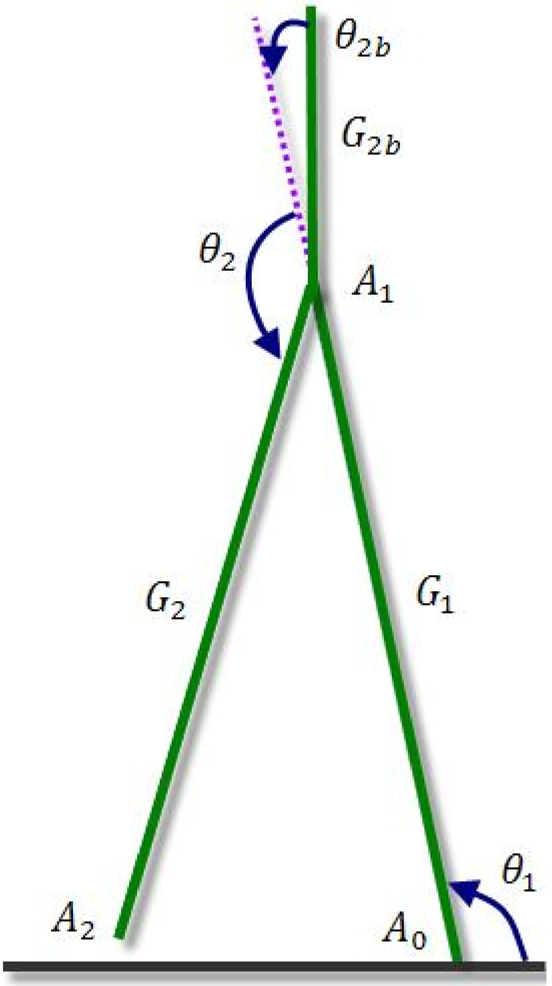
EQUATIONS OF IMPACT



Consider open loop chain with joint A_0 . The chain will fall with point A_2 at the ground en A_0 will lift up. The impact is not elastic.

$\bar{v}_{G2}^{+}$= velocity of center of mass of link 2 after impact.

$\bar{v}_{G2}^{-}$=velocity of center of mass of link 2 before impact. Idem for $\bar{v}_{G1}^{+}$, $\bar{v}_{G1}^{-}$, $\bar{v}_{G2b}^{+}$, $\bar{v}_{G2b}^{-}$.

Absolute joint velocities are:

$\overline{\omega_1} = \dot{\theta}_1 \overline{1_z}$

$\overline{\omega_2} = (\dot{\theta}_1 + \dot{\theta}_2)\overline{1_z}$

$\overline{\omega_{2b}} = (\dot{\theta}_1 + \dot{\theta}_2/2)\overline{1_z} = (\overline{\omega_1} + \overline{\omega_2})/2$ (special constraint, so the middle body is always in the middle between the 2 other body's.)

If I do not consider the special constraint for the middle body, I can write equations of impact like these to calculate eventually the joint velocity after impact:

$m_2(\bar{v}_{G2}^{+} - \bar{v}_{G2}^{-}) = \bar{\pi}_{A_2} + \bar{\pi}_{A_{2b}}$ (x, y component)

$I_{G2}^{zz}\omega_2^{+} - I_{G2}^{zz}\omega_2^{-} = \overline{G_2A_2} \times (\bar{\pi}_{A_2}) + \overline{G_2A_1} \times \bar{\pi}_{A_{2b}}$ (z-component)

$m_{2b}(\bar{v}_{G2b}^{+} - \bar{v}_{G2b}^{-}) = -\bar{\pi}_{A_{2b}} + \bar{\pi}_{A_1}$ (x,y component)

$I_{G2b}^{zz}\omega_{2b}^{+} - I_{G2b}^{zz}\omega_{2b}^{-} = \overline{G_{2b}A_1} \times (-\bar{\pi}_{A_{2b}}) + \overline{G_{2b}A_1} \times \bar{\pi}_{A_1}$ (z-component)

$m_1(\bar{v}_{G1}^{+} - \bar{v}_{G1}^{-}) = -\bar{\pi}_{A_1} + \bar{\pi}_{A_0}$ (x,y component)

$I_{G1}^{zz}\omega_1^{+} - I_{G1}^{zz}\omega_1^{-} = \overline{G_1A_1} \times (-\bar{\pi}_{A_1}) + \overline{G_1A_0} \times \bar{\pi}_{A_0}$ (z component)

With $\bar{\pi}_{A_2}, \bar{\pi}_{A_{2b}}, \bar{\pi}_{A_1}, \bar{\pi}_{A_0}$ impulses of force..

Consider $\bar{v}_{G2}^{+}$ zero (constraint of impact) and $\bar{\pi}_{A_0}$ zero (approximation), and knowing that we can write the velocities like $\bar{v}_{G1}^{+}$ in terms of the joint velocities, then we can solve 9 equations in 9 unknowns ($\bar{\pi}_{A_2}, \bar{\pi}_{A_{2b}}, \bar{\pi}_{A_1}, \omega_2^{+}, \omega_{2b}^{+}$ and ω_1^{+}).

HOWEVER… There is the constraint of the middle body: $\overline{\omega_{2b}} = (\dot{\theta}_1 + \dot{\theta}_2/2)\overline{1_z} = (\overline{\omega_1} + \overline{\omega_2})/2$ and I don't know how to incorporate that. There is an unknown less, so I think there must be also an equation less… HELP :-) !

My actual problem has many more links, but I've tried to keep it short here. I hope my problem is clear. Any ideas are welcome!

Thanks,

J.