SteeringTrans:
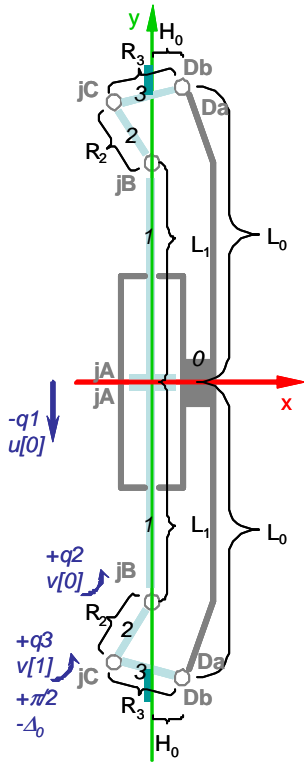
basic geometric parameters:

$$sd := 1 \quad H_0 := 0.053 \quad L_0 := 0.370 \quad L_1 := 0.2891 \quad R_2 := 0.097 \quad R_3 := 0.08614$$

$$sH := 1$$

initial displacement: $\quad u01_0 := -0.040$

abbreviations:

$$K0\_(u,sd) := L_0 - L_1 - sd \cdot u \qquad\qquad K0\_(u01_0, 1) = 0.121$$

$$K1\_(u,sd) := \frac{R_2^2 - H_0^2 - R_3^2 - K0\_(u,sd)^2}{2 \cdot R_3} \qquad K1\_(u01_0, 1) = -0.09$$

constraints:

$$\phi30\_(u,sd) := 2 \cdot atan\left(\frac{H_0 - sH \cdot \sqrt{H_0^2 + K0\_(u,sd)^2 - K1\_(u,sd)^2}}{K0\_(u,sd) + K1\_(u,sd)}\right)$$
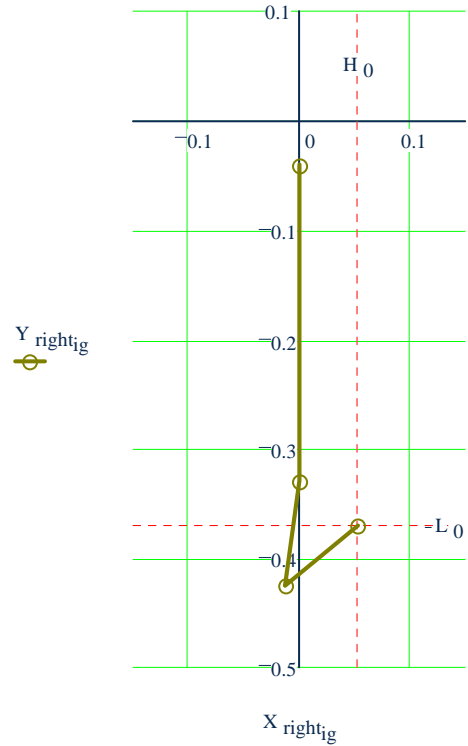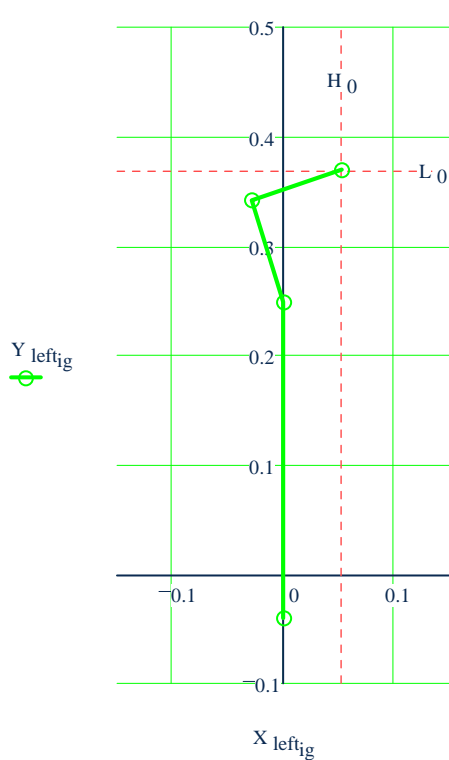
$$\phi12\_(u,sd) := -sd \cdot asin\left(\frac{H_0 + R_3 \cdot sin(\phi30\_(u,sd))}{R_2}\right)$$

$$\phi23\_(u,sd) := \left(\phi30\_(0,1) - \frac{\pi}{2} \cdot sd\right) - \phi30\_(u,sd) \cdot sd - \phi12\_(u,sd)$$

