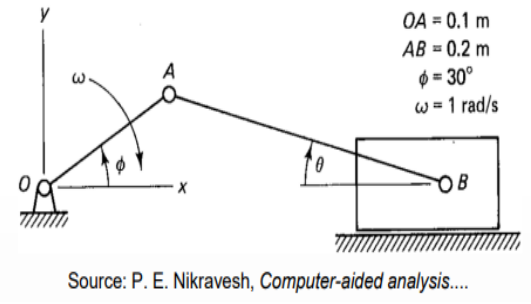
a link to my repository: https://github.com/Narges-Derakhshandeh/cmim10_assignment

▪ The Solve the problem from previous slide using $\phi = \pi$ 6 + ωt ▪ Create plots of t versus angle θ, displacement d, and their time derivatives



Source: P. E. Nikravesh, *Computer-aided analysis....*

In this assignment, there is a four-bar mechanism which the link named OA=a rotates with the rotational speed w=1 rad per second. These mechanisms have 2 unknown values (time depended) as theta and OB (or known as d). The initial value of the theta is calculated in the code and To find these 2 variables, we need 2 constraints equations to solve which are defined by the question. As the question has asked to find the derivative of theta and d, so we need to solve the Jacobian matrix.

So, for the coding we need to define the initial values given by the question like (a, b, ϕ, omega, time, and theta and d as our two variable).

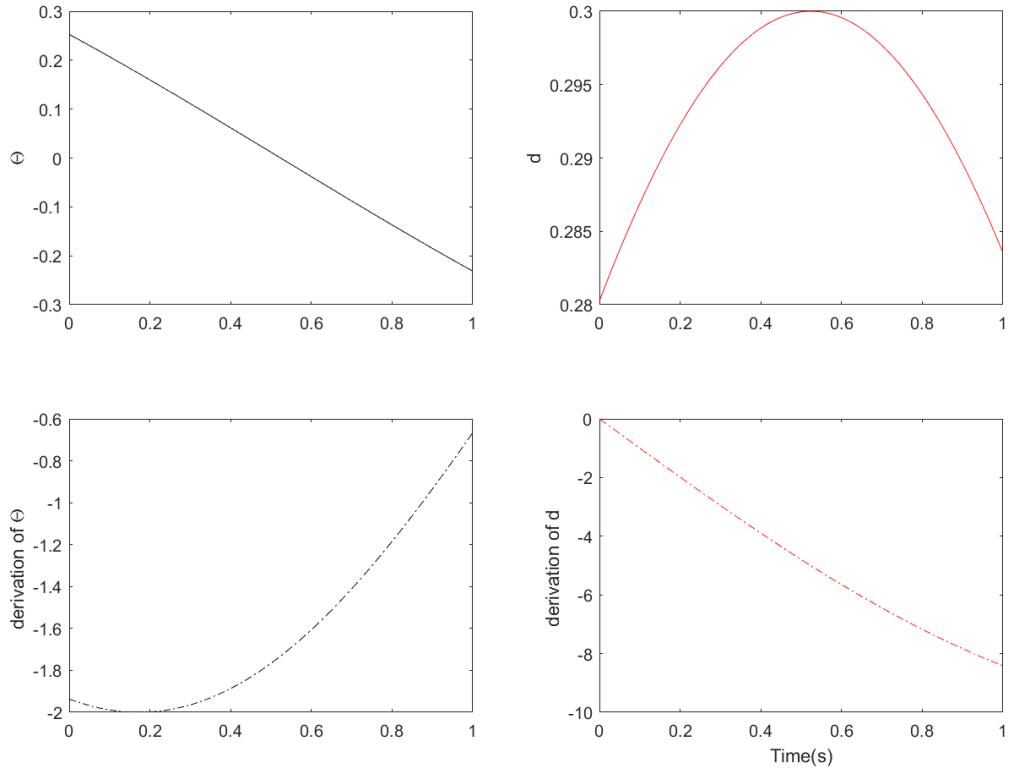
The method which is used to solve the constraint equations is Newton-Raphson. This method is defined in the code as function of four variables (1: constraints equations 2: Jacobian matrix, 3: the variable (theta and d) 4: error=1e-9). "The Newton - Raphson Method" uses one initial approximation to solve a given equation y = f(x). “In this method the function f(x), is approximated by a tangent line, whose equation is found from the value of f(x) and its first derivative at the initial approximation. The tangent line then intersects the X - Axis at second point. This second point is again used as next approximation to find the third point.”

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

So, constrains equations are needed in the newton Raphson method. These equations can be defined as the function of theta and d.

$$a\cos\phi + b\cos\theta - d = 0$$
$$a\sin\phi - b\sin\theta = 0$$

Then the Jacobian matrix is defined as the function of x (including theta and d) and b. After that we need to write a loop because our problem is time dependent (we have omega). Inside the loop, for each second the constraint equations and Jacobian matrix are solved to gain theta, d and derivative of theta and d. Now by storing these four, we can get their plot in time. In the next page, the plots are shown. The results show that by starting time the value of the d increase then theta reaches to zero, the value of the d starts to decrease.


Θ
d
derivation of Θ
derivation of d
Time(s)