Title: MultiFlex Spiral Motion Path Generation
Products(s): All MultiFlex ETH and PCI motion controllers
Keywords: Spiral Motion, Contour Motion, Pulse Axis, MCCL
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Summary

Following is a description of a method for generating spiral motion on PMC Multiflex controllers. This technique utilizes the controller’s contouring feature to produce a spiral described by

\[ r = a + b\theta \]

where \( b \) is the radial increase constant.

Overview

The figure below shows a spiral with \( b = 1000 \) produced by the Multiflex controller. The actual x-y position data has been superimposed over the calculated points representing the ideal curve.
The example MCCL macro code was used to produce the spiral motion where x axis is pulse axis 5 and the y axis is pulse axis 6. The axes are configured as a contour pair to allow smooth motion from point to point.

The angle theta is incremented from 0 to $2\pi$ in 200 steps in each circular cycle. At each step, the radius, $\sin(\Theta)$, $\cos(\Theta)$ and the x and y coordinates are calculated and inserted into the contour buffer. In this example, the radial increase is set to 1000/cycle and five cycles are executed.

The macro code in the following section can be transferred into the Multiflex controller and the example motion can be executed by a call to macro 200. The radius can be adjusted by changing the value placed in register 99 shown below by

```
a1000, ar99
```

**Spiral Motion MCCL Macro Implementation**

```
spiral motion calculation

\[
\begin{align*}
  r &= \left[ \text{radial increment} / (2 \times \pi) \right] \times \theta \\
  x &= r \times \cos(\theta) \\
  y &= r \times \sin(\theta)
\end{align*}
\]

register usage

- \text{r90} - \theta \quad \text{(init = 0)}
- \text{r91} - \theta \text{ increment} \quad \text{(init = 2 \times \pi / 200)}
- \text{r92} - \text{const} \quad \text{(init = 2 \times \pi)}
- \text{r93} - \text{radius} \quad \text{(init = 0)}
- \text{r94} - \sin(\theta) \quad \text{(init = 0)}
- \text{r95} - \cos(\theta) \quad \text{(init = 1)}
- \text{r96} - \text{x position} \quad \text{(init = 0)}
- \text{r97} - \text{y position} \quad \text{(init = 0)}
- \text{r98} - \text{radial increment} \quad \text{(init = (r99) / (2 \times \pi))}
- \text{r99} - \text{spiral radius} \quad \text{(init = 1000)}

set r99 to spiral radius value and perform register initialization

\[
\text{al1000,ar99,md40,al0,ar90,ar93,av23,ar92,ad200,ar91,al@99,ad@92,ar98}
\]

calculations

- m42 - increment \theta
- m43 - \sin(\theta) \cos(\theta) \text{ radius}
- m44 - x and y position

\[
\text{md42,ra90,aa@91,ar90,md43,ra90,av11,ar95,ra90,av10,ar94,ra90,am@98,ar93,md44,ra95,am@93,ar96,ra94,am@93,ar97}
\]
; single-cycle spiral position move
; md50,mc42,mc43,mc44,wa0.005
md51,5cp3,5ca0,6ca0,5ma@96,6ma@97
md52,mc50,mc51,rp199
;
; 5-cycle spiral motion
; md200,mc20,mc40,mc202
md202,mc52,5ws,mc510,rp4
;
; dump registers
; md500,tr90,tr91,tr93,tr94,tr95,tr96,tr97,tr98
md501,ra90,od"theta: %fr"
md502,ra93,od"r: %fr"
md503,ra94,od"sin(t): %fr"
md504,ra95,od"cos(t): %fr"
md505,ra96,od"x: %fr"
md506,ra97,od"y: %fr"
md510,mc501,mc502,mc503,mc504,mc505,mc506
;