$$\phi30\_(u01_0, 1) \cdot \frac{180}{\pi} = -109.077 \qquad \phi30\_(u01_0, -1) \cdot \frac{180 \cdot (-1)}{\pi} = 50.14$$

$$\phi12\_(u01_0, 1) \cdot \frac{180}{\pi} = 17.03 \qquad \phi12\_(u01_0, -1) \cdot \frac{180}{\pi} = -7.775$$

$$\phi23\_(u01_0, 1) \cdot \frac{180}{\pi} = -80.956 \qquad \phi23\_(u01_0, -1) \cdot \frac{180}{\pi} = -35.368$$
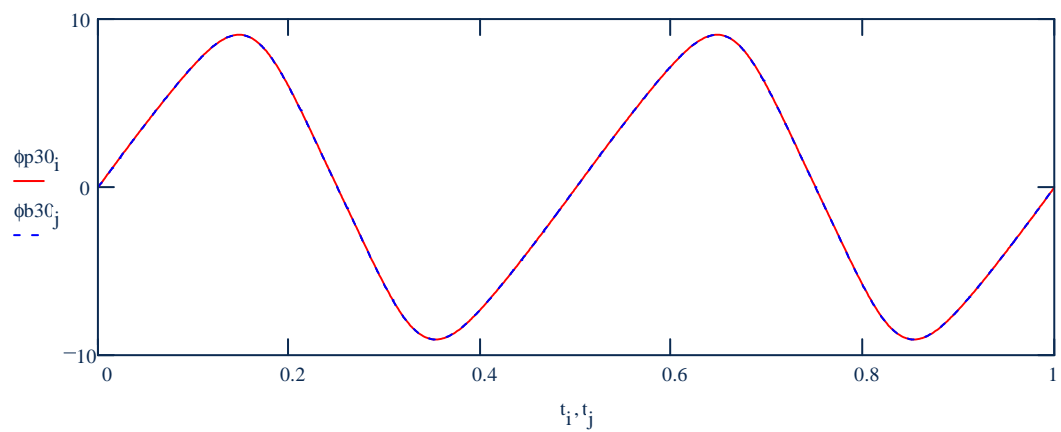
Bvu:

$$sd = 1$$

$$\phi p30\_(\phi30, \phi12, up) := \frac{-\,sd \cdot R_2 \cdot \cos(\phi12)}{R_3 \cdot \cos(\phi30) \cdot R_2 \cdot \sin(\phi12) + R_3 \cdot \sin(\phi30) \cdot R_2 \cdot \cos(\phi12)} \cdot up$$
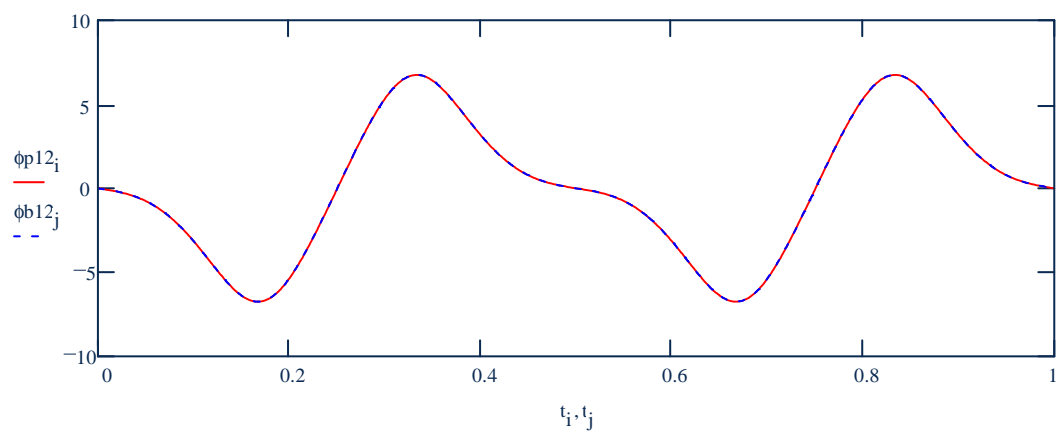
$$\phi p12\_(\phi30, \phi12, up) := \frac{sd \cdot R_3 \cdot \cos(\phi30)}{R_3 \cdot \cos(\phi30) \cdot R_2 \cdot \sin(\phi12) + R_3 \cdot \sin(\phi30) \cdot R_2 \cdot \cos(\phi12)} \cdot up$$

