RoboAmbler Walking Base

Introduction

We offer the new construction of walking Robo Base, we use the 5-link mechanisms as foots for quadroped.

Mechanics of 5- link mechanism

Let us see the geometry of the mechanism

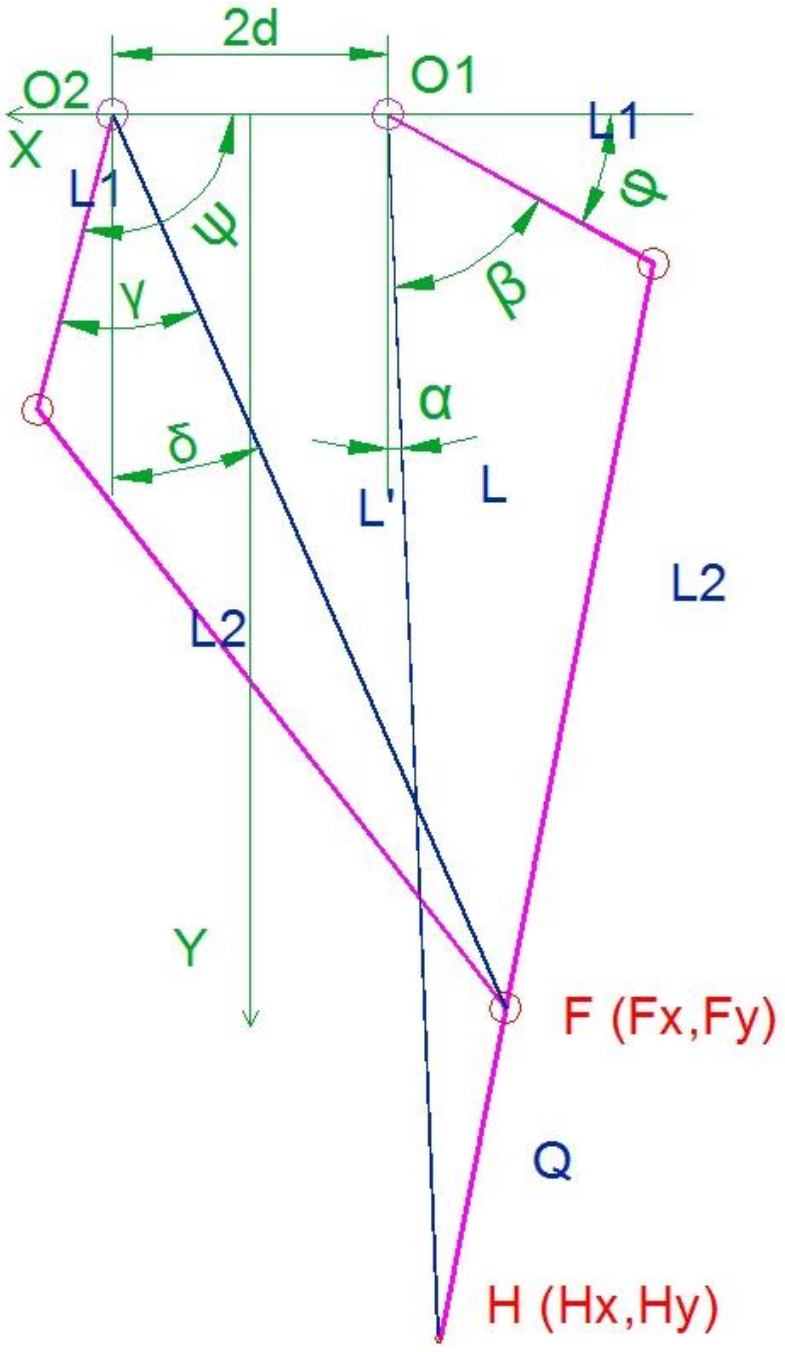

Fig. 1 Geometry of the 5-Link Mechanism.

