Reducing Structural Error in Function Generating Mechanisms via the Addition of Large Numbers of Double-Crank Linkages

Hessein Ashour

University of Dayton, stander@udayton.edu

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Reducing Structural Error in Function Generating Mechanisms via the Addition of Large Numbers of Double-Crank Linkages

Hessein Ali
Advisors: Dr. Andrew Murray & Dr. David Myszka

Objective: This research presents a methodology for synthesizing planar linkages to approximate any prescribed periodic function.

Introduction:
The three planar mechanisms selected for this research are the slider-crank and the geared five-bar with connecting rod and sliding output (GFBS), where any number of drag-link (or double crank) four-bars are used as drivers.

For single maximum periodic functions, the following chain is used:

\[
\begin{align*}
&h_1 a_1 \quad b_1 \quad \theta_1 \\
&h_2 a_2 \quad b_2 \quad \theta_2 \\
&\vdots \\
&h_n a_n \quad b_n \quad \theta_n
\end{align*}
\]

The chain of drag-link mechanisms added to a terminal slider-crank mechanism.

For multiple maxima periodic functions, the following chain is used:

\[
\begin{align*}
&h_1 a_1 \quad b_1 \quad \theta_1 \\
&h_2 a_2 \quad b_2 \quad \theta_2 \\
&\vdots \\
&h_n a_n \quad b_n \quad \theta_n
\end{align*}
\]

The chain of drag-link mechanisms added to a GFBS.

Examples:
A piecewise-linear periodic function

Motivation:
Without constraining the complexity (e.g. number of links) of 1 DOF devices, how accurately can we produce arbitrary periodic curves?

Methodology:
- Develop design equations for the three mechanisms utilized.
- Apply local random search optimization technique.
- Utilize MATLAB to run the optimization.

Verification of the Results:
A slider-crank driven by eight drag-link mechanisms

Conclusions:
- Structural error is decreased as drag-link mechanism is added as a driver.
- The synthesized mechanisms are allowed to be of any number of links.