

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

Hameed Juma

Advisor Prof . Andrew Murray

-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

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

Moving pivot by solving

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

Moving Actuator Singularity Points

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

Fixed Actuator Singularity Points

$$\vec{g}_i^T (\vec{g}_i - \vec{g}_j) = 0 \quad \vec{g}_j^T (\vec{g}_i - \vec{g}_j) = 0$$

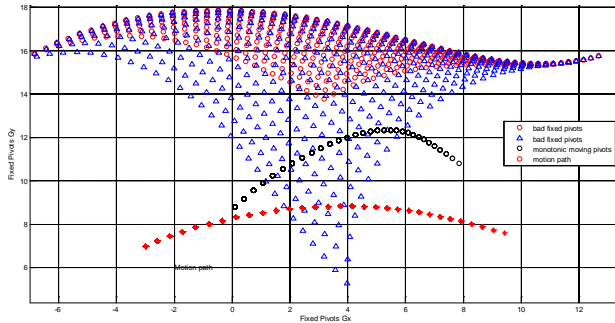
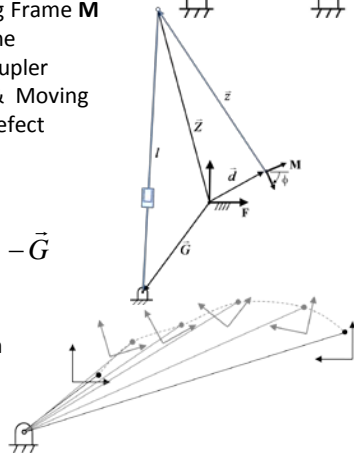
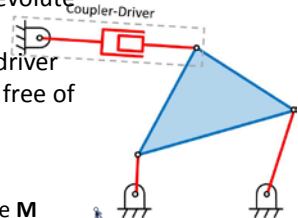


Figure Shows the area of singular pivots

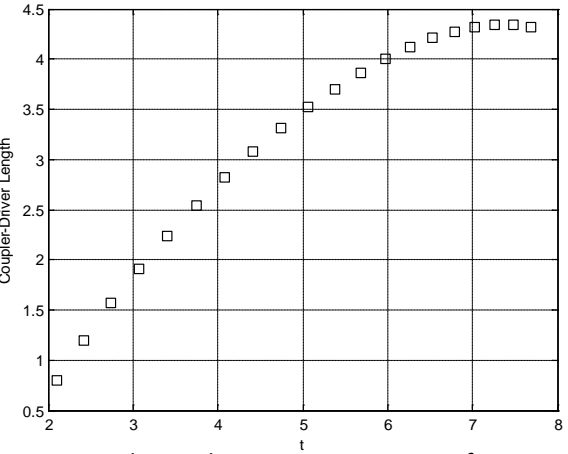


Figure shows the Monotonic motion of RPR CD

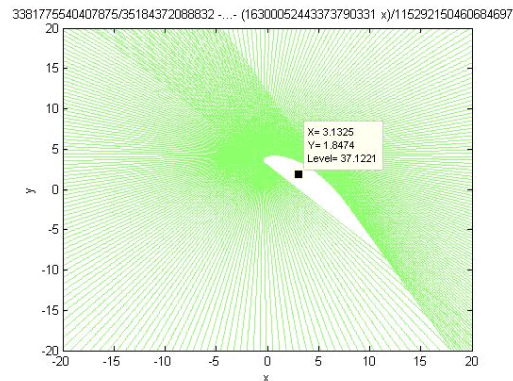


Figure the moving pivots that is not singular

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