

CORDIC in Matlab / Octave

- Octave Special Functions

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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)

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

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

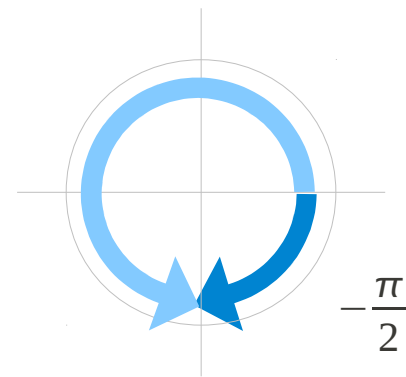
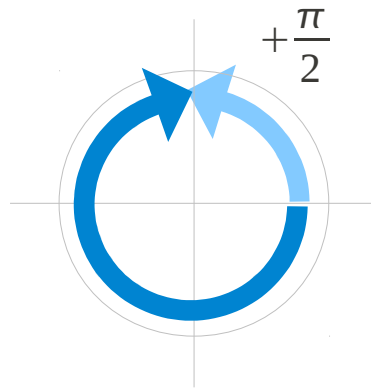
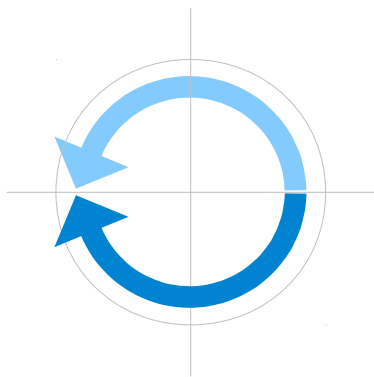
$$\beta = -\pi$$

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

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



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



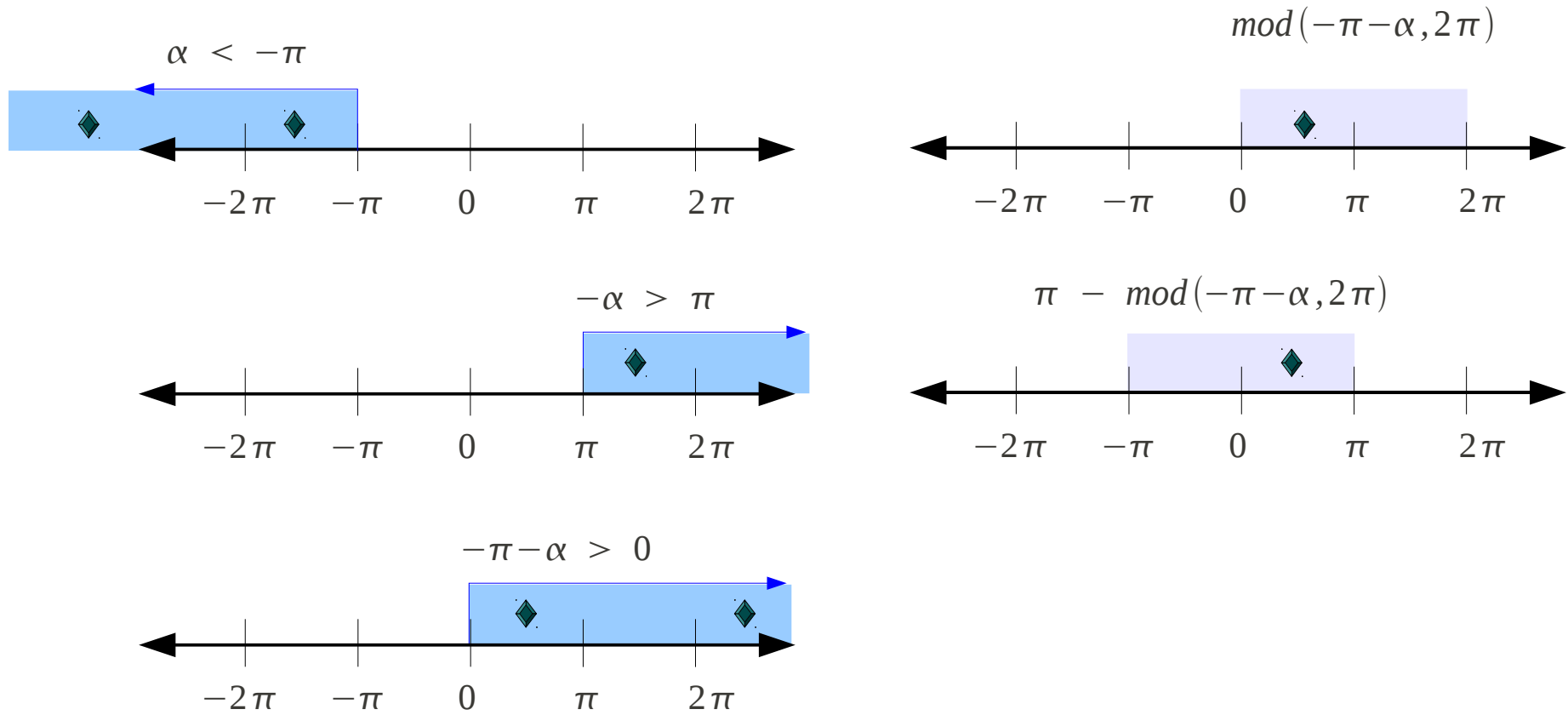
angle_shift (2)

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

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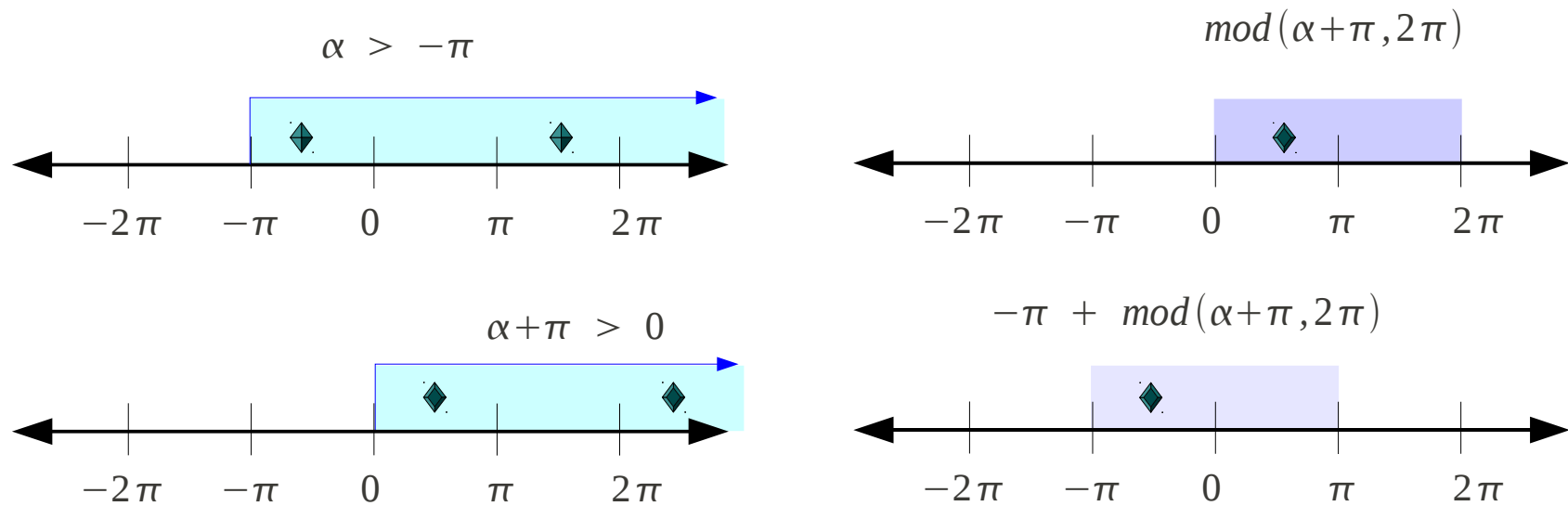
$-\pi < \gamma < +\pi$



angle_shift (3)

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

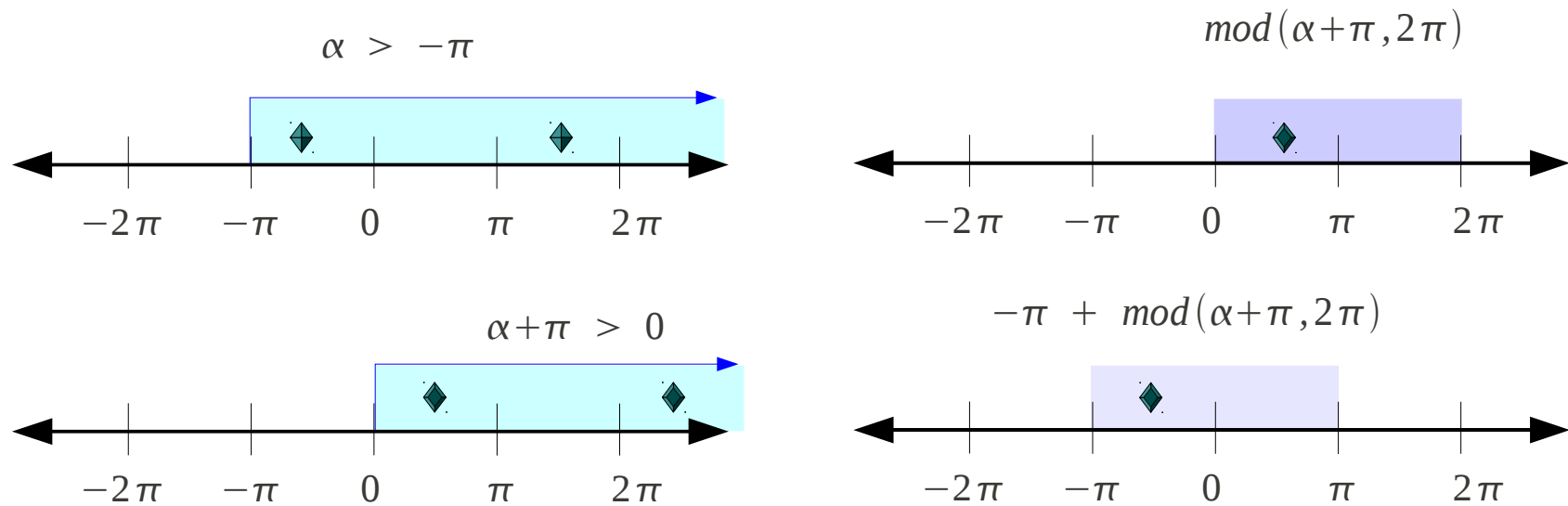
} \rightarrow $-\pi < \gamma < +\pi$



angle_shift (3)

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

} \rightarrow $-\pi < \gamma < +\pi$



cosin_cordic (1)

input β angle in radian
 n the number of iterations

$$\theta = \text{angle_shift}(\beta, -\pi)$$



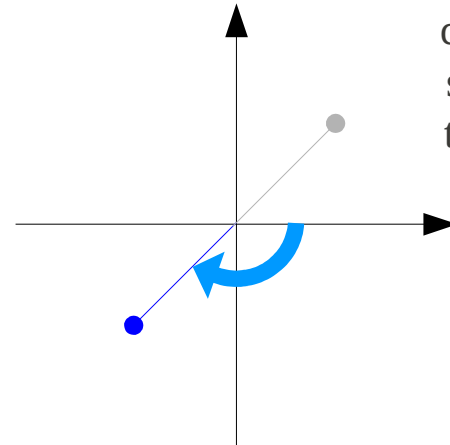
$$-\pi < \theta < +\pi$$



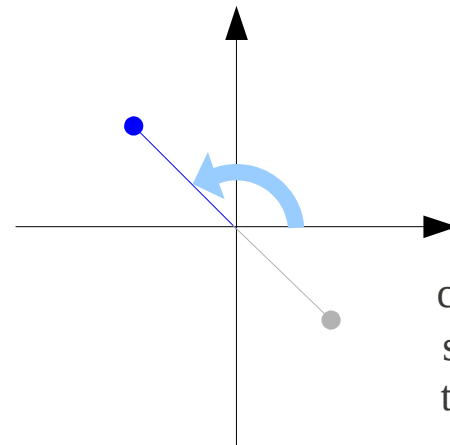
$\theta < -\frac{\pi}{2}$	$\theta \leftarrow \theta + \pi$ $\text{signfactor} \leftarrow -1.0$
$\theta > +\frac{\pi}{2}$	$\theta \leftarrow \theta - \pi$ $\text{signfactor} \leftarrow +1.0$



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



$$\begin{aligned}\cos(\theta + \pi) &= -\cos \theta \\ \sin(\theta + \pi) &= -\sin \theta \\ \tan(\theta + \pi) &= -\tan \theta\end{aligned}$$



$$\begin{aligned}\cos(\theta - \pi) &= -\cos \theta \\ \sin(\theta - \pi) &= -\sin \theta \\ \tan(\theta - \pi) &= -\tan \theta\end{aligned}$$

cosin_cordic (2)

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

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

$$\theta = \theta - \sigma \cdot \text{angle}$$

$$60 < j+1 \quad \text{angle} = \text{angle}/2$$

$$\text{angle} = \text{angles}(j+1)$$

$\text{angles}(60)$

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

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

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

$$\text{poweroftwo} = 1.0$$

$$\text{factor} = \sigma \cdot \text{poweroftwo}$$

$$\text{poweroftwo} = \text{poweroftwo}/2$$

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

$$j = 1 \quad \Rightarrow \quad \text{poweroftwo} = 1.0$$

$$j = 2 \quad \Rightarrow \quad \text{poweroftwo} = 1/2^1$$

$$j = 3 \quad \Rightarrow \quad \text{poweroftwo} = 1/2^2$$

cosin_cordic (3)

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

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

$$\text{factor} = \sigma \cdot \text{poweroftwo}$$

References

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