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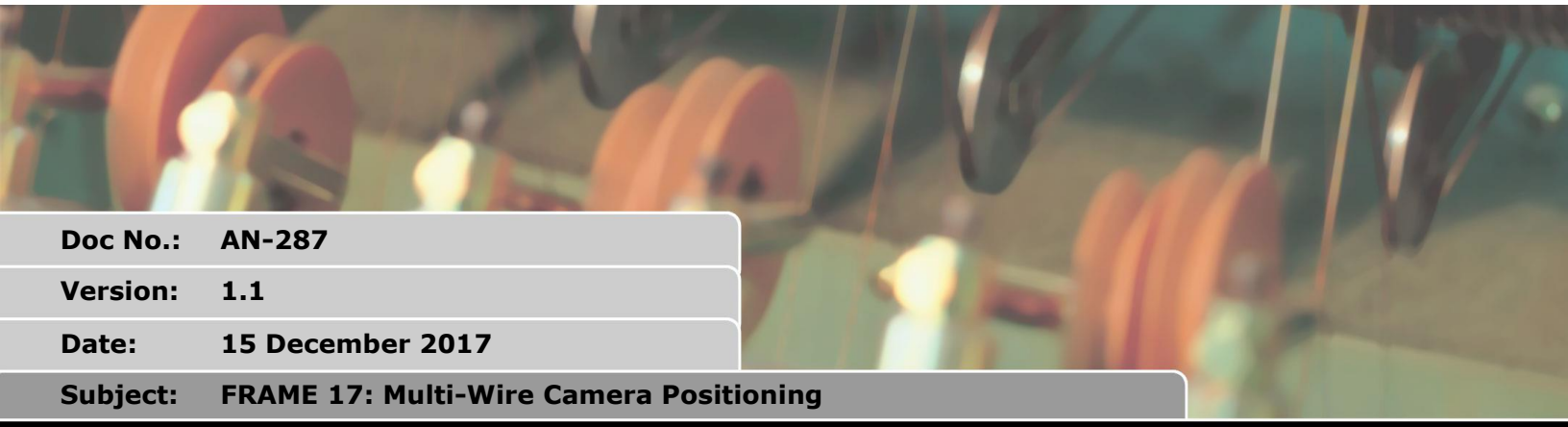


Doc No.: AN-287
Version: 1.1
Date: 15 December 2017
Subject: FRAME 17: Multi-Wire Camera Positioning

APPLICATION NOTE

1. Change log

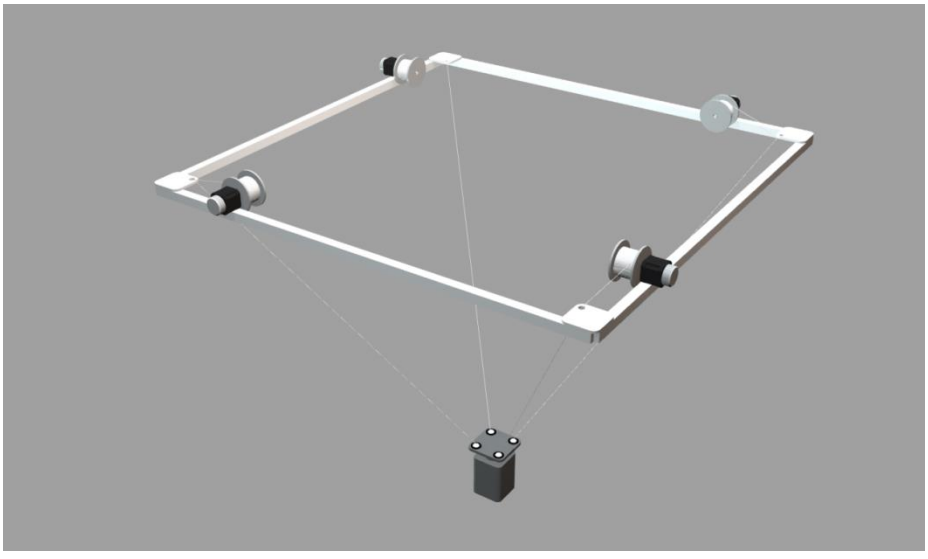
04 December 2012	V1.0	First release
15 December 2017	V1.1	Correction to example; scale = 100000. It was 1000.

2. Introduction

The FRAME 17 transformation allows a wire mounted stadium camera to be easily programmed. The transformation function calculates the initial XYZ position of the camera using trilateration from 3 wire mounting points. During running the FRAME 17 calculations will calculate the wire lengths for up to 6 support wires with reels mounted in any XYZ positions. The FRAME 17 transformation is available for MC4XX controllers (including MC464, EURO408, MC405 and MC403) with the Robotic Function FEC (feature enable code) fitted.

3. Diagram

The following picture shows the general type of stadium arrangement:



4. Datuming

The length of wire related to each motor position must be known for the FRAME 17 transformation to operate. This requires that the wire winding drums are fitted with absolute encoders or that the system can start from a known position effectively datuming the axes.

