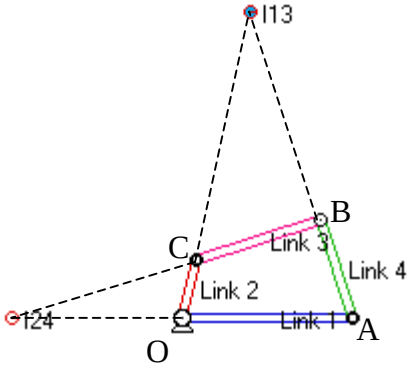
Instant Center



The instant center is defined as a point in which the two links have the same velocity. For a four-bar linkage, the instant center of the two conjunct links is the point at the pin joint between them; the instant center of the two opposite links, such as link 1 and link 3, is solved by the following method.

The instant center of link 1 and link3 is the cross point of extensions of link 4 and link 2.

The equation of link 4 is:

$$(x-x_B)(y_B-y_A)+(y-y_B)(x_B-x_A)=0$$

The equation of link 2 is:

$$(x-x_C)(y_C-y_O)+(y-y_C)(x_C-x_O)=0$$

Solve the above two equation, we get the coordinate of instant center I13

$$x=\frac{x_B(y_B-y_A)(x_C-x_O)-x_C(y_C-y_O)(x_B-x_A)-(y_C-y_B)(x_B-x_A)(x_C-x_O)}{(y_B-y_A)(x_C-x_O)-(y_C-y_O)(x_B-x_A)}$$

$$y=\frac{y_B(x_B-x_A)(y_C-y_O)-y_C(x_C-x_O)(y_B-y_A)-(x_C-x_B)(y_B-y_A)(y_C-y_O)}{(x_B-x_A)(y_C-y_O)-(x_C-x_O)(y_B-y_A)}$$

In the working Model file

output[22].y1 = Point[18].p.x = x_O, output[22].y2 = Point[18].p.y = y_O
output[23].y1 = Point[25].p.x = x_C, output[23].y2 = Point[25].p.y = y_C
output[24].y1 = Point[20].p.x = x_B, output[24].y2 = Point[20].p.y = y_B
output[26].y1 = Point[21].p.x = x_A, output[26].y2 = Point[21].p.y = y_A

output[29].y1 = (output[23].y1 - output[22].y1) * (output[26].y2 - output[24].y2) -
(output[24].y1 - output[26].y1) * (output[22].y2 - output[23].y2)
= (x_C - x_O)(y_A - y_B) – (x_B – x_A)(y_O – y_C)
output[30].y1 = (output[23].y1 - output[22].y1) * ((output[24].y1 - output[26].y1) *
output[24].y2 - (output[24].y2 - output[26].y2) * output[24].y1)
= (x_C - x_O)((x_B – x_A)y_B - (y_B – y_A) x_B)
output[30].y2 = (output[24].y1 - output[26].y1) * ((output[23].y1 - output[22].y1) *
output[23].y2 - (output[23].y2 - output[22].y2) * output[23].y1)
= (x_B – x_A)((x_C – x_O)y_C - (y_C – y_O) x_C)
output[30].y1 - output[30].y2
= (x_C - x_O)((x_B – x_A)y_B - (y_B – y_A) x_B) - (x_B – x_A)((x_C – x_O)y_C - (y_C – y_O) x_C)
= (x_C - x_O)(x_B – x_A)(y_B - y_C) - (x_C - x_O)(y_B – y_A) x_B + (x_B – x_A)(y_C – y_O) x_C

output[31].y1 = ((output[23].y1 - output[22].y1) * output[23].y2 - (output[23].y2 - output[22].y2) * output[23].y1) * (output[26].y2 - output[24].y2)

$= ((x_C - x_O)y_C - (y_C - y_O)\, x_C)(y_A - y_B)$

output[31].y2 = ((output[24].y1 - output[26].y1) * output[24].y2 - (output[24].y2 - output[26].y2) * output[24].y1) * (output[22].y2 - output[23].y2)

$= ((x_B - x_A)y_B - (y_B - y_A)\, x_B)(y_O - y_C)$

output[31].y1 - output[31].y2

$= ((x_C - x_O)y_C - (y_C - y_O)\, x_C)(y_A - y_B) - ((x_B - x_A)y_B - (y_B - y_A)\, x_B)(y_O - y_C)$

$= (x_C - x_O)(y_B - y_A)\, y_C - (x_B - x_A)(y_C - y_O)y_B + (y_B - y_A)\, (y_C - y_O)(x_C - x_B)$

So:

x = (output[30].y1-output[30].y2)/output[29].y1

y = (output[31].y1-output[31].y2)/output[29].y1

In the same way the coordinate of instant center I24 is:

x = (output[36].y1-output[36].y2)/output[35].y1

y = (output[37].y1-output[37].y2)/output[35].y1