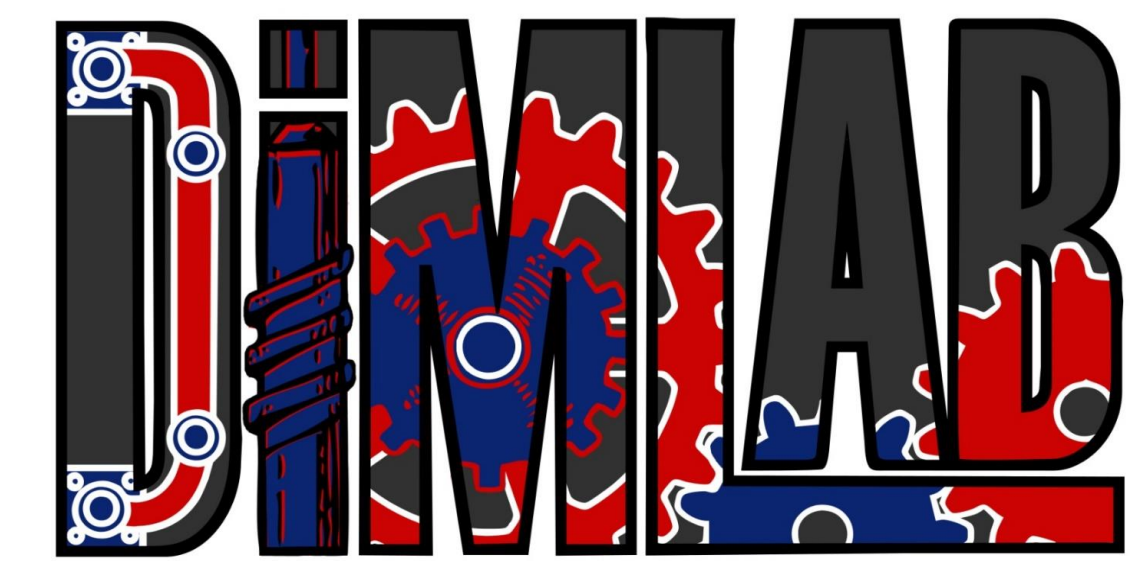


Dimensioning Mechanical Presses Driven by a Geared Five-Bar for Desired Dwell using Advanced Algebraic Techniques

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Objective: To create optimized press designs through the use of advanced algebraic techniques.

Introduction

A mechanical press uses a linkage that oscillates a ram in order to form or cut sheet metal. This research develops design theories that use a unique mechanical linkage to obtain alternative ram oscillation patterns, such as a prolonged dwell. A geared five-bar press with sliding output is proposed to produce these alternative motions.

Vector Loops:

Loop1:

$$a \begin{pmatrix} \cos(\theta_a) \\ \sin(\theta_a) \end{pmatrix} + b \begin{pmatrix} \cos(\theta_b) \\ \sin(\theta_b) \end{pmatrix} - c \begin{pmatrix} \cos(\theta_c) \\ \sin(\theta_c) \end{pmatrix} - d \begin{pmatrix} \cos(\theta_d) \\ \sin(\theta_d) \end{pmatrix} - f \begin{pmatrix} \cos(\theta_f) \\ \sin(\theta_f) \end{pmatrix} = 0$$

Loop2:

$$a \begin{pmatrix} \cos(\theta_a) \\ \sin(\theta_a) \end{pmatrix} + b \begin{pmatrix} \cos(\theta_b) \\ \sin(\theta_b) \end{pmatrix} + e \begin{pmatrix} \cos(\theta_e) \\ \sin(\theta_e) \end{pmatrix} - v \begin{pmatrix} \cos(\theta_v) \\ \sin(\theta_v) \end{pmatrix} - f \begin{pmatrix} \cos(\theta_f) \\ \sin(\theta_f) \end{pmatrix} - \begin{pmatrix} 0 \\ s \end{pmatrix} = 0$$

Isotropic Coordinates:

Loop1:

$$aT_a + bT_b - cT_c - dT_d - fT_f = 0$$

$$a\bar{T}_a + b\bar{T}_b - c\bar{T}_c - d\bar{T}_d - f\bar{T}_f = 0$$

Loop2:

$$aT_a + bT_b + eT_e - vT_v - fT_f - s = 0$$

$$a\bar{T}_a + b\bar{T}_b + e\bar{T}_e - v\bar{T}_v - f\bar{T}_f - s = 0$$

What are Isotropic Coordinates?

$$T_j = \cos\theta_j + i * \sin\theta_j, i = \sqrt{-1}$$

$$\bar{T}_j = \cos\theta_j - i * \sin\theta_j$$

$$T_j \bar{T}_j = 1$$

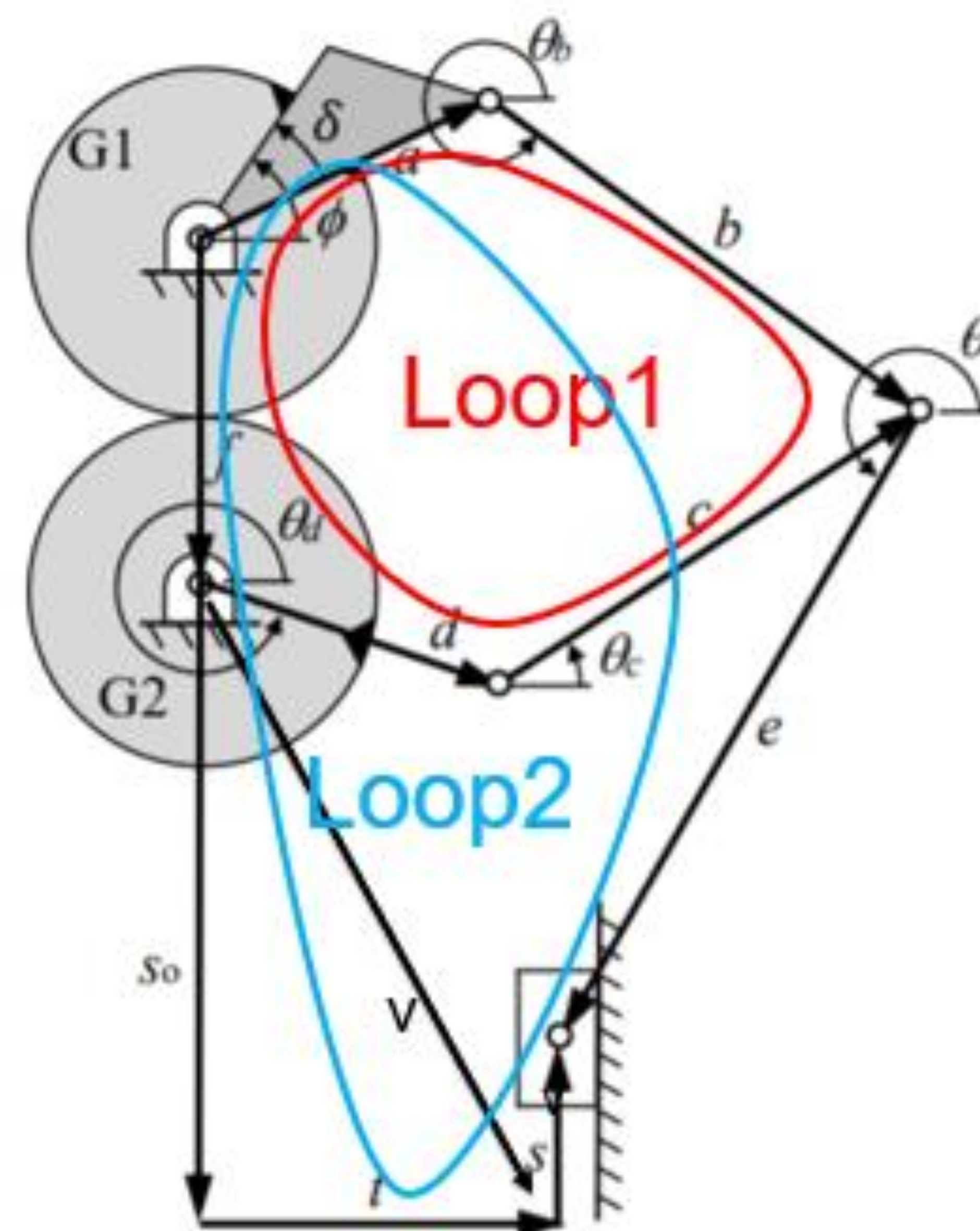
Why use Isotropic Coordinates?

$\cos(\theta_a)^2 + \sin(\theta_a)^2 = 1$, is second order.

$T_j \bar{T}_j = 1$ is bilinear.

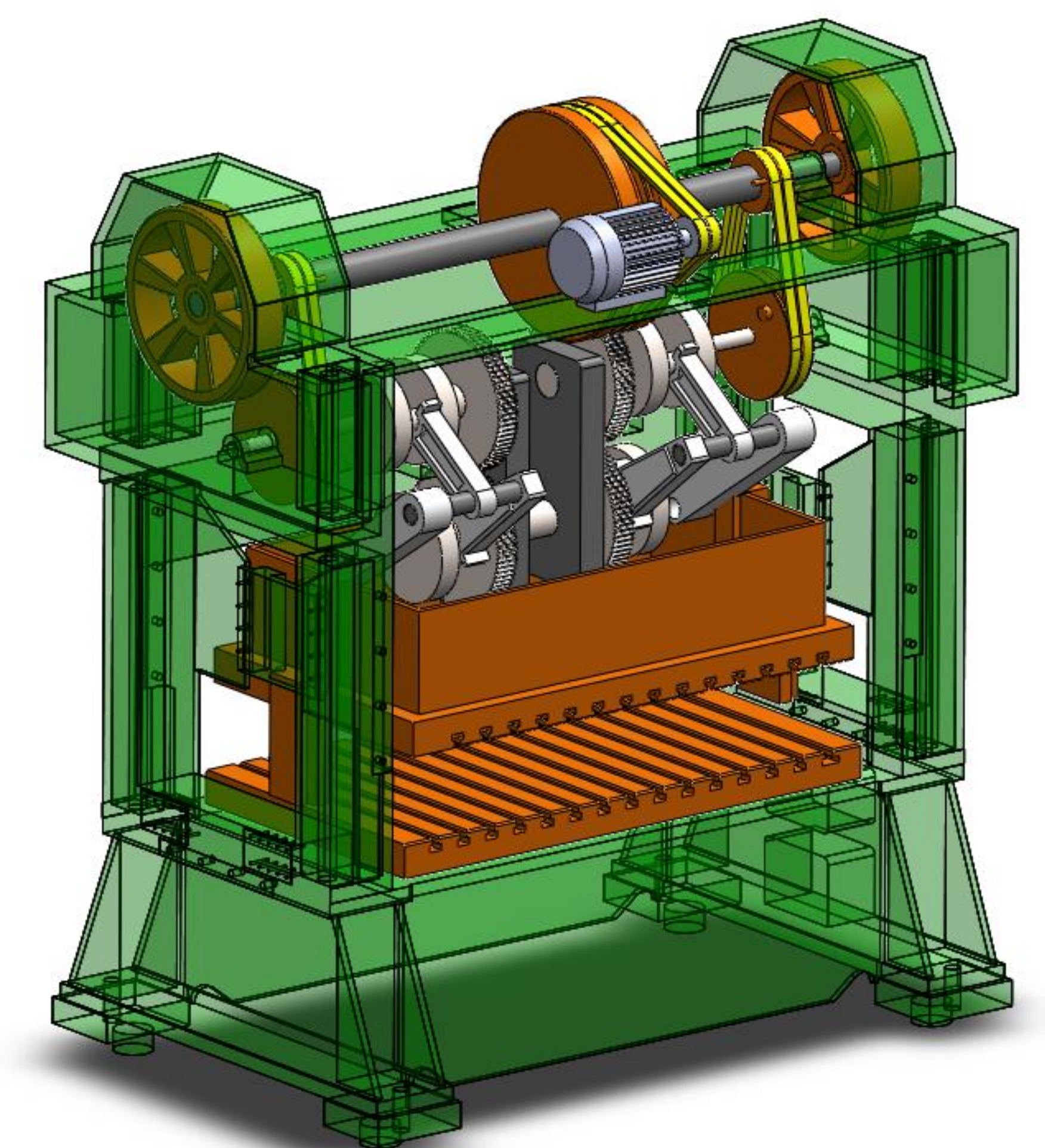
The resulting algebraic equations have a smaller number of solutions.

Vector Diagram of Geared Five-Bar



As shown to the right, a geared five-bar drivetrain is able to vastly improve dwell when incorporated into the design of the press.

Press Driven by Geared Five Bar



Stroke Curve Comparison

