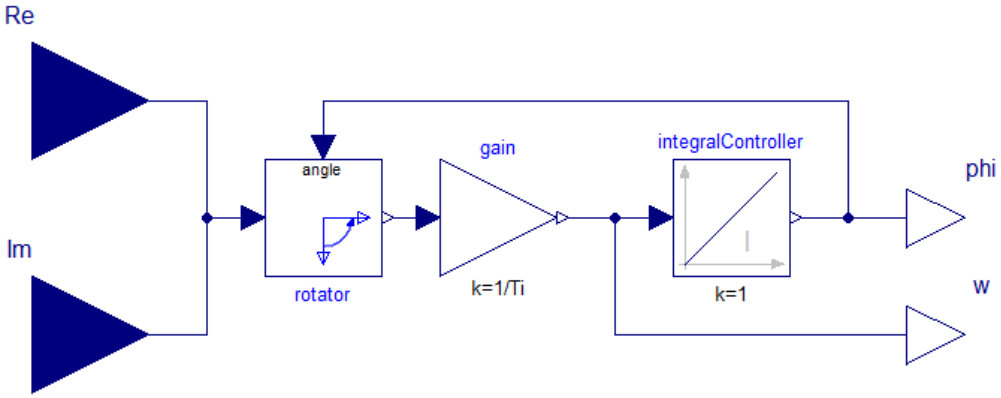
The **Angle Tracking Observer** is a robust method to determine the angle of a space phasor or the rotor position from the signal of a sin/cos-resolver.



Turning a phasor by an angle $-\varphi'$:

$$e^{j\varphi} \cdot e^{-j\varphi'} = e^{j(\varphi-\varphi')} = (cos\varphi + jsin\varphi) \cdot (cos\varphi' - jsin\varphi') =$$
$$(cos\varphi \cdot cos\varphi' + sin\varphi \cdot sin\varphi') + j(-cos\varphi \cdot sin\varphi' + sin\varphi \cdot cos\varphi')$$

The controller drives the imaginary part of the rotated phasor to zero:

$$Im = \sin(\varphi - \varphi') = -cos\varphi \cdot sin\varphi' + sin\varphi \cdot cos\varphi' \rightarrow 0$$

Linearization for small deviations (control error): $\varphi \approx \varphi'$: $Im \approx \varphi - \varphi'$

Transfer function of the closed loop using an integral controller:

$$\varphi' = (\varphi - \varphi') \cdot \frac{1}{sT_i}$$

$$\varphi' = \frac{\varphi}{1 + sT_i}$$

Additionally the phasor's angular velocity $\omega = \frac{d\varphi}{dt}$ is determined at the integral controller's input.