$$\phi p23\_(\phi30, \phi12, up) := \frac{sd \cdot R_2 \cdot \cos(\phi12) - sd \cdot R_3 \cdot \cos(\phi30)}{R_3 \cdot \cos(\phi30) \cdot R_2 \cdot \sin(\phi12) + R_3 \cdot \sin(\phi30) \cdot R_2 \cdot \cos(\phi12)} \cdot up$$
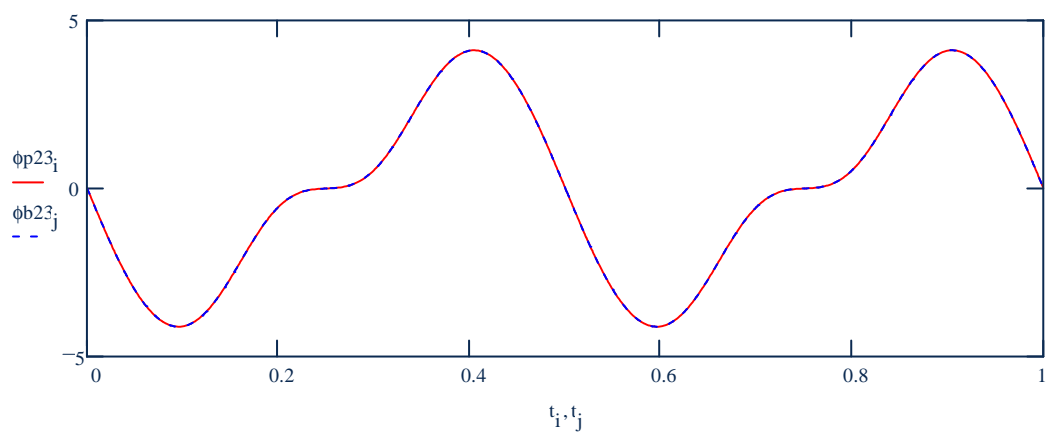
$$\phi p30_i := \phi p30\_\left(\phi30_i, \phi12_i, up_i\right)$$

$$\phi p12_i := \phi p12\_\left(\phi30_i, \phi12_i, up_i\right)$$

$$\phi p23_i := \phi p23\_\left(\phi30_i, \phi12_i, up_i\right)$$

dBvu:

$$D(\phi30, \phi12) := R_3 \cdot \cos(\phi30) \cdot R_2 \cdot \sin(\phi12) + R_3 \cdot \sin(\phi30) \cdot R_2 \cdot \cos(\phi12)$$

$$dD(\phi30, \phi12, \phi p30, \phi p12) := R_3 \cdot \cos(\phi30) \cdot R_2 \cdot \cos(\phi12) \cdot \phi p12 - R_3 \cdot \sin(\phi30) \cdot \phi p30 \cdot R_2 \cdot \sin(\phi12) \ldots$$
$$+ - R_3 \cdot \sin(\phi30) \cdot R_2 \cdot \sin(\phi12) \cdot \phi p12 + R_3 \cdot \cos(\phi30) \cdot \phi p30 \cdot R_2 \cdot \cos(\phi12)$$

