CORDIC in Matlab / Octave

- Octave Special Functions

Please send corrections (or suggestions) to youngwlim@hotmail.com.

This document was produced by using OpenOffice and Octave.

Based on the following site:

John Burkardt

CORDIC Approximation of Elementary Functions

http://people.sc.fsu.edu/~jburkardt/m_src/cordic/cordic.html

angle_shift (1)

$$\text{if} \quad \alpha < \beta \qquad \gamma = \beta - mod(\beta-\alpha, 2\pi) + 2\pi$$

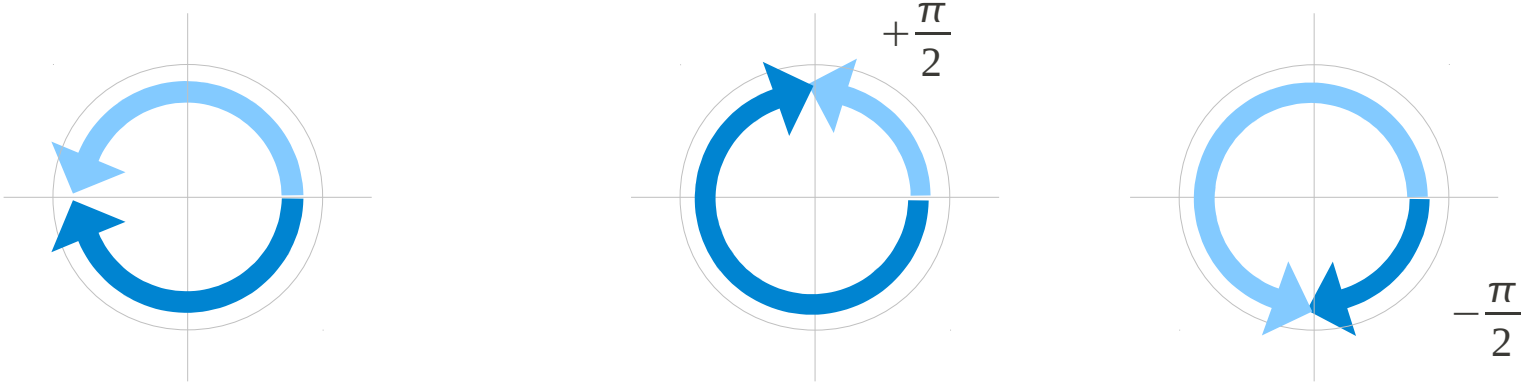
$$\text{else} \qquad \gamma = \beta + mod(\alpha-\beta, 2\pi)$$

$\beta = -\pi$

$$\text{if} \quad \alpha < -\pi \qquad \gamma = \pi - mod(-\pi-\alpha, 2\pi)$$

$$\text{else} \qquad \gamma = -\pi + mod(\alpha+\pi, 2\pi)$$

$$-\pi < \gamma < +\pi$$

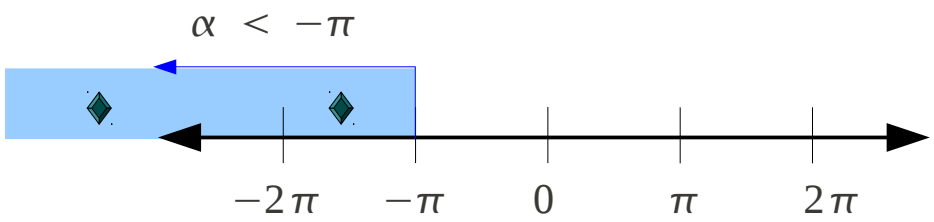


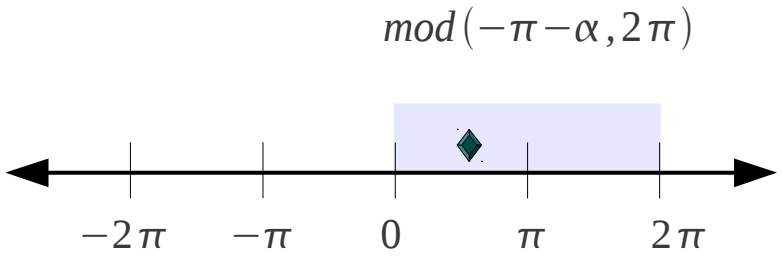
angle_shift (2)

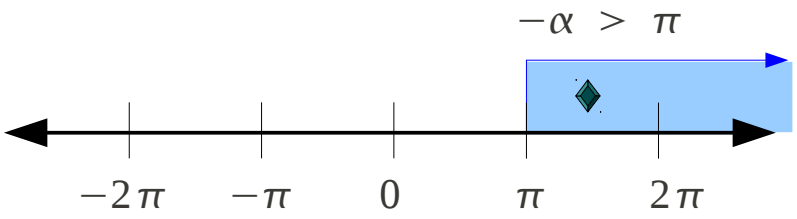
$$\text{if} \quad \alpha < -\pi \qquad y = \pi - mod(-\pi-\alpha, 2\pi)$$

