Singularity-Free Synthesis of Coupler-Drivers for Actuating Single Degree-of-Freedom Mechanisms

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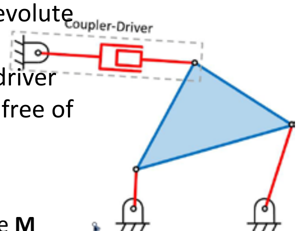
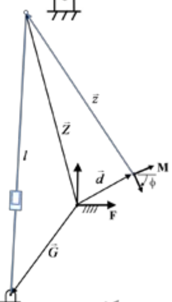
-Coupler driver Mechanisms.
A revolute-prismatic-revolute chain
-Synthesize a coupler-driver to satisfy a singularity free of motion .

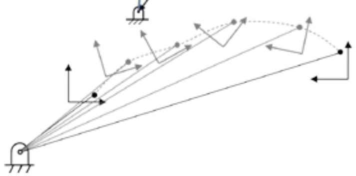


Consider a Moving Frame **M**
Goals to predict the coordinates of coupler pivots –Fixed **G** & Moving **Z** satisfy free of defect motion



$$\vec{l}_i = A_i\vec{z} + \vec{d}_i - \vec{G}$$

Monotonic motion excellent position for the CD- no singularity exist



Governing equation that satisfy monotonic motions

$$\vec{l}^T\dot{\vec{l}} > 0 \qquad \vec{l}^T\dot{\vec{l}} < 0 \qquad \vec{l}^T\dot{\vec{l}} = (A\vec{z}+\vec{d}-\vec{G})^T(\dot{A}\vec{z}+\dot{\vec{d}}) = [\vec{z}^T \quad 1]B\begin{Bmatrix}\vec{G}\\ 1\end{Bmatrix} = 0$$

Moving pivot by solving

$$[\vec{z}^T \quad 1]B\begin{Bmatrix}\vec{G}\\ 1\end{Bmatrix} = 0$$

Moving Actuator Singularity Points

$$\dot{\vec{Z}}_i^T(\vec{Z}_i - \vec{Z}_j) = 0 \;\&\; \dot{\vec{Z}}_j^T(\vec{Z}_i - \vec{Z}_j) = 0$$

Fixed Actuator Singularity Points

$$\dot{\vec{g}}_i^T(\vec{g}_i - \vec{g}_j) = 0 \;\&\; \dot{\vec{g}}_j^T(\vec{g}_i - \vec{g}_j) = 0$$

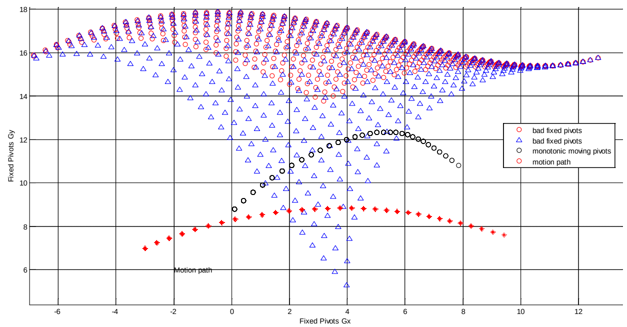


Figure Shows the area of singular pivots

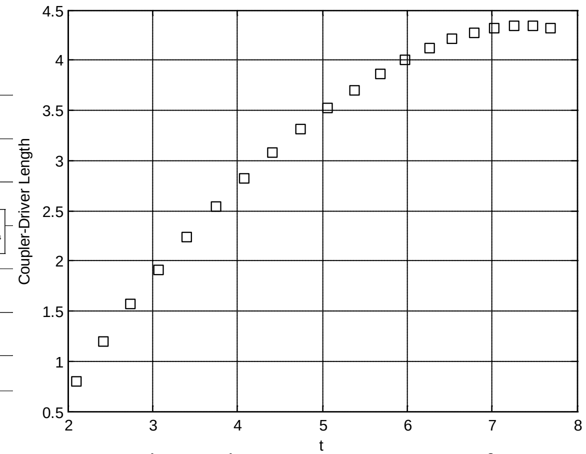


Figure shows the Monotonic motion of RPR CD

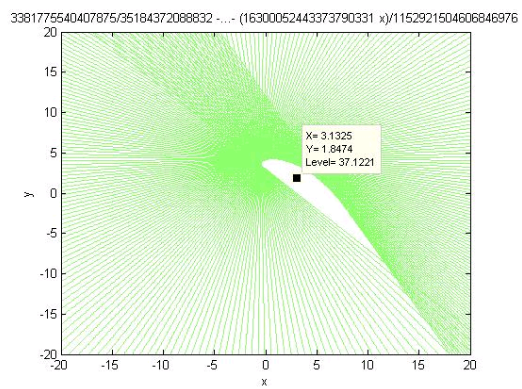


Figure the moving pivots that is not singular

- Conclusion

- A new method of synthesizing coupler-drivers by calculating the actuator singularity points
  - Applies to any motion generated by a single DOF mechanism
  - Generate circuit-defect free solutions, synthesize coupler-driver
- Generation of space description of coupler driver revolute joints.
- This method shows how to predict the correct pivots locations fixed and moved one by using the actuate singularity techniques