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Four-bar Linkage Synthesis for A Combination of Motion and Path-point Generation

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Four-bar Linkage Synthesis for A Combination of Motion and Path-point Generation

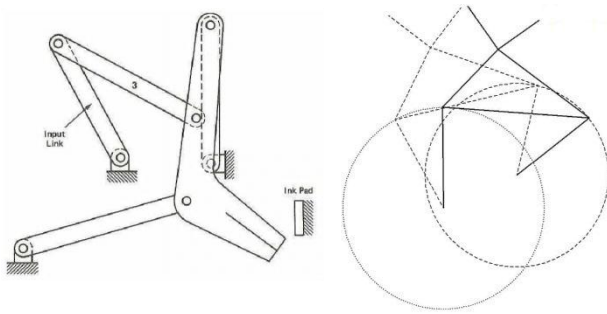
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Objective: To develop techniques that address the design of planar four-bar linkages for tasks common to pick-and-place devices, common in assembly and manufacturing operations.

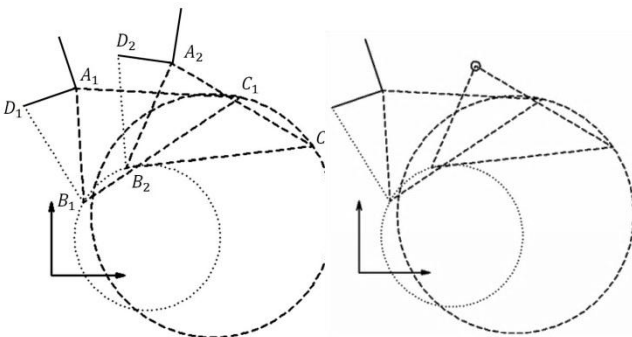
Introduction

- Pick-and-place machines are mechanical devices designed to repetitively perform a specific sequence of part movements



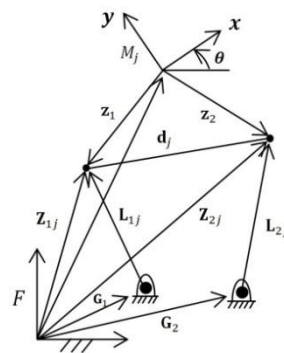
GCP Methodology

- Geometric Constraint Programming (GCP) is a technique that has the advantages of both the graphical and analytical techniques for the kinematic synthesis



Numerical Methodology

- Numerical methods formulate the kinematic chain constraint equations and solve for the appropriate link lengths and pivot locations.



Vectors

$$\begin{aligned} Z_{1i} &= T_i z_1 + d_i \\ Z_{2i} &= T_i z_2 + d_i \\ L_{1i} &= Z_{1i} - G_1 \\ L_{2i} &= Z_{2i} - G_2 \end{aligned}$$

System Equations

$$\begin{aligned} L_{1i} \bar{L}_{1i} - L_{11} \bar{L}_{11} &= 0 \\ L_{2i} \bar{L}_{2i} - L_{21} \bar{L}_{21} &= 0 \\ i &= 2, 3, 4, 5, 6. \end{aligned}$$

- All the combination of precision points and task positions that produce a finite number of mechanisms.

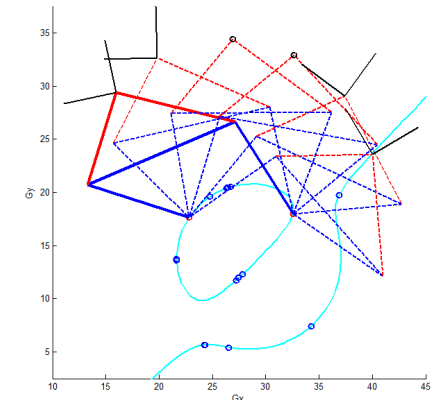
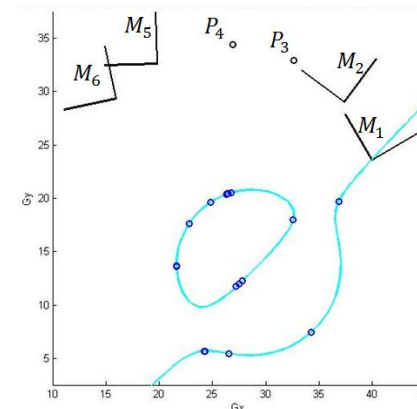
No. of Task Positions:	5	4	3	2	1	0
No. of Precision Points:	0	2	4	6	8	9
No. of Eqs. and Variables	8	12	16	20	24	24

Conclusion

- Techniques developed to design planar four-bar linkages for tasks common to pick-and-place devices.

Examples

- Combination have finite solutions: 4 positions and 2 points



- Combination have 1-parameter solutions: 3 positions and 3 points

