Binary Angle Measurement (5A)

- Adaptive CORDIC
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Young Won Lim
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Please send corrections (or suggestions) to youngwlim@hotmail.com.

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BAM Background

T.K. Rodrigues, “Adaptive CORDIC: Using Parallel Angle Recording to Accelerate Rotations”, IEEE Trans on Computers, 2010

Rotation of 25 degree

Original CORDIC

$$
\begin{aligned}
25^\circ \approx \quad & +45^\circ \\
& -26.565^\circ \\
& +14.036^\circ \\
& -7.125^\circ \\
& -3.576^\circ \\
& +1.79^\circ \\
& +0.895^\circ \\
& +0.448^\circ \\
& +0.2238^\circ \\
\hline
= \quad & 25.1268^\circ
\end{aligned}
$$

Angle Constants that is used

$$Q = \{45^\circ, 26.565^\circ, 14.036^\circ, 7.125^\circ, 3.576^\circ, 1.79^\circ, 0.895^\circ, 0.448^\circ, 0.2238^\circ\}$$

Range of Residual Angles around Angle Constant

45°	
	35.78
26.565°	
	20.295
14.036°	
	10.5775
7.125°	
	5.5305
3.576°	
	2.6825
1.79°	
	1.342
0.895°	
	0.6715
0.448°	
	0.3359
0.2238°	
	0.1119

$$\frac{(45+26.565)}{2}$$

$$\begin{aligned}
[Z_{45^\circ}] &= [35.78,\ \ 67.5] \\
[Z_{26.565^\circ}] &= [20.295,\ \ 35.78] \\
[Z_{14.036^\circ}] &= [10.5775,\ \ 20.295] \\
[Z_{7.125^\circ}] &= [5.3505,\ \ 10.5775] \\
[Z_{3.576^\circ}] &= [2.6825,\ \ 5.3505] \\
[Z_{1.79^\circ}] &= [1.342,\ \ 2.6825] \\
[Z_{0.895^\circ}] &= [0.6715,\ \ 1.342] \\
[Z_{0.448^\circ}] &= [0.3359,\ \ 0.6715] \\
[Z_{0.2238^\circ}] &= [0.1119,\ \ 0.3359]
\end{aligned}$$

Vector Rotation (3)

$$m_i = \frac{(\alpha_{i+1} + \alpha_i)}{2}$$

$$[Z_{\alpha i}] = [m_i, \ m_{i-1}]$$

$$\begin{array}{llll} step & i-1 & \alpha_m & [Z'_{\alpha n}] \\ step & i & \alpha_n & [Z_{\alpha n}] \end{array}$$

$$\alpha_m > \alpha_n$$

$$\begin{array}{ll} RHS & [Z'_{\alpha n}] = \alpha_m + [Z_{\alpha n}] \\ LHS & [Z'_{\alpha n}] = \alpha_m - [Z_{\alpha n}] \end{array}$$

Successive Rotations

CORDIC Rotation

cos θ in term of tan θ

References

[1] http://en.wikipedia.org/
[2] CORDIC FAQ, www.dspguru.com
[3] R. Andraka, A survey of CORDIC algorithms for FPGA based computers
[4] J. S. Walther, A Unified Algorithm for Elementary Functions
[5] J. P. Deschamps, G. A. Bioul, G.D. Sutter, Synthesis of Arithmetic Circuits
[6] T.K. Rodrigues, “Adaptive CORDIC: Using Parallel Angle Recording to Accelerate Rotations”, IEEE Trans on Computers, 2010