Graphical Synthesis: Motion Generation with Ground Pivot Specification

At the end of this video, you should be able to:

• Describe the concept of kinematic inversion
• Graphically synthesize a four bar motion generator with three precision positions by specifying the ground pivots
Digression: Kinematic Inversion

*Kinematic Inversion*: Considering the motion of a mechanism with different links as ground
3 Precision Position Motion Generation

1. Pick ground pivots \((A_0, B_0)\)

2. Find \(A_0'\) and \(A_0''\) using kinematic inversion
   - \(A_0'\) is the location of \(A_0\), viewed from \(P_2\), drawn in 1st position
3 Precision Position Motion Generation

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3. Find moving pivot \(A_1\) at center of \(A_0, A_0', A_0''\)
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   center of \(A_0, A_0', A_0''\)
4. Repeat for B side
At the end of this video, you should be able to:

- Graphically synthesize a path generation four bar mechanism through three precision positions with and without specified timing
Path Generation

Source: Erdman, et al., Mechanism Design
Graphical Path Synthesis

Prescribed: $P_1, P_2, P_3$

Free Choices:
1. $A_0$ and $B_0$
2. Input link length
3. Initial input link angle

Procedure:
1. Find $A_0'$ and $A_0''$ by grounding coupler
Graphical Path Synthesis

Prescribed: $P_1, P_2, P_3$

Free Choices:
1. $A_0$ and $B_0$
2. Input link length
3. Initial input link angle

Procedure:
1. Find $A_0'$ and $A_0''$ by grounding coupler
Graphical Path Synthesis

Prescribed: $P_1$, $P_2$, $P_3$

Free Choices:
1. $A_0$ and $B_0$
2. Input link length
3. Initial input link angle

Procedure:
2. Locate $B_0'$ and $B_0''$
   - $A_0B_0=A_0'B_0'=A_0''B_0''$
   - $P_2B_0=P_1B_0'$, $P_3B_0=P_1B_0''$
Graphical Path Synthesis

Prescribed: $P_1, P_2, P_3$

Free Choices:
1. $A_0$ and $B_0$
2. Input link length
3. Initial input link angle

Procedure:
3. Locate $B_1$ with perpendicular bisectors
Graphical Path Synthesis

Prescribed: $P_1$, $P_2$, $P_3$

Free Choices:
1. $A_0$ and $B_0$
2. Input link length
3. Initial input link angle

Procedure:
4. Draw final mechanism
Graphical Path Synthesis: Free Choices

Prescribed: $P_1, P_2, P_3$

Free Choices:
1. $A_0$ and $B_0$
2. Input link length
3. Initial input link angle
Mechanism Timing

- Timing: Specifying input link rotation between precision positions
<table>
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<th>Path Generation</th>
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Path with Timing Synthesis Procedure

I. Find $r_2$ and $\beta_1$ using kinematic inversion grounding input link

II. Find $B_1$ as done in Path w/o Timing synthesis
Graphical Path w/ Timing, Part I

Prescribed: $P_1, P_2, P_3, \beta_2=45^\circ, \beta_3=75^\circ$

Procedure:
1. Pick $A_0$
2. Draw $A_0P_2$ & $A_0P_3$
3. Invert (ground input link)
   a) Locate $P_2'$ by rotating $P_2A_0$ by $-\beta_2$ about $A_0$
   b) Locate $P_3'$ by rotating $P_3A_0$ by $-\beta_3$ about $A_0$
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4. Find \( A_1 \) at center of \( P_1, P_2', P_3' \)
5. Repeat Path w/o Timing Synthesis
Graphical Path w/ Timing, Part I

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5. Repeat Path w/o Timing Synthesis