

Doc No.: AN-229

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Subject: Title DUAL ARM ROBOT TRANSFORMATION – FRAME 13

APPLICATION NOTE

www.triomotion.com

What is “Frame 13” ?

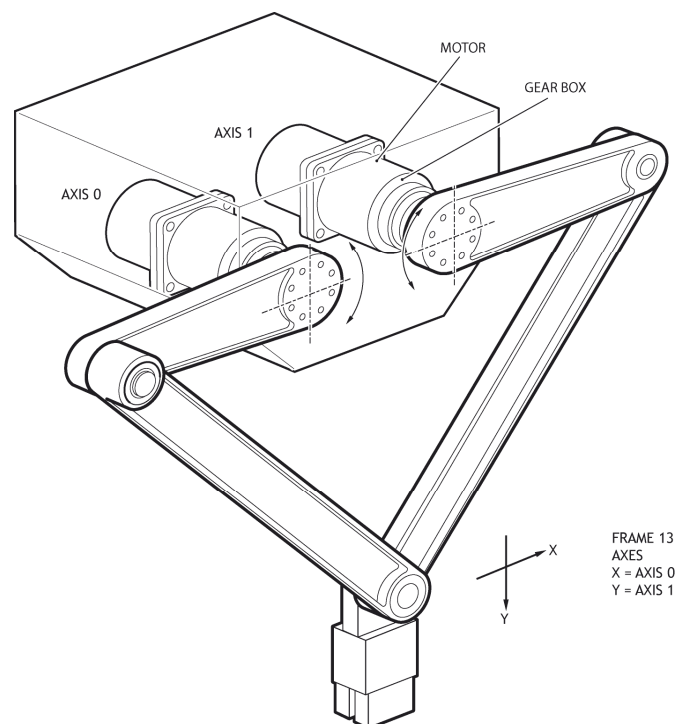
“Frame 13” is built in to Motion Coordinators from version 1.6671 onwards. “Frame 13” is the name given to the mathematical transformations required to simplify control of mechanisms such as that illustrated on the right. Using the frame transformation allows the mechanism to be programmed in X-Y coordinates. The transformation continuously converts the programmed XY positions into the axis 0 and 1 positions.

Inverse “Reverse” Transformation:

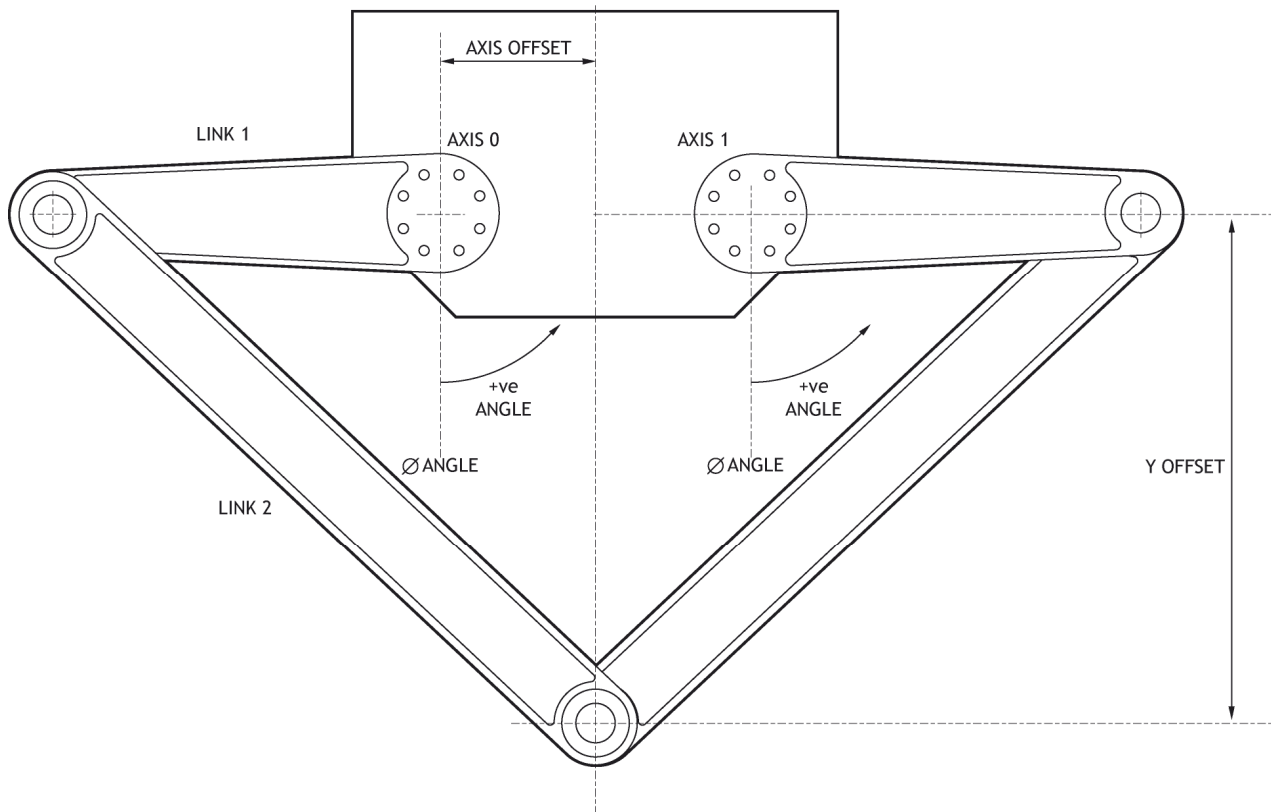
When the “Frame 13” is first switched on an inverse of the transformation is used to convert axis positions in to the X and Y positions. For this process to work the Reverse Transformation has to make some assumptions:

1. The axes are already datumed and their angles set relative to a determined geometric position
2. The link lengths must be known
3. The motor encoder edges/radian must be known
4. Half the offset between the motors must be specified
5. The required vertical position where $Y = 0$ needs to be specified

The parameters are illustrated on the following diagram:



Note how the 2 motors absolute positions are datumed relative to the “straight down” position being zero. Of course it is not necessary for the motors to actually go to this position:



Parameter Setting:

Some things to note:

- The link lengths and offsets are in microns. (mm/1000)
- The encoder ratios are in position edges/radian
- The six required parameters are entered into TABLE positions 0..5
- The FRAME axes 0 and 1 cannot be changed, other axes work as usual.

Here is an example:

```
'
' Enter Configuration Parameters:
'
TABLE(0,250000)'      Link length 1 in microns
TABLE(1,500000)'      Link length 2 in microns
TABLE(2,32594.9324)'  Encoder edges/radian axis 0
TABLE(3,32594.9324)'  Encoder edges/radian axis 1
TABLE(4,75000)'        Horizontal offset axes from x datum
TABLE(5,379967)'       Set Vertical datum with arms straight out
FRAME=13
```

After setting FRAME=13 the joint where the 2 arms meet will be set as (0,0) in the X-Y axes as illustrated.

All the normal move types can then be run within the FRAME=13 setting until it is reset by setting FRAME=0. The FRAME=13 mathematics effectively make the resolution of axes 0 and 1 microns. The usual UNITS parameter can be set to work in mm:

For example:

UNITS AXIS(0)=1000

UNITS AXIS(1)=1000

DPOS and TRANS_DPOS:

When running in the FRAME=13 mode the axis positions before the transformation are stored in axis parameter DPOS. The positions after the transformation are stored in TRANS_DPOS. When FRAME=0 these values are 1:1. The MPOS values effectively track TRANS_DPOS. The MPOS display in Motion Perfect can often be used as a quick way to examine TRANS_DPOS.

Example Startup Program:

The following is a typical startup program for FRAME 13.

```

FRAME=0
WA(10)
'-----
TABLE(0,220000)'Arm
TABLE(1,600000)'Forearm
TABLE(2,(2048*4*70)/2/PI)'pulse/radian
TABLE(3,(2048*4*70)/2/PI)'pulse/radian
TABLE(4,15000)'X-offset
TABLE(5,450000)'Y-offset = 450 mm below axis 0 centre
'-----

' set home position for arms at +/-90 degrees
DATUM(4) AXIS(0) 'find home switch for left arm
DATUM(3) AXIS(1) 'find home switch for right arm
WAIT IDLE AXIS(0)
WAIT IDLE AXIS(1)
home_0 = -TABLE(2)*PI/2
home_1 = TABLE(3)*PI/2
BASE(0,1)
DEFPOS(home_0,home_1)

WA(10)
FRAME=13

```