axis mills you should comment out mom\_kin\_5th\_axis\_vector.
- #
- # Depending on the requirements of your machine tool, you will need
- # to uncomment the following mom variables for four and five axis
- # machine tools and set them as necessary according to the NX3 documentation.
- #
-

# Non-Orthogonal Axes

- set A [expr 105.655/25.4];#4.15964
- set B [expr 504.445/25.4];#19.86043
- set angle 40.003
- set mom\_kin\_machine\_type "5\_axis\_dual\_head"
- set mom\_kin\_4th\_axis\_vector(0) 0.0
- set mom\_kin\_4th\_axis\_vector(1) 0.0
- set mom\_kin\_4th\_axis\_vector(2) 1.0
- set mom\_kin\_5th\_axis\_vector(0) 0.0
- set mom\_kin\_5th\_axis\_vector(1) [expr cos(\$angle\*\$DEG2RAD)]
- set mom\_kin\_5th\_axis\_vector(2) [expr sin(\$angle\*\$DEG2RAD)]
- set mom\_kin\_4th\_axis\_point(0) 0.0
- set mom\_kin\_4th\_axis\_point(1) [expr cos(\$angle\*\$DEG2RAD)\*\$B]
- set mom\_kin\_4th\_axis\_point(2) [expr sin(\$angle\*\$DEG2RAD)\*\$B+\$A]
- set mom\_kin\_5th\_axis\_point(0) 0.0
- set mom\_kin\_5th\_axis\_point(1) 0.0
- set mom\_kin\_5th\_axis\_point(2) \$A
- set mom\_kin\_spindle\_axis(0) 0.0
- set mom\_kin\_spindle\_axis(1) 0.0
- set mom\_kin\_spindle\_axis(2) 1.0

# Non-standard 5 axis machine

- 3 rotary and 2 linear simultaneous axes.
- NX only allows 2 simultaneous rotary axes.
- This type of machine is NOT a “standard” 5 axis machine.
- How do the 3 axes move simultaneously?
- It is possible to get to the tool axis with only 2 of the 3 axes.
- Therefore rules are needed. (UDEs and embedded in the code.)

# Non-standard 5 axis machine

- My example is a tool that has a dual head at a right angle head a table rotation.
- There is no Y axis.
- Head rotates A zx-plane, B xy-plane.
- Table rotates C xy-plane.
- The spindle axis is along Y (at A0 B0 C0 the tool is pointing in Y.)
- This machine simulates what NX thinks of as turning with a rotary head.
- Because of the rotary head needing a tool axis I must create this post as a milling machine.
- And the path is also a milling operation.

# Non-standard 5 axis machine

- To program this we need to modify motion output.
- This is done in MOM\_before\_motion and the motion type event.
- In postbuilder you put the code in the custom command PB\_CMD\_before\_motion.
- And add a custom command to the motion type events.

# Non-standard 5 axis machine

- First I need polar coordinates to get the 2 linear axes and 1 rotary.
- This is done for all motion types so I put the code in MOM\_before\_motion.
- Then each machine type is analyzed to see what the output type requires.
- I need to combine rotary motion if only 1 rotary axis is rotating.

# Non-standard 5 axis machine

- Cutting a cylinder:
  - With a zigzag path the C table rotates at each level then Z and again the C table rotates until the cylinder is cut.
  - With a helical path only Z and C move.
- Cutting a cone:
  - Similar to cylinder
  - Zigzag path same except the step over is X and Z
  - Helical path moves X,Z and C

# Non-standard 5 axis machine

- Cutting a bowl shape:
  - Here it's similar only with A rotating.
- NOTE: Because there is no Y, B is rotated to align the tool in X
- Feedrate may be the hardest to control.
- See if the machine tool builder has an equation you can use.
- It may be ok to use inverse time.

# Non-standard 5 axis machine

- I was lucky because the customer does not cut linear moves in Y.
- If this is to be done I will need to linearize the polar coordinate motion.
- Circular moves are a problem.
- I have to insist the tool path does not output circular motion.

# UGPost with Non Standard Motion

- DEMO