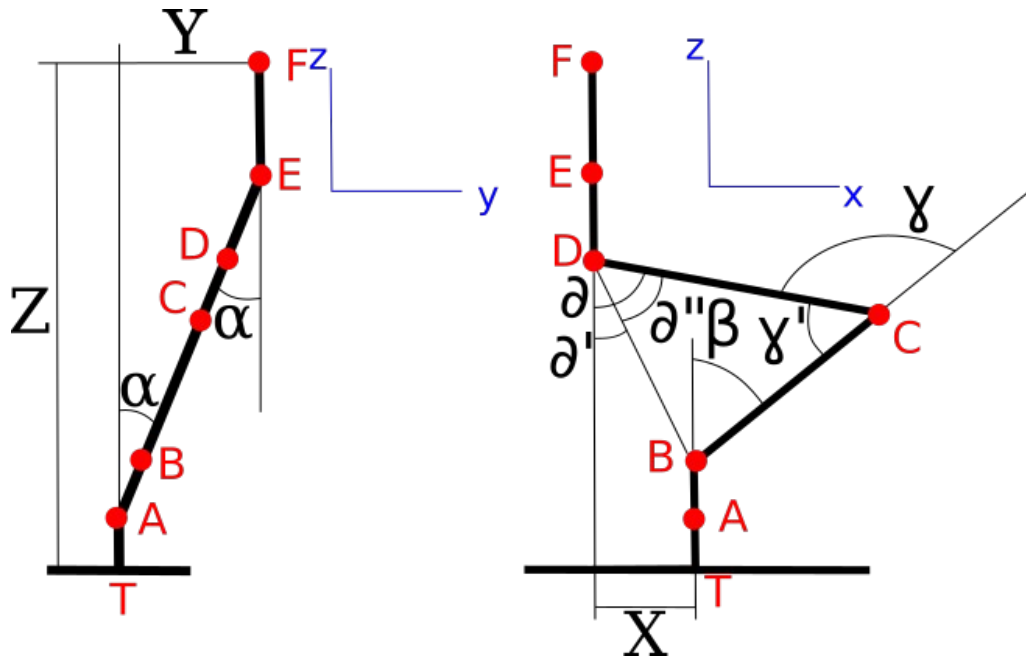


INVERSE KINEMATICS:

That's a Tamtam leg schema in the **zy** and **zx** planes :



Where **T** is referred from **F** and has the components **(X , Y , Z)**, so first we may compute the α angle:

$$\alpha = \text{tg}^{-1}\left(\frac{Y}{Z - \overline{TA} - \overline{EF}}\right)$$

Now we can compute the distance between **B** and **D** using pitagoras:

$$\overline{BD} = \sqrt{X^2 + (Y - \overline{AB} \sin \alpha - \overline{DE} \sin \alpha)^2 + (Z - \overline{AB} \cos \alpha - \overline{DE} \cos \alpha - \overline{TA})^2}$$

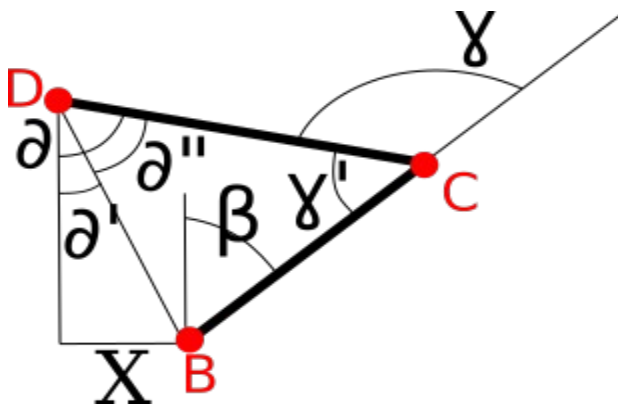
So now we have a triangle which we know all the dimensions but the angles:

aplying the law of cosinus we may obtain γ' angle:

$$\gamma' = \cos^{-1}\left(\frac{\overline{BC}^2 + \overline{CD}^2 - \overline{BD}^2}{2 \overline{BC} \overline{CD}}\right)$$

and since $\gamma = 180 - \gamma'$:

$$\gamma = 180 - \cos^{-1}\left(\frac{\overline{BC}^2 + \overline{CD}^2 - \overline{BD}^2}{2 \overline{BC} \overline{CD}}\right)$$



we also may compute δ' : $\delta' = \sin^{-1}\left(\frac{X}{\overline{BD}}\right)$ and δ'' : $\delta'' = \cos^{-1}\left(\frac{\overline{CD}^2 + \overline{BD}^2 - \overline{BC}^2}{2 \overline{CD} \overline{BD}}\right)$

And since $\delta = \delta' + \delta''$:

$$\delta = \sin^{-1}\left(\frac{X}{BD}\right) + \cos^{-1}\left(\frac{CD^2 + BD^2 - BC^2}{2 CD BD}\right)$$

And to finish, using the fact that adding all the intern angles of a triangle you get 180 degrees:

$$\beta = 180 - \delta - (180 - \gamma) = \gamma - \delta$$

Now we need to add the rotation component for the leg, I'll use a rotation matrix in Z axis:

so we obtain: $x, y, z, \varepsilon \rightarrow X, Y, Z$:

to do so:

$$\begin{aligned} X &= x \cos \varepsilon + y \sin \varepsilon \\ Y &= y \cos \varepsilon - x \sin \varepsilon \\ Z &= z \end{aligned}$$

where ε is the **F** rotation angle.