$$\phi pp30\_(\phi30, \phi12, up, \phi p30, \phi p12, upp) := \left[\frac{R_2 \cdot \cos(\phi12)}{D(\phi30, \phi12)} \cdot upp \ldots + - \frac{R_2 \cdot \sin(\phi12) \cdot \phi p12 \cdot D(\phi30, \phi12) \ldots + R_2 \cdot \cos(\phi12) \cdot dD(\phi30, \phi12, \phi p30, \phi p12)}{D(\phi30, \phi12)^2} \cdot up \right] \cdot - sd$$
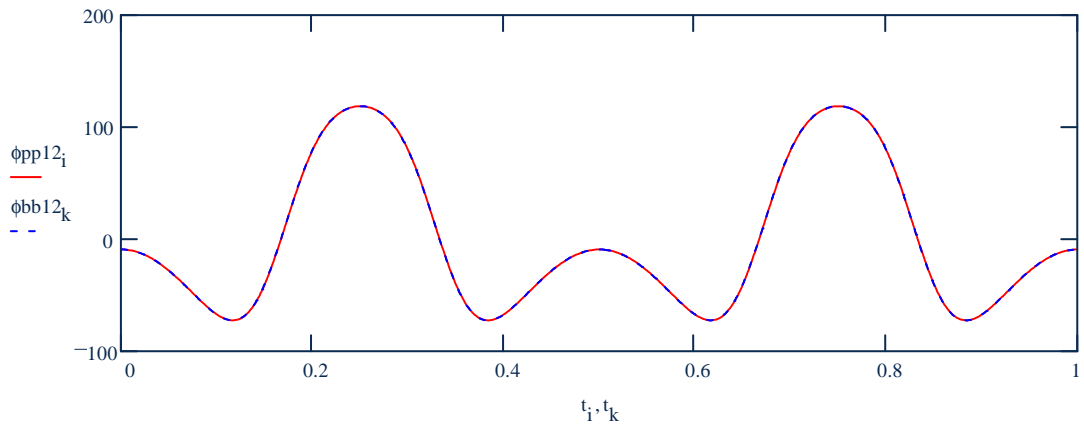
$$\phi pp12\_(\phi30, \phi12, up, \phi p30, \phi p12, upp) := \left[\frac{R_3 \cdot \cos(\phi30)}{D(\phi30, \phi12)} \cdot upp \ldots + - \frac{R_3 \cdot \sin(\phi30) \cdot \phi p30 \cdot D(\phi30, \phi12) \ldots + R_3 \cdot \cos(\phi30) \cdot dD(\phi30, \phi12, \phi p30, \phi p12)}{D(\phi30, \phi12)^2} \cdot up \right] \cdot sd$$

$$\phi pp23\_(\phi30, \phi12, up, \phi p30, \phi p12, upp) := \left[\frac{R_2 \cdot \cos(\phi12) - R_3 \cdot \cos(\phi30)}{R_3 \cdot \cos(\phi30) \cdot R_2 \cdot \sin(\phi12) + R_3 \cdot \sin(\phi30) \cdot R_2 \cdot \cos(\phi12)} \cdot upp \ldots + - \frac{\left(R_2 \cdot \sin(\phi12) \cdot \phi p12 - R_3 \cdot \sin(\phi30) \cdot \phi p30\right) \cdot D(\phi30, \phi12) \ldots + \left(R_2 \cdot \cos(\phi12) - R_3 \cdot \cos(\phi30)\right) \cdot dD(\phi30, \phi12, \phi p30, \phi p12)}{D(\phi30, \phi12)^2} \cdot up \right] \cdot sd$$

$$\phi pp30_i := \phi pp30\_\left(\phi 30_i, \phi 12_i, up_i, \phi p30_i, \phi p12_i, upp_i\right)$$
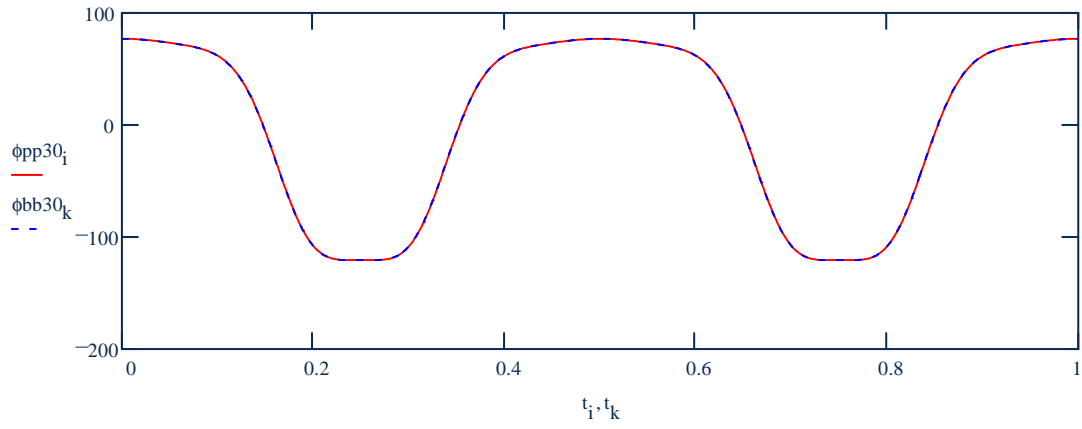
$$\phi pp12_i := \phi pp12\_\left(\phi 30_i, \phi 12_i, up_i, \phi p30_i, \phi p12_i, upp_i\right)$$

$$\phi pp23_i := \phi pp23\_\left(\phi 30_i, \phi 12_i, up_i, \phi p30_i, \phi p12_i, upp_i\right)$$