SPOTMICRO – INVERSE KINEMATICS (IK)

Forward kinematics :
θ_1, θ_2 et θ_3 are the servos angles
→ $x_{paw}, y_{paw}, z_{paw}$ are calculated from the angles

Not an easy way to plan movements

Inverse Kinematics (IK):
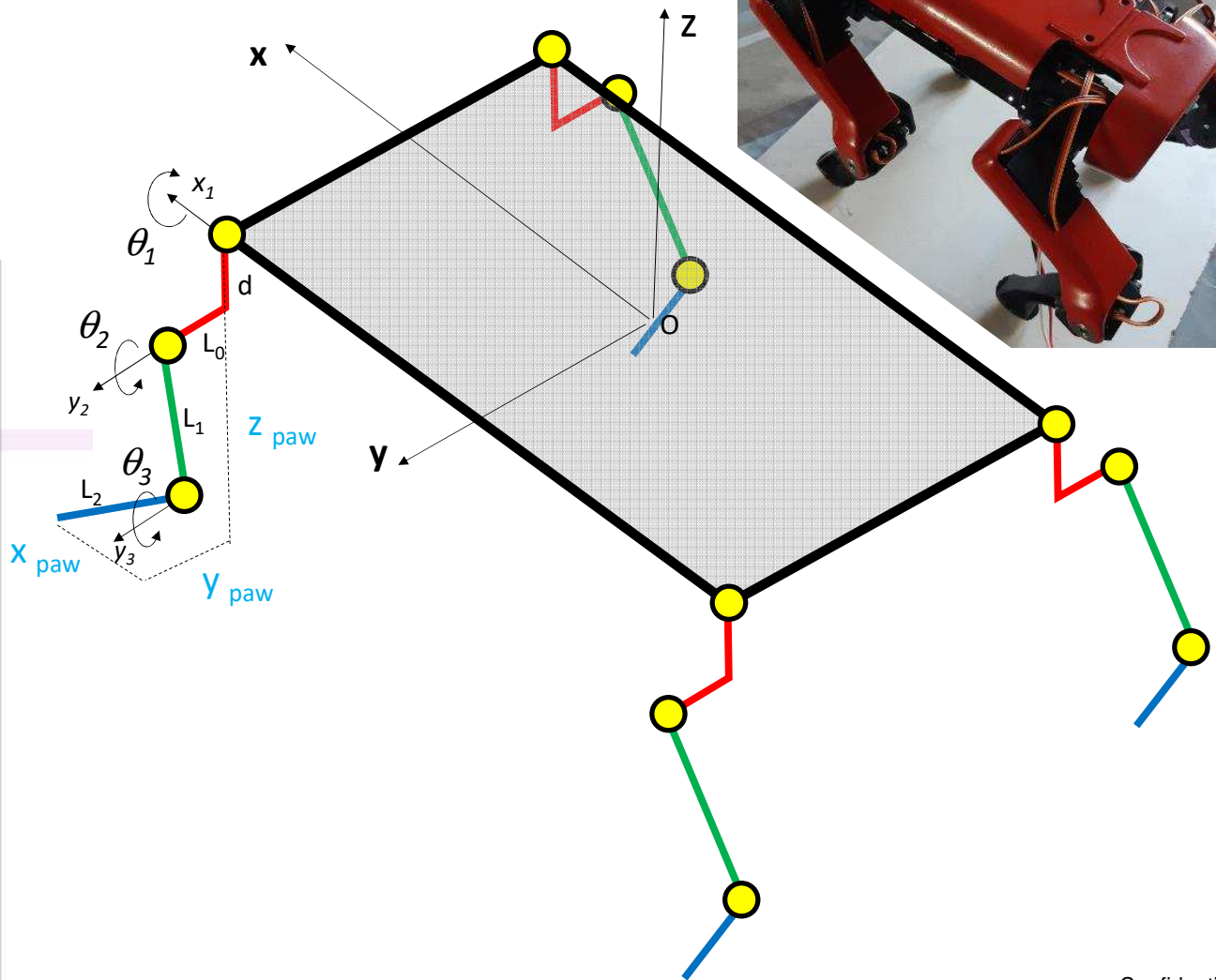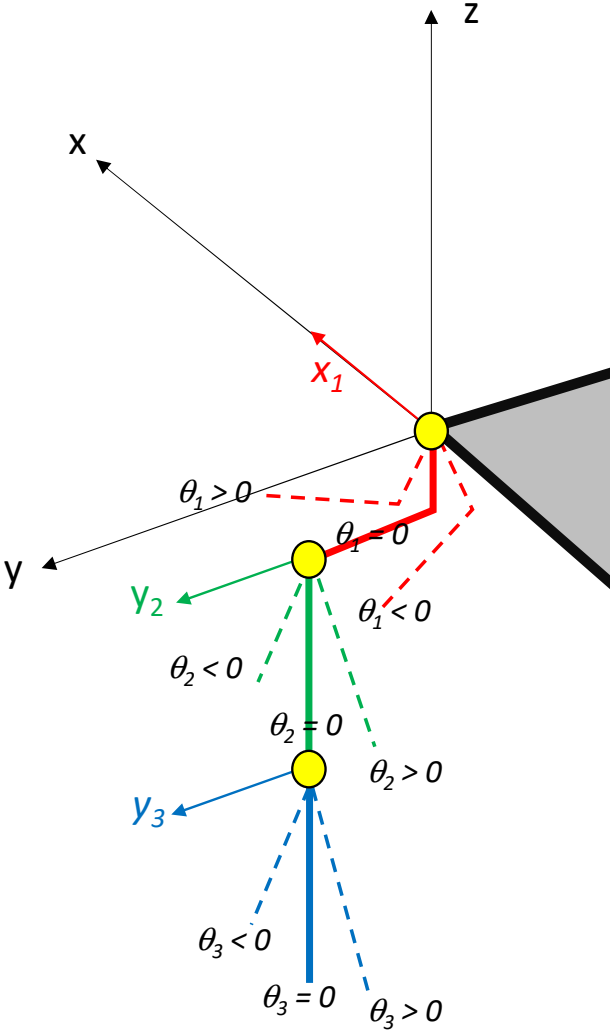Paw position ($x_{paw}, y_{paw}, z_{paw}$) is what we want
→ calculate θ_1, θ_2 et θ_3 to set the servos
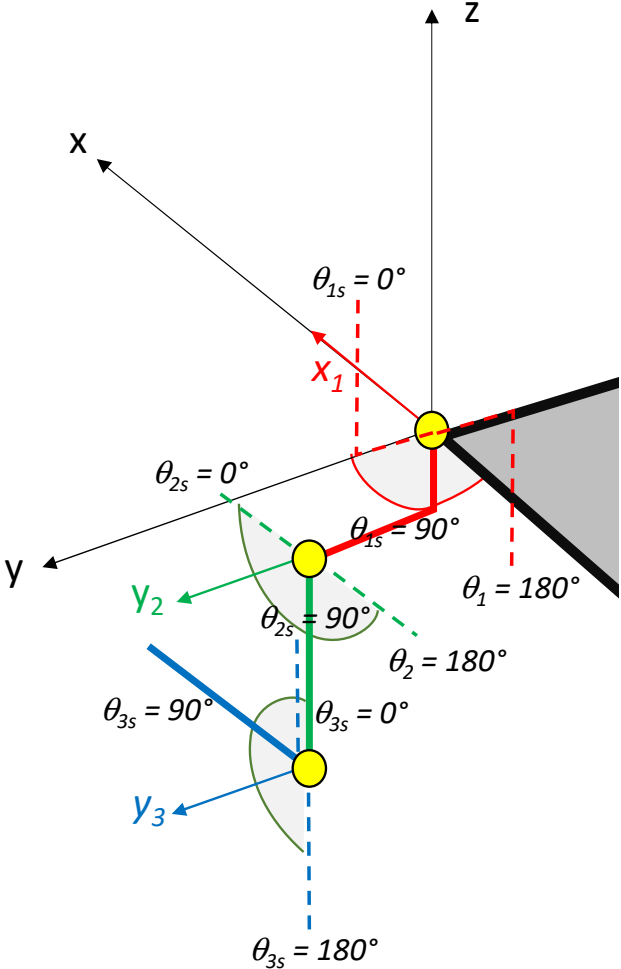
```python
178    def IK (self,L0, L1, L2, d, x, y, z, side): #Leg inverse Kinematics
