TechNOTE

Title: 3-Axis Curvilinear Motion using MultiFlex Motion Controllers
Products(s): All MultiFlex 1000 Series motion controllers
Keywords: MultiFlex, MCCL, Thread-cutting, Contouring, Master/Slave
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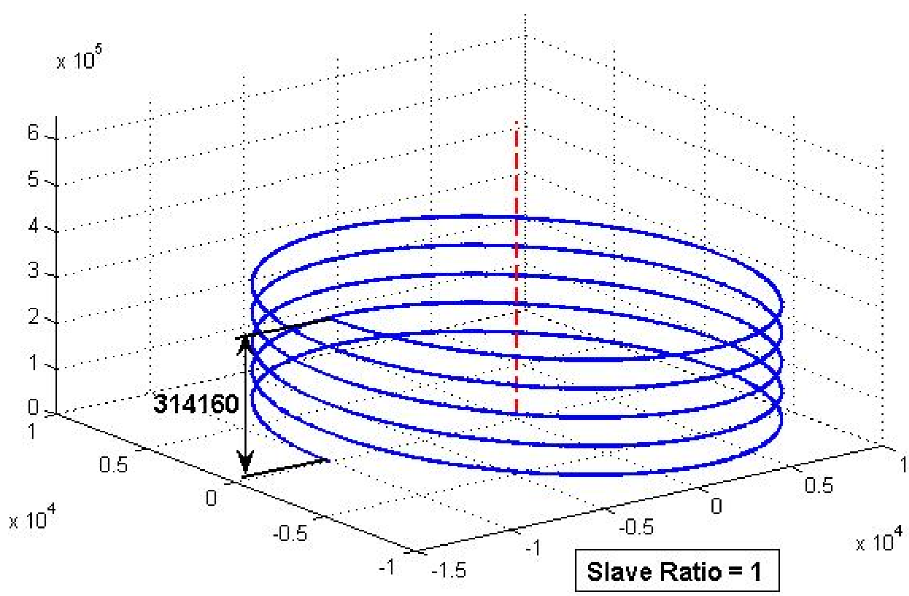
Summary

The MultiFlex 1000 series of motion controllers contain powerful multi-axis coordination features that can be used to quickly implement several advanced machining operations such as thread-cutting, camming, coil winding and other industrial etching operations.

More Information

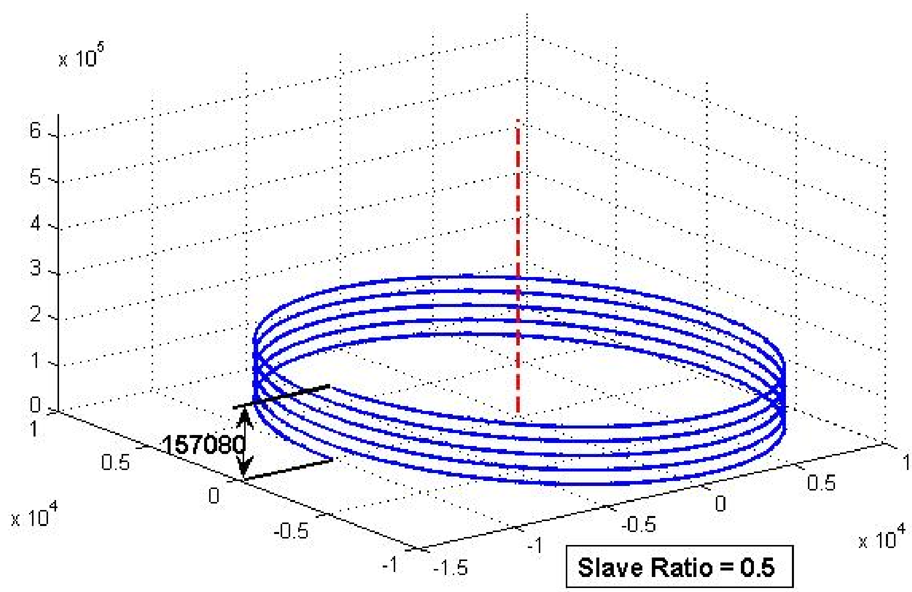
Thread-cutting is traditionally implemented by motion controllers utilizing a dual-axis algorithm where the cutting tool is assumed to be controlled by a single linear motor stage and the work is rotated by another single servo or stepper motor stage. Following is a description of a 2-axis implementation of rotation control that allows several significant advantages and unlimited flexibility in defining 3-dimensional surfaces.

