

# The First Task

Smart Methods Training - By Amer Maghrabi

## Finding the angle:

Using reference [1] the allowed step size can be assumed to be 20% of the total leg length of the robot = 12.8 cm

Knowing that both legs are the same length, the maximum angle of rotation can easily be found using the Isosceles Triangle properties [2].

### Angle calculations:

$a$  = legs length = 64 cm

$b$  = allowed step size =  $0.2(64) = 12.8$  cm

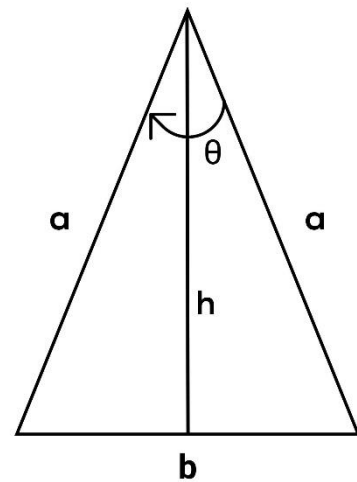
Calculating the angle of rotation  $\theta$ :

$$h = a \cos(\theta/2)$$

$$\sqrt{a^2 - (b^2/4)} = a \cos(\theta/2)$$

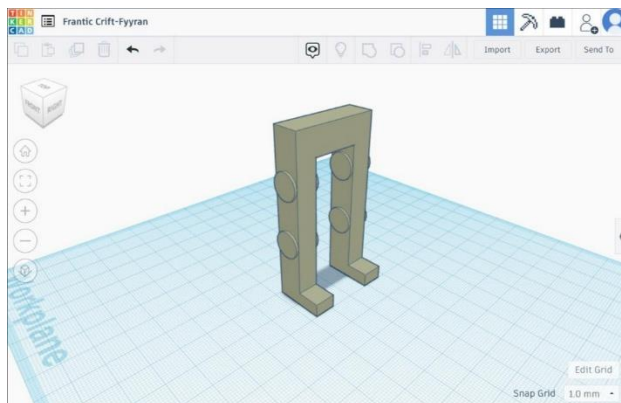
$$63.68 = 64 \cos(\theta/2)$$

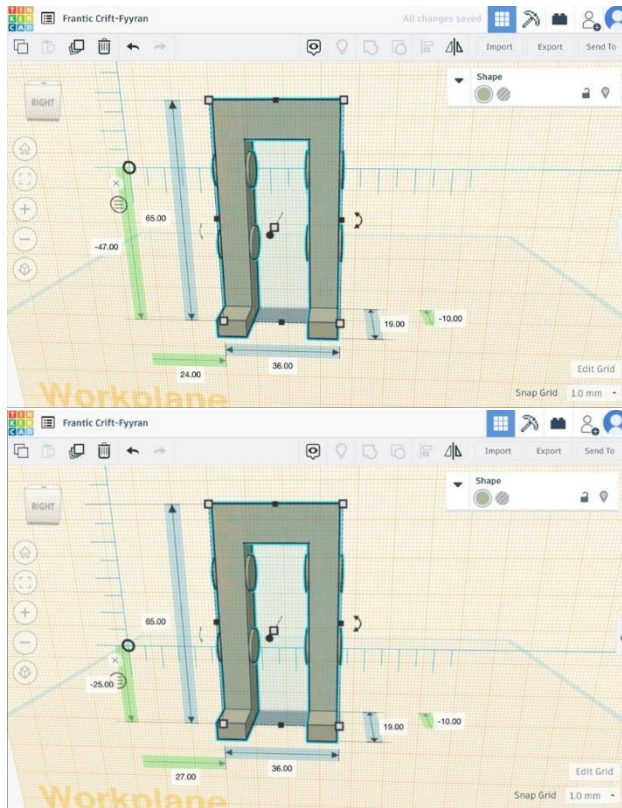
$$\rightarrow \theta = 11.48 \text{ degrees}$$



## Determining joints positions:

Using the online CAD software Tinkercad, I tested multiple joint positions.





### The final results:-

The knee joints position: 25 cm from the ground.

The hip joints position: 47 cm from the ground.

And the distance between them is: 22 cm

## References

[1]

F. Aller, M. Harant, S. Sontag, M. Millard and K. Mombaur, "I3SA: The Increased Step Size Stability Assessment Benchmark and its Application to the Humanoid Robot REEM-C," 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2021, pp. 5357-5363, doi: 10.1109/IROS51168.2021.9636429. <https://ieeexplore.ieee.org/document/9636429>

"The initial step size is defined as 20% of the total leg length of the robot. After three successful trials, the step size is continuously increased until REEM-C's last successful trial at 40% of its total leg length, leading to REEM-C's I3SA rating of 40."

[2]

<https://mathworld.wolfram.com/IsoscelesTriangle.html>