Five Link Mechanisms are well known in mechanical engineering, and the calculation in common is very difficult. We introduce simple trigonometric way, without generalized coordinates and matrices. Let us calculate the angles ϕ and ψ, using the Hx and Hy coordinates of a target point as arguments. Let us see the Figure1.2. Two rotary drives (situated in O_1 and O_2 points) rotate the lower levers L1. Two upper levers L2 are connected with flat joints with lower L1 levers, and is connected at a point F. One of lever is longer and it takes L2+Q total length. Let us see leftn elements of a mechanism – O1 joint with the lever L1 at the ϕ angle to the 0X axe. The distance between O1 and the target point H is, using the Pythagoras' theorem

$$L^2 = (Hx-d)^2+Hy^2 \qquad (1)$$

$$\alpha = \text{arctg}((Hx+d)/Hy) \qquad (2)$$

or we can use usual for programmer ATAN2(a,b) operator:

$$\alpha = \text{ATAN2}(Hx+d,Hy) \qquad (3)$$

We can use the cosine rule

$$(L2+Q)^2 = L^2+L1^2- 2L1L\cos\beta \qquad (4)$$

$$\cos\beta = (L^2+ L1^2- (L2+Q)^2)/2LL1 \qquad (5)$$

$$\beta = \arccos((L^2+ L1^2- (L2+Q)^2)/2LL1) \qquad (6)$$

$$\phi = \pi/2- \alpha – \beta \qquad (7)$$

For the right elements of FLM, using proportions

$$Fx = -d-L1\cos\phi + (Hx+d+L1\cos\phi)L2/(L2+Q) \qquad (8)$$

$$Fy = L1*\sin\phi + (Hy-L1\sin\phi)L2/(L2+Q) \qquad (9)$$

Here we use Fx and Fy coordinates to calculate the ψ angle, as in (1) – (7) steps:

$$L'^2 = Fy^2 + (d-Fx)^2 \qquad (10)$$

$$\delta = \text{arctg}(((Fy, d- Fx) \qquad (11)$$

$$\delta = \text{ATAN2}(Fy, d-Fx) \qquad (11)$$

using the cosine rule

$$L2^2 = L'^2+L1^2- 2L1L'\cos\gamma \qquad (12)$$

$$2LL'\cos\gamma = L12 + L'2 – L22 \qquad (13)$$

$$\cos\gamma = (L12 + L'2 - L22)/ 2L1L' \qquad (14)$$

$$\gamma = \arccos ((L12 + L'2 - L22)/2LL') \qquad (15)$$

$$\psi = \pi/2 + \gamma - \delta \qquad (16)$$

So we can use the values of ϕ and ψ to control the mechanism.

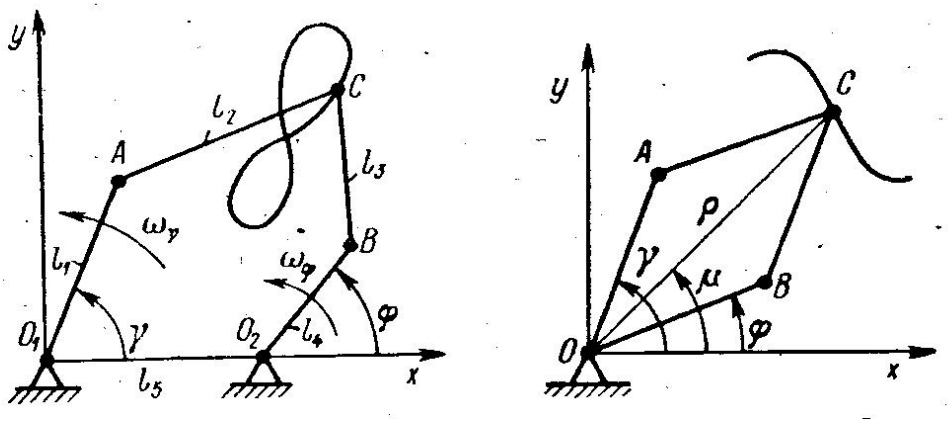

Fig. 02. Five Links Mechanism from old-school college textbook on mechanical engineering.

To be continued…