



Datapath – Trigonometric Overview

The trigonometric IP, many of which can be inferred, are applicable to ASIC or SoC designs. These IP are high performance trigonometric implementations (based on a fast carry look-ahead architecture).

Related Topics

For a listing of Building Block components and associated datasheets, see:

- [DesignWare Building Block IP Documentation Overview](#)

Theory of Operation

DW_sincos performs the sine or cosine of π times the input angle A . If the control signal `SIN_COS` port is LOW, DW_sincos calculates $\sin(\pi A)$. If `SIN_COS` port is HIGH, DW02_sincos calculates $\cos(\pi A)$.

The input angle A is treated as a binary fixed point number which is a binary subdivision of the range $0 \leq A < 2$ (unsigned) or the range $-1 \leq A < 1$ (signed). It does not matter whether the input is signed or unsigned because the sine or cosine from $-\pi$ to zero is the same as it is from π to 2π .

The sine function can be converted to the cosine function because of the following:

$$\cos(\pi A) = \sin\left(\pi A - \frac{\pi}{2}\right) = \sin\left(\pi\left(A - \frac{1}{2}\right)\right)$$

Parameter `A_width` is the width of input angle A . It can have a value of 2 to 34.

Therefore, if `SIN_COS` = 0, then

$$A[A_width-1:A_width-2] = A[A_width-1:A_width-2] - 1$$

If `A[A_width-2]` = 1, then `A[A_width-3:0]` = $-A[A_width-3:0]$

Now, if `A[A_width-1]` xor `A[A_width-2]` = 1, then set a `change_sign` bit.

The problem has been reduced to a quarter-wave cosine function, where $0 \leq A < 1/2$.

If `A_width` \leq 8, then the quarter-wave cosine function is directly decoded from `A[A_width-3:0]`.

Else, if $A_width > 8$, there are three cases as follows:

- $wave_width \leq 16$
Perform a linear interpolation of the quarter-wave cosine as 64 straight-line segments.
- $16 < wave_width \leq 24$
Perform a quadratic polynomial interpolation of the quarter-wave cosine as 64 second-order equation curve segments.
- $24 < wave_width \leq 34$
Perform a cubic polynomial interpolation of the quarter-wave cosine as 64 third-order equation curve segments.

Finally, if `change_sign` was set, the answer is negated.

Related Topics

- [DesignWare Building Block IP Documentation Overview](#)

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