5. Parameterization

7 parameters needed to be set into a sequence of TABLE values for use by the transformation mathematics. The base TABLE position is set using FRAME_GROUP.

Offset		
0	X axis position of payout position 1	User choice units
1	Y axis position of payout position 1	User choice units
2	Z axis position of payout position 1	User choice units
3	X axis position of payout position 2	User choice units
4	Y axis position of payout position 2	User choice units
5	Z axis position of payout position 2	User choice units
6	X axis position of payout position 3	User choice units
7	Y axis position of payout position 3	User choice units
8	Z axis position of payout position 3	User choice units
9	X axis position of payout position 4 (optional)	User choice units
10	Y axis position of payout position 4 (optional)	User choice units
11	Z axis position of payout position 4 (optional)	User choice units
12	X axis position of payout position 5 (optional)	User choice units
13	Y axis position of payout position 5 (optional)	User choice units
14	Z axis position of payout position 5 (optional)	User choice units
15	X axis position of payout position 6 (optional)	User choice units
16	Y axis position of payout position 6 (optional)	User choice units
17	Z axis position of payout position 6 (optional)	User choice units
18	Edges per user unit payout reel 1	Ratio (E.G. edges/mm)
19	Edges per user unit payout reel 2	Ratio (E.G. edges/mm)
20	Edges per user unit payout reel 3	Ratio (E.G. edges/mm)
21	Edges per user unit payout reel 4 (optional)	Ratio (E.G. edges/mm)
22	Edges per user unit payout reel 5 (optional)	Ratio (E.G. edges/mm)
23	Edges per user unit payout reel 6 (optional)	Ratio (E.G. edges/mm)
24	Option	0 or 1
25	Axes	3..6
26	Scale	Scale User units (see below)
27	Calculation Error	Output 0 (Error) 1 (Solution)

Note:

Payout positions: The positions (X,Y,Z) of between 3 and 6 payout positions must be specified to the calculation. These can be in the users choice of units. For example mm

Edges per user unit payout reel: These factors specify the number of encoder edges/user unit for each of the wire payout reels. The user units must be consistent with the payout positions so if the payout positions are specified in metres the edges number specified here must be edges/metre.

Option: The calculation for the camera position from 3 given lengths has 2 potential solutions. (The alternative solution normally requires negative gravity !) The Option parameter should be set to zero or 1 to give the correct solution.

Axes: A minimum of 3 wires are required. The FRAME 17 function will calculate the required wire lengths for between 3 and 6 payout drums. Note that the first 3 payouts only are used for calculating the starting position in XYZ from the 3 lengths. Where 4 or more wires are used the first 3 specified should be the most critical for the camera position.

Scale: When the FRAME 17 is running it calculates INTEGER positions in the XYZ space for the motion generator program inside the MC4XX. Since the user units (for example metres) are quite large distances a scale factor is required to ensure the integer positions are of fine resolution. The value should give fine resolution but the exact value is not critical. For example if the user units are metres the scale factor should be 100,000 or higher.

Calculation Error: In certain conditions (for example if the length of 1 or more wires is too short) the FRAME 17 calculation cannot be performed during the initial trilateration. In this case TABLE offset (27) is set to 0. 1 indicates a solution can be calculated.

Test program using the FRAME_TRANS function to check correct operation:

```
ATYPE AXIS(0) = 0
ATYPE AXIS(1) = 0
ATYPE AXIS(2) = 0
ATYPE AXIS(3) = 0

FRAME_GROUP(1, 100, 0, 1, 2, 3)

' These positions are in user units (mm for example)

TABLE(100, 0, 0, 0)
TABLE(103, 70, 0, 0)
TABLE(106, 70, -40, 0)

' 4th axis is not used to calculate starting position

TABLE(109, 0, 0, 0)
TABLE(112, 0, 0, 0)
TABLE(115, 0, 0, 0)

' ratios:

ratio1 = 1000
ratio2 = 1000
ratio3 = 1000
ratio4 = 1000

TABLE(118, ratio1, ratio2, ratio3)
```

```
TABLE(121, ratio4, ratio5, ratio6)

' option:

scale = 100000

TABLE(124, 1)'    solution option (1 or 0)
TABLE(125, 4)'    axes 3..6
TABLE(126, 1000)' scale factor


' These distances simulate axis positions so should be in edges:
TABLE(200, 92.195 * ratio1, 60 * ratio2, 72.111 * ratio3)


FRAME_TRANS(17, 200, 300, 1, 100)' convert wire lengths to XYZ

PRINT TABLE(300), TABLE(301), TABLE(302)

FRAME_TRANS(17, 300, 400, 0, 100)' convert XYZ to wire lengths

PRINT TABLE(400)/ratio1,TABLE(401)/ratio2,TABLE(402)/ratio3,TABLE(403)/ratio4
```