Design of Barrel’s Cam Curve Profile Using B-Spline Curves

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Abstract: One of the biggest challenges the cam designer faces up is to find the equation that satisfies the timing diagram for a movement in a cam. There are several ways to get a model for a curve like Simple Harmonic Motion (SHM), Modified Trapezoidal Acceleration, Polynomial Functions, etc. This kind of equations works under some conditions of velocity and acceleration, but in the interval of its movement it can present erratic behavior because those equations are not allowed to control the discontinuities of acceleration or jerk. Getting forward in this problem this paper proposes the use of B-Spline curves to obtain the displacement function for a barrel cam, because its characteristics of local control give it an advantage over other families of curves. The methodology to build B-Splines curves is analyzed from the analytical point and then we use the software Dynacam to get the SVAJ diagram getting a shape of cam in real time. The results obtained were imported to Solid Works, reducing the time it takes to get a shape of a cam.

Keywords: B-Spline, Local Control, Jerk.

1. Introduction

From all mechanical elements, the cam is the most versatile one, because a simple movement can be transformed into a wide range of output movements (Norton RL, 2009). Nevertheless, one of the challenges when using a cam is that the velocities and accelerations can be very high, and that is why it is necessary to take into account the right selection of the movement equation to achieve the best performance.

This work shows the literature review about the most used models for cam design, their characteristics and operation ranges. Also proposes the use of B-Spline curves to obtain the position function for a barrel cam, which own characteristics of local control in each point (knot) inside the curve’s motion.

2. Literature Review

According to Nguyen and Kim (2007) the cams are widely used in a number of applications in machines because you can obtain a countless quantity of movements from them. Even the follower cam system needs the cam profile being as smooth as possible so it can achieve the adequate cinematic and dynamic properties. There are many ways to mathematically express a cam profile. Among these functions that stand out for their movement are included the harmonic, the cycloidal, the modified harmonic, the trapezoidal curve, the polynomial, etc.

The spline curves have been applied in the cam design for over 20 years. The spline curves method is flexible enough to allow that movement programs refine and optimize them while the movement limitation can be satisfied. As they are, the spline methods have been applied to synthesized movements that would have turned complex with traditional methods. The processes to solve these problems include the task to satisfy a set of arbitrary movement restrictions.

In other hand, the objective was to address with several design factors to cinematic and dynamic optimization. But the fact that is based in B-Spline curves the affection only takes a part of the points close to it. According to this experiment results, the analysis could show some profile points that are not desirable specially when these adjusts are required in the speed or acceleration curves.

2.1 Dynamic Analysis of the Mechanism

Livija (2006) mentions two cam mechanism models that are used for their dynamic analysis. A model considers a rigid cam, the shaft that drives the cam and its follower is considered an elastic body (spring). The other model considers the cam as an elastic body as well as the driven shaft, and the follower as a rigid element.