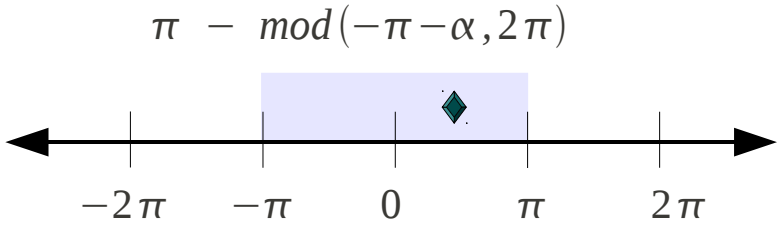
$$\text{else} \qquad y = -\pi + mod(\alpha+\pi, 2\pi)$$

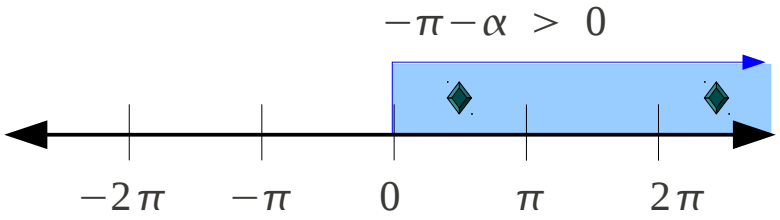
$$\Rightarrow \quad -\pi < y < +\pi$$











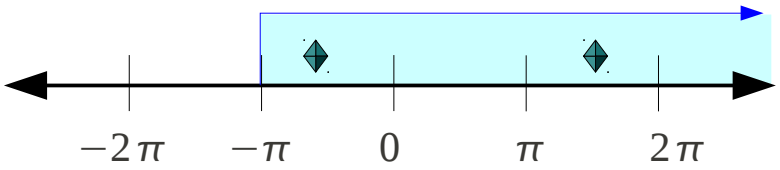
angle_shift (3)

$$\text{if} \quad \alpha < -\pi \qquad y = \pi - mod(-\pi-\alpha, 2\pi)$$

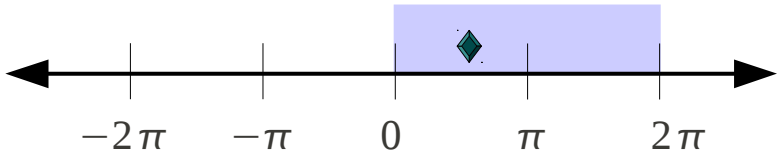
$$\text{else} \qquad y = -\pi + mod(\alpha+\pi, 2\pi)$$

$$\Rightarrow \quad -\pi < y < +\pi$$

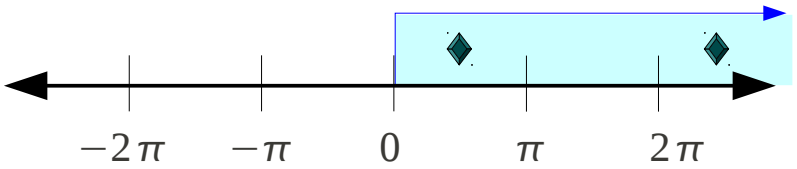
$\alpha > -\pi$



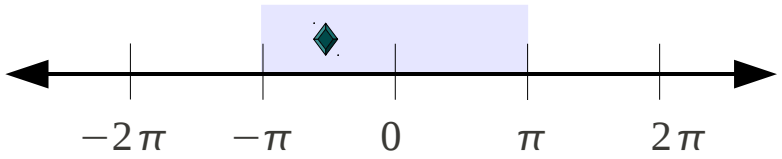
$mod(\alpha+\pi, 2\pi)$



$\alpha+\pi > 0$



$-\pi + mod(\alpha+\pi, 2\pi)$



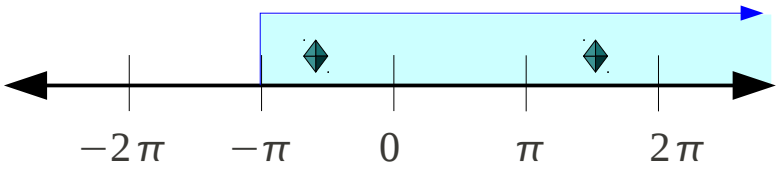
angle_shift (3)

$$\text{if} \quad \alpha < -\pi \qquad y = \pi - mod(-\pi-\alpha, 2\pi)$$

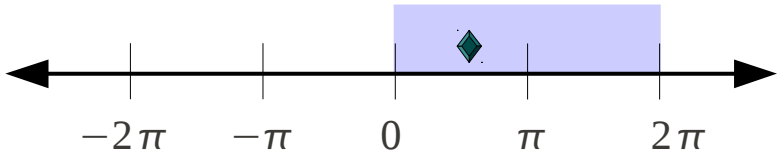
$$\text{else} \qquad y = -\pi + mod(\alpha+\pi, 2\pi)$$

$$\Rightarrow \quad -\pi < y < +\pi$$

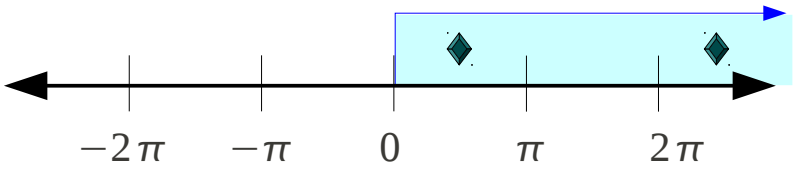
$\alpha > -\pi$



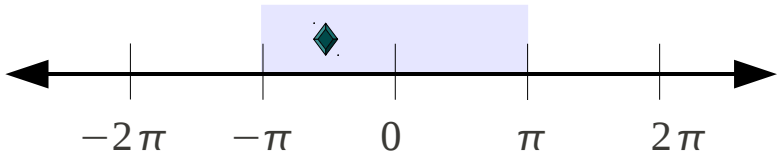
$mod(\alpha+\pi, 2\pi)$



$\alpha+\pi > 0$



$-\pi + mod(\alpha+\pi, 2\pi)$



cossin_cordic (1)

input β angle in radian

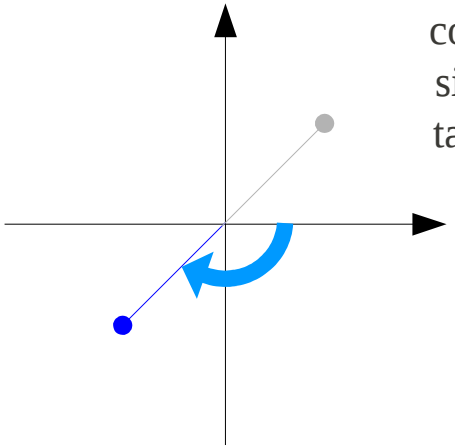
n the number of iterations

$$\theta = angle\_shift(\beta, -\pi)$$

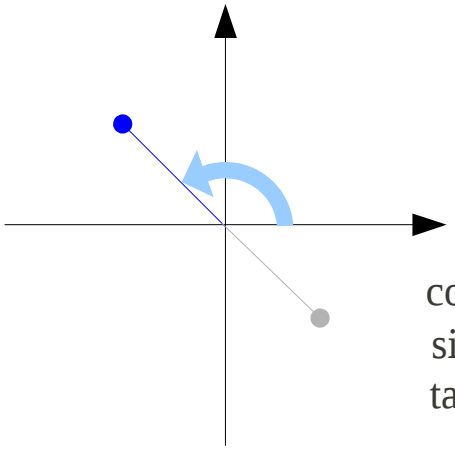
$$-\pi < \theta < +\pi$$

$\theta < -\frac{\pi}{2}$	$\theta \leftarrow \theta + \pi$ $signfactor \leftarrow -1.0$
$\theta > +\frac{\pi}{2}$	$\theta \leftarrow \theta - \pi$ $signfactor \leftarrow +1.0$

$$-\frac{\pi}{2} < \theta < +\frac{\pi}{2} \quad , \quad signfactor$$



$$\cos(\theta+\pi) = -\cos\theta$$
$$\sin(\theta+\pi) = -\sin\theta$$
$$\tan(\theta+\pi) = -\tan\theta$$



$$\cos(\theta-\pi) = -\cos\theta$$
$$\sin(\theta-\pi) = -\sin\theta$$
$$\tan(\theta-\pi) = -\tan\theta$$

cossin_cordic (2)

$\theta < 0 \Rightarrow \sigma = -1$
$\theta > 0 \Rightarrow \sigma = +1$

$$\theta = \theta - \sigma \cdot angle$$

$60 < j+1$	$angle = angle/2$
	$angle = angles(j+1)$

$angles(60)$

$angles(1) \Rightarrow \tan^{-1}(\frac{1}{2})$

$angles(2) \Rightarrow \tan^{-1}(\frac{1}{2^2})$

$angles(3) \Rightarrow \tan^{-1}(\frac{1}{2^3})$

$$poweroftwo = 1.0$$

$$factor = \sigma \cdot poweroftwo$$

$$poweroftwo = poweroftwo/2$$

$$(\frac{1}{2})^{L} = (\frac{1}{2})^{j-1}$$

$j = 1 \Rightarrow poweroftwo = 1.0$

$j = 2 \Rightarrow poweroftwo = 1/2^1$

$j = 3 \Rightarrow poweroftwo = 1/2^2$

cossin_cordic (3)

$$R = \begin{bmatrix} \cos\theta_i & -\sin\theta_i \\ \sin\theta_i & \cos\theta_i \end{bmatrix}$$

$$= \cos\theta_i \begin{bmatrix} 1 & -\tan\theta_i \\ \tan\theta_i & 1 \end{bmatrix}$$

$$\tan\theta_i = \pm 1, \ \pm\frac{1}{2,} \ \pm\frac{1}{2^{2,}} \cdots$$

$$factor = \sigma \cdot poweroftwo$$

References

[1] http://en.wikipedia.org/
[2] http://people.sc.fsu.edu/~jburkardt/m_src/cordic/cordic.html