This type of motion control combines two MultiFlex features – circular contour motion and master/slave axis coordination. In the following example, axis 5 and 6 are used to generate circular arcs in the X-Y plane. Axis 5 is the contour profiler and therefore determines the vector velocity of the circular motion. Axis 5 is also the master axis of the master/slave pair that allows motion in the z-axis (axis 7) to be synchronized to the circular arc.



The X-Y-Z plots shown here are generated from position data logged from a MultiFlex ETH series controller driving 3 pulse axes. In all three examples, the contouring axes describe a circle with radius 1E4 counts. This results in a total arc distance of 62832 counts per revolution and 5 revolutions are executed. As shown in the first figure above, the slave ratio of the Z axis is set to 1, resulting in a total excursion of 314160 counts.

In the example shown below, the slave ratio is set to 0.5 which causes the Z-axis to move one-half the total arc length, or 157080 counts.



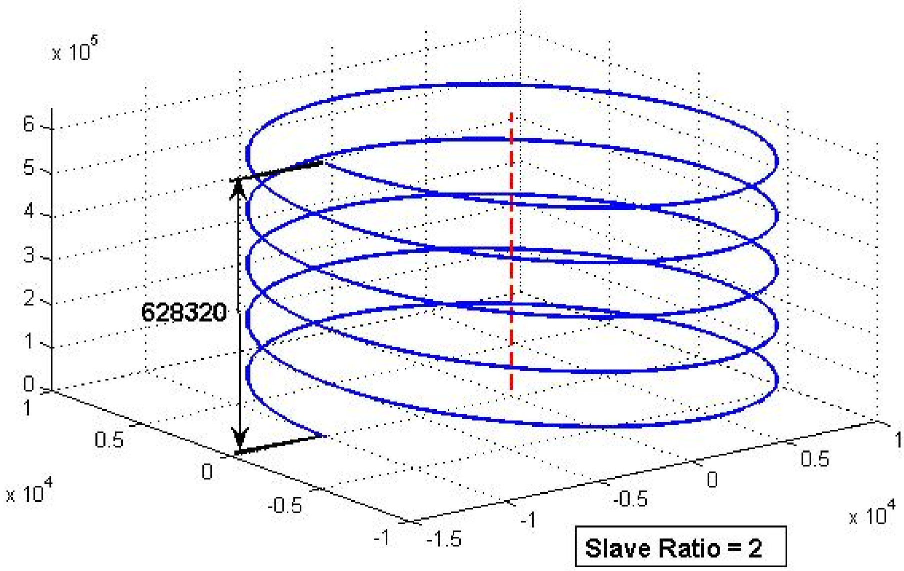
Clearly, the distance and velocity of the Z-axis excursion can be defined as:

$$S_Z = 2\pi R * SR * N$$
$$V_Z = V_C * SR$$

where

R	= radius of circular motion
SR	= slave ratio of Z axis
N	= number of circular revolutions
V_C	= vector velocity of circular contour profile axis

In the final example shown below, the slave ratio is set to 2, resulting in twice the excursion on the Z-axis and consequently, the coarsest thread pitch. With a judicious choice of axis velocities, user scales and slave ratios, virtually any helical geometry can be described by this method.



The next page contains a sample listing in the MCCL control language of the macros that were created to generate the motion shown here. It should be noted that full high-level language support is available in the PMC MotionControl API. The following functions are relevant to the examples described here:

- MCSetVectorVelocity( )
- MCSetContourConfig( )
- MCEnableGearing( )

```
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
; axis initialization
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
; axis reset, motion parameter initialization
md1,7mf,5mf,6mf,7rt,5rt,6rt
md2,7dh,5dh,6dh
md3,7mn,5mn,6mn
md4,7pm,5pm,6pm
md5,5sa500000,5ds500000,5sv200000
md6,6sa500000,6ds500000,6sv200000
md7,7sa500000,7ds500000,7sv200000
;
; 6 contoured to 5
md8,5mn,6mn,5cm5,6cm5
;
; initialization macros set contour mode axis 5-6
md20,mc1,mc2,mc3,mc4,mc5,mc6,mc7,mc8
;
;call initialization macros, set vector velocity and master/slave mode axis 5-7
;and set slave ratio to 1
md30,mc20,5vv50000,7sm5,7ss1
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
; arc contour moves
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
md70,5cp2,5ca0,6ca0,5ma10000,6ma0
md71,5cp2,5ca0,6ca0,5ma-10000,6ma0
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
; sample 5-rotation motion macro
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
md31,mc70,mc71,mc70,mc71,mc70,mc71,mc70,mc71,mc70,mc71
```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