179        """
180            s = 1 for left leg
181            s = -1 for right leg
182        """
183        t2 = y**2
184        t3 = z**2
185        t4 = t2+t3
186        t5 = 1/sqrt(t4)
187        t6 = L0**2
188        t7 = t2+t3-t6
189        t8 = sqrt(t7)
190        t9 = d-t8
191        t10 = x**2
192        t11 = t9**2
193        t15 = L1**2
194        t16 = L2**2
195        t12 = t10+t11-t15-t16
196        t13 = t10+t11
197        t14 = 1/sqrt(t13)
198        error = False
199        try:
200            theta1 = side*(-pi/2+asin(t5*t8))+asin(t5*y)
201            theta2= -asin(t14*x)+asin(L2*t14*sqrt(1/t15*1/t16*t12**2*(-1/4)+1))
202            theta3 =-pi + acos(-t12/2/(L1*L2))
203
204        except ValueError:
205            print ('ValueError IK')
206            error = True
207            theta1=90
208            theta2=90
209            theta3=90
210
211        theta = [theta1, theta2, theta3]
212        return (theta,error)
```
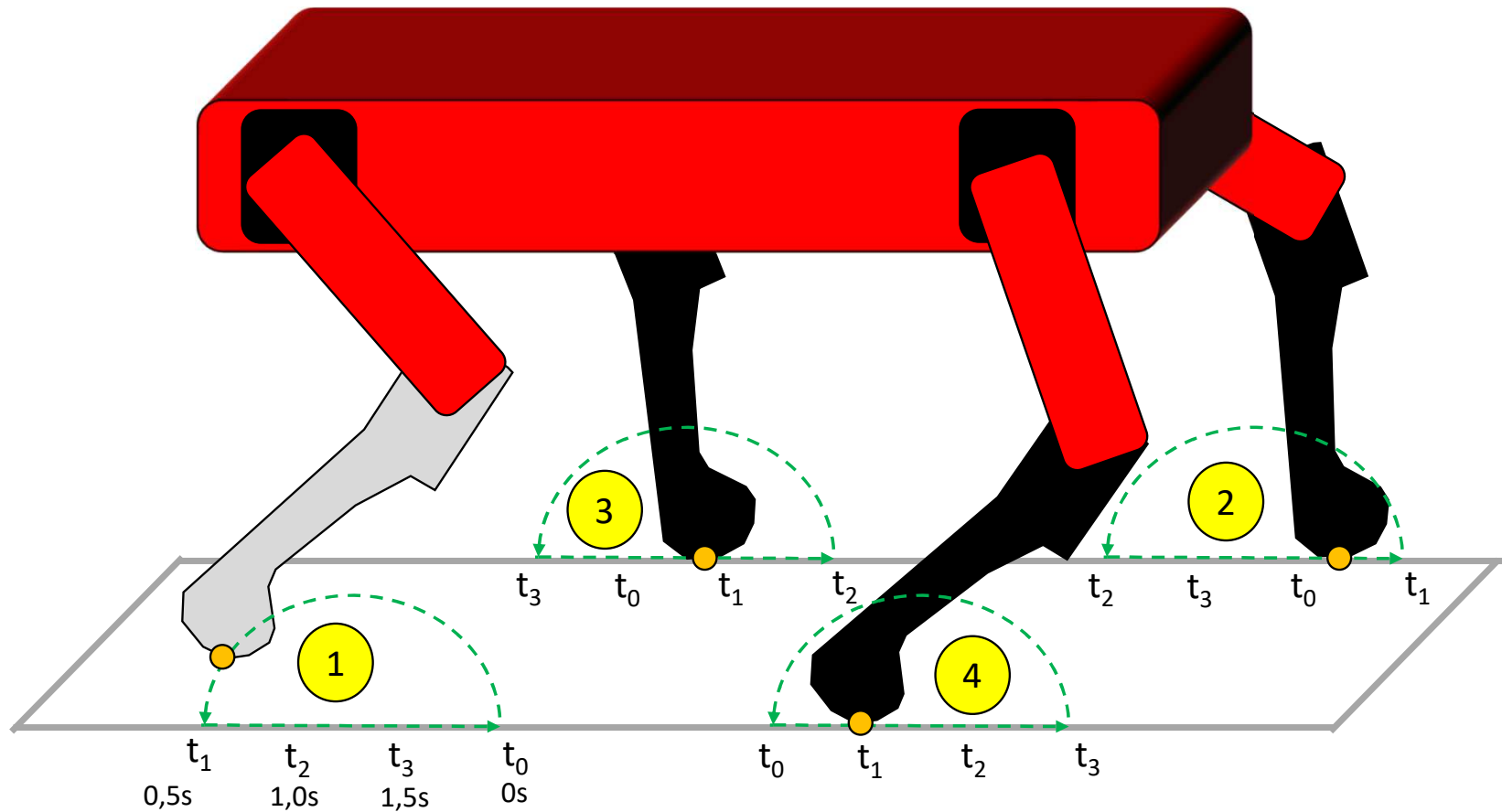
Inverse Kinematics – Zeros angles

