Week 2 Homework

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Task 1

You should find:

1. simulate this mechanism (obtain all positions.)
2. velocities for A, B, C, E, F, D. Find angular velocities for all links.
3. acc. for A and B and ang. vel for AB
4. draw plots for previous statements.

Needed variables:
$\omega_{O_1A} = 2\ rad/s$;
$\phi = 60°$; $a = 56$; $b = 10$; $c = 26$; $d = 16$; $e = 25$;
$O_1A = 21$; $O_2B = 25$; $O_3F = 20$; $AB = 54$; $BC = 52$;
$CD = 69$; $CE = 35$; $EF = 32$.

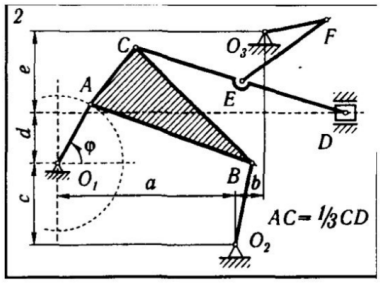

Figure 3: HW 2, task 1 (Yablonskii (rus) K4)

Let O1 be the origin

$$x_A = O_1A \begin{bmatrix} cos(\phi(t)) \\ sin(\phi(t)) \end{bmatrix}$$

Writing the equations of intersections of two circles to find XB

$$\begin{cases} (x_B - x_A)^2 + (y_B - y_A)^2 = (AB)^2 \\ (x_B - x_{o_2})^2 + (y_B - y_{o_2})^2 = (O_2B)^2 \end{cases}$$

From the triangle ABC, we can find Xc in the intersection of two circles:

$$\begin{cases} (x_C - x_A)^2 + (y_C - y_A)^2 = (AB)^2 \\ (x_C - x_B)^2 + (y_C - y_B)^2 = (BC)^2 \end{cases}$$

point D slides horizontally over axis x, thus

$$X_D = \begin{bmatrix} x_D(t) \\ d \end{bmatrix}$$

$$|X_c - X_D| = CD$$

We know that D is on CD, hence

$$X_E = X_C + CE \frac{\overrightarrow{CD}}{|\overrightarrow{CD}|}$$

F can also be found from the equation of intersection of two circles:

$$\begin{cases} (x_F - x_E)^2 + (y_F - y_E)^2 = (EF)^2 \\ (x_F - x_{o_3})^2 + (y_F - y_{o_3})^2 = (O_3F)^2 \end{cases}$$

let us use Instantaneous Velocity Centre to find the angular velocity for AB

$$\omega_{AB} = V_A\, r_{AB}$$

r can be found with the intersection of two lines O1A and O2B

$$r_{AB} = \begin{cases} y = (\frac{y_A - y_{o_1}}{x_A - y_{o_1}})x + (y_A - \frac{y_A - y_{o_1}}{x_A - y_{o_1}} x_A) \\ y = (\frac{y_B - y_{o_2}}{x_B - y_{o_2}})x + (y_B - \frac{y_B - y_{o_2}}{x_B - y_{o_2}} x_B) \end{cases}$$

Now after finding all positions, we can obtain velocities and accelerations by differentiating once and twice in order.