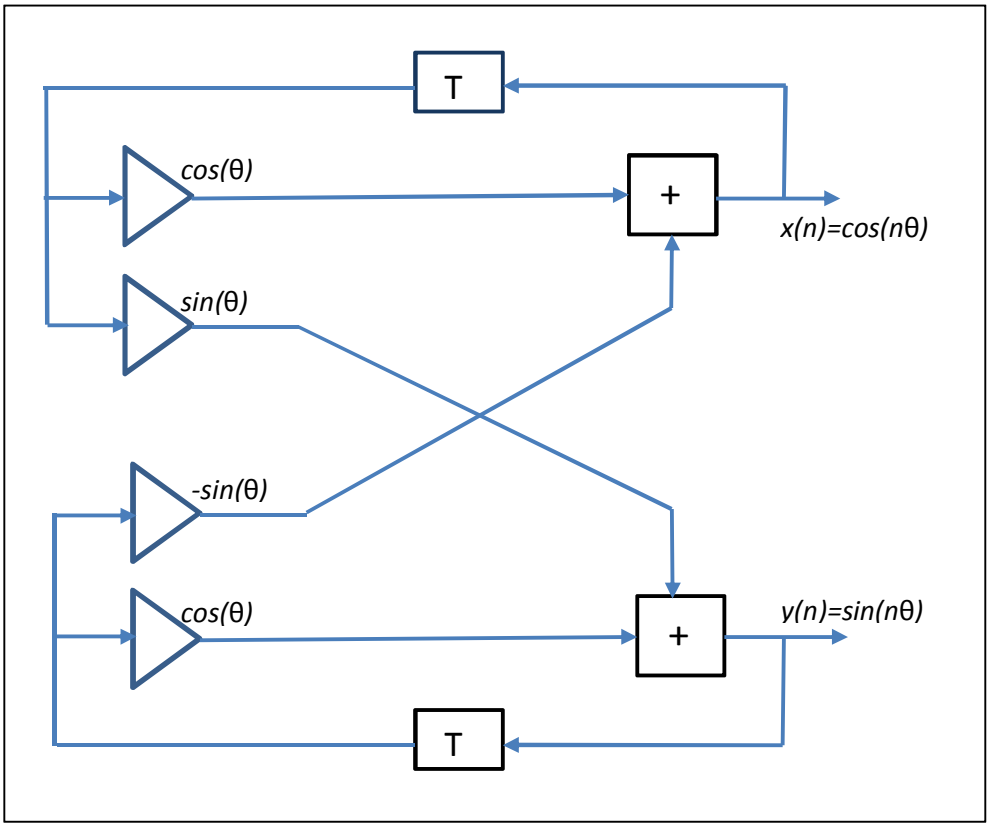
Quadrature carrier oscillator

Passband communications systems such as in wireless systems use quadrature oscillators to produce multi-level (*M-ary*) passband signals. We are primarily interested here in the design of the digital quadrature oscillator itself. The purpose of the oscillator is to produce 2 outputs tones that are in phase quadrature (90^0), i.e. a cosine and a sine signal.

$$x(n) = \cos n\theta_0, \quad y(n) = \sin n\theta_0$$
$$x(n+1) = \cos\left[(n+1)\theta_0\right] = \cos(n\theta_0 + \theta_0)$$
$$x(n+1) = \cos(n\theta_0)\cos\theta_0 - \sin(n\theta_0)\sin\theta_0$$
$$Substitute\ n \to n-1$$
$$x(n) = \cos n\theta_0 = \cos\left[(n-1)\theta_0\right]\cos\theta_0 - \sin\left[(n-1)\theta_0\right]\sin\theta_0$$
$$y(n) = \sin n\theta_0 = \sin\left[(n-1)\theta_0\right]\cos\theta_0 + \cos\left[(n-1)\theta_0\right]\sin\theta_0$$



Note that in comparison to the single oscillator, this is a 1st order system rather than the previous 2nd order.