z

x

x_1

$\theta_1 > 0$

$\theta_1 = 0$

$\theta_1 < 0$

y

y_2

$\theta_2 < 0$

$\theta_2 = 0$

$\theta_2 > 0$

y_3

$\theta_3 < 0$

$\theta_3 = 0$

$\theta_3 > 0$

Servos - Zero angles

z

x

$\theta_{1s} = 0°$

x_1

$\theta_{2s} = 0°$

$\theta_{1s} = 90°$

$\theta_1 = 180°$

y

y_2

$\theta_{2s} = 90°$

$\theta_2 = 180°$

$\theta_{3s} = 90°$

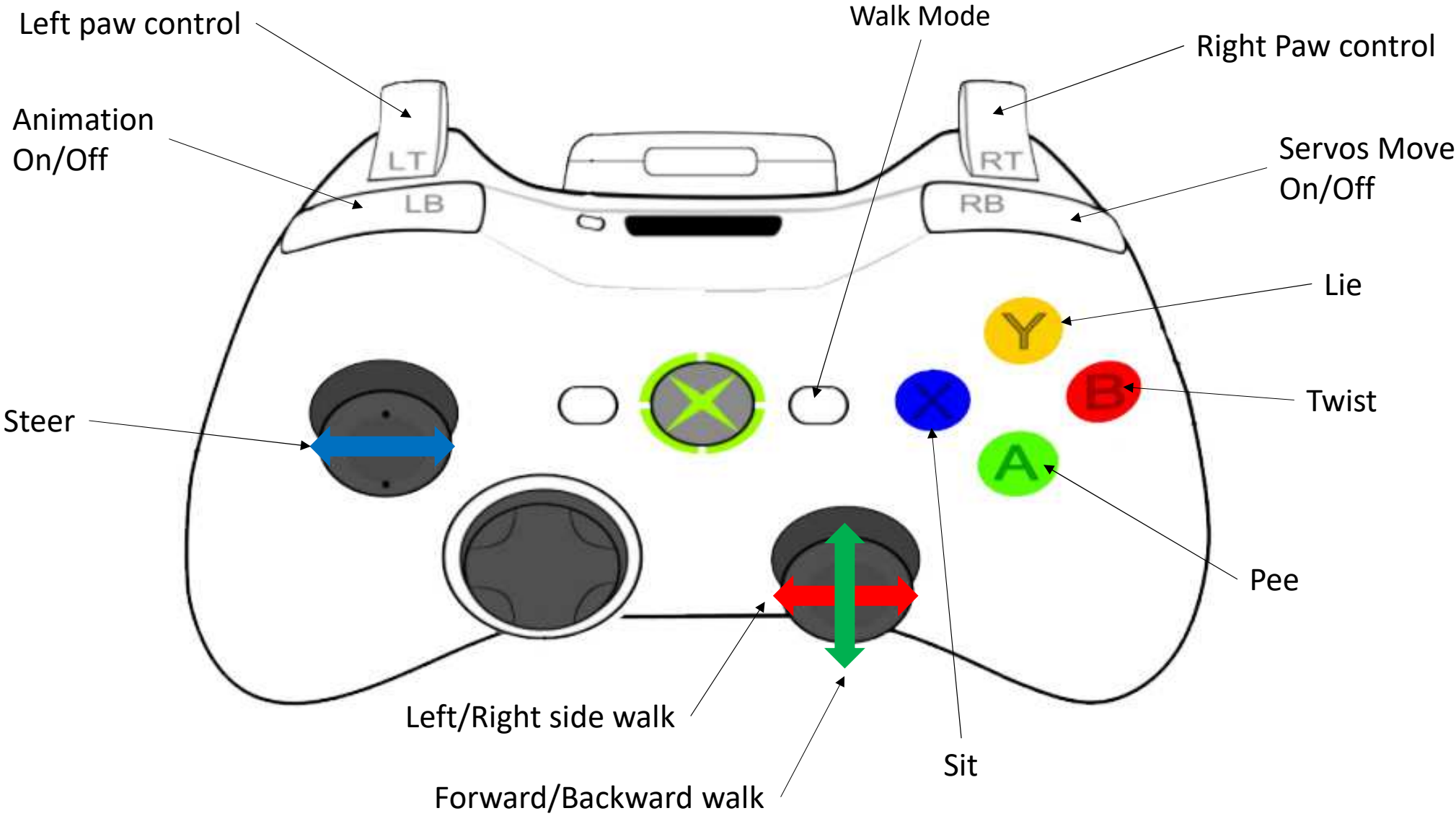$\theta_{3s} = 0°$

y_3

$\theta_{3s} = 180°$

The Walk

- Legs describe a half ellipse forward followed by a translation backwards.
- Leg cycles are shifted by 1/4th of the full walk cycle

XBOX ONE CONTROLLER FUNCTIONS

Left paw control

Walk Mode

Right Paw control

Animation On/Off

Servos Move On/Off

Lie

LT

RT

LB

RB

Y

B

Twist

Steer

X

A

Pee

Left/Right side walk

Sit

Forward/Backward walk

XBOX ONE CONTROLLER VARIABLES

pos_leftpaw

but_anim

but_walk

pos_rightpaw

but_move

but_lie

but_twist

but_pee

pos_turn

pos_leftright

but_sit

pos_frontrear