American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-8, Issue-11, pp-01-04
www.ajer.org
Research Paper Open Access

Development of a Software to Cam Follower Projects

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ABSTRACT : *With reports of use since the beginning of the development of Mechanics, the follower cam mechanism is widely used to this day. Integrating several machines and equipment, this mechanism is summarized to two components: The first, which works with rotation, and the following, which translates according to the rotation of the first. Frequently designed by means of number methods, the follower cam set has some software for the development of its projects, but often these softwares are expensive or not so accessible to users. Result of a scientific research initiation funded by CNPq, the present paper aims to show a software to do cam follower projects. Passing through a theoretical reference with the presentation of the cam follower mechanism, besides some characteristics of these two, the methodology used consist in the development of an easy and simple to use software. At the end of this work, it is expected to validate the results obtained from the output of the program with an example of a dynamics of machinery book simulated on the software.*

KEYWORDS *cam follower mechanism, kinematics and dynamics of machinery, MATLAB, algorithms and software.*

Date of Submission: 25-10-2019 Date of acceptance: 06-11-2019

I. INTRODUCTION

One of the pillars of the classic mechanics, the cam follower is one of the most used mechanisms until today. According to [2], the part in modern machinery who cams plays is very important, once this component is extensively used in machine tools, instruments, internal-combustion engines and a lot of others applications.

Integrating a lot of machines, this mechanism consists of a disk who has a rotary movement and, meanwhile, a follower in contact with the face of this disk translate according with the curve design of this. As will be presented in this paper, the follower has a few types as flat-faced, knife edge and roller, for example.

While this former and classical introduced mechanism continues to be used, the whole Engineering has undergone a series of changes. To specialists, these changes can be resumed by the widely used of the notebooks and software in these days, not forgetting that a few years ago the calculators took the place of ruler calculators. As expected, such changes had a strong influence on Mechanical Engineering. With the electric and electronic development, besides the computation, is in this context who new areas as mechatronics arises.

Therefore, in the presented context, the aim of this work is showing the development of a software to make cam follower projects. As will be prove at the end of the currently article, the software was able to give the mechanism displacement, velocity and acceleration curves, besides the contour of the cam disk. Other available functions to help the design engineer can be mention, as give information about the types of the followers and movements, together with an option to make a simulation and test if the currently project has a fail as cusps, for example.

II. THE CAM FOLLOWER MECHANISM

Also known as track follower, according to [3], the cam follower is a mechanical dispositive extremely useful without which the machine designers' tasks would be harder to make, corroborating to the important of the mechanism studied in this article.

To [1], two of the most relevant authors of the Classic Mechanics, especially in the mechanisms and dynamics of the machinery area, cam disks have a fundamental importance in the modern machines. Besides that, these two authors explain that are two basic methods to make a track follower project: The first one using a cam disk design as input and, before that, perform an analysis of the translate who this disk will trigger in the follower. The second way is choosing a displacement to the follower and then make the design of the cam disk aiming to reach the desired mechanism movement. Once the second method is the most used and it is most didactic, this one was choosing to the development of the project, where the software user will input the displacements desired types.

A. Cam disk

In the track follower mechanism, the cam disk is responsible for the rotational movement. Rotating around an axle that is taken as the project origin, this disk rule the mechanism movement once that its contour is directly in contact with the face of the follower. To make a design of this component, a fundamental parameter know as minimum radius must be defined. With this radius as input data, a circumference with center in the project origin has to be drawn. The distance between the contour of this circumference to the edges of the cam disk will define the final format of the disk and, consequently, the movement of the follower. A cam disk is represented in Fig. 1.

Fig.1. Cam disk.

B. Follower

These components can be classified by two groups: Radial and oscillating. This classification occurs according to the type of the follower displacement. Because of the bending moment generated by the oscillating type, this type of follower is avoided when it is possible. Fig. 2 shows a few types of followers.

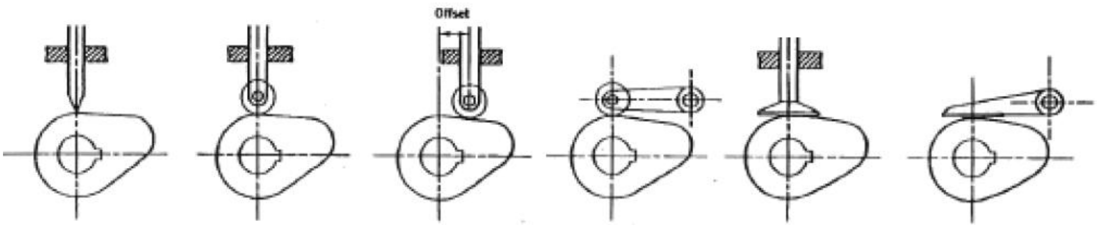

Fig. 2. Types of followers.

III. TYPES OF MOTIONS: KLOOMOK AND MUFFLEY EQUATIONS

According to [4], the cam follower mechanism is function of four variables, which are displacement, velocity, acceleration and disk rotation. As presented in the topic above, the cam contour depends of the desired motion of the follower and this can be governed by the Kloomok and Muffley equations. Depending on the combination of these equations, the motion can be harmonic, cycloidal or eight-power polynomial, besides constant velocity displacement and dwell.

A. Cycloidal motion

With zero acceleration at the beginning and the final of the action, the cycloidal motion can be coupled to a dwell. Because of this, other important characteristic of this type of motion is that it should not be coupled with other cycloidal, once that the acceleration returning to zero frequently is unnecessarily

B. Harmonic motion

Considering the three types of motion approached by the Kloomok and Muffley equations, the harmonic is the motion that provides the lowest acceleration peak. A disadvantage of the harmonic is that it cannot be coupled together with a dwell because jerk tends to infinity.

C. Eighth-order polynomial motion

Relatively to the harmonic and the cycloidal, the eighth-order polynomial motion provides an intermediate peak acceleration. Unlikely of the others types of motions, this one does not have symmetrical acceleration curves.

D. Constant velocity and dwell

A motion is classified as dwell when the cam disk rotates and the follower do not translate. In constant velocity case, the acceleration must be null and the velocity must be the same at the beginning and at the end of the action.

IV. THE SOFTWARE

Aiming to do a software easy to use, a simple graphical interface with the main information is disponible to the user. With the entire code made in MATLAB R2016b, who has a domain specific language (DSL) based in C and Java, the initial page shows some information about the software. In the second page, called dados de entrada (“input data”, from the Portuguese), the values of displacement, velocity, acceleration and rotation, besides the minimum radius of the cam and the maximum displacement of the de follower can be input. The third and last page is called resultados (“results”, from the Portuguese). In this page, the design of cam and the charts of the input parameters can be seen. Is in this page who the software user can make a simulation of the behavior of the project, detecting failures as curbs.

V. CONCLUSIONS: VALIDATION OF THE SOFTWARE OUTPUTS

Aiming to validate the software developed, an adapted example was extracted from “Mecanismos” (1980, p. 65), as Fig.3. shows. The only difference from the original example is the minimum radius of cam disk, who was defined as 100mm to the software be able to drawing of the cam disk. As described in this example, the cam follower motion is described by a dwell (O-A path), a C-5 cycloidal (A-B path), another dwell (B-C path) and a C-6 cycloidal (C-D path). All of these paths lasted a range of $\pi/2$ (90°) came rotation, and the nomenclature of the motions is according to the Kloomok and Muffley equations, who was shown above.

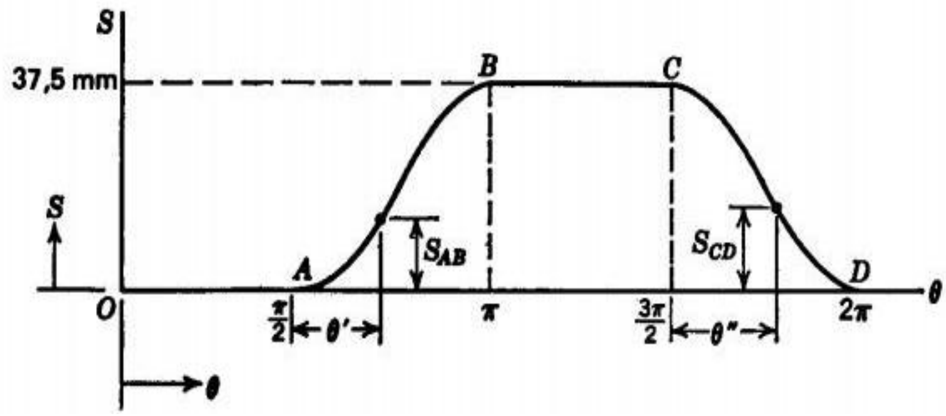

Fig.3. Expected displacement contour

As described in the example, the kinematic table of the program could be filled. The displacement curve obtained and the cam contour follows in the Fig. 4 and Fig. 5, respectively.

Fig.4. Displacement curve.

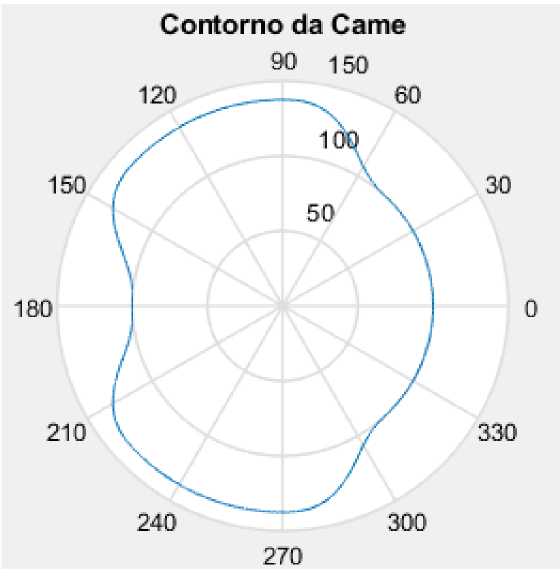

Fig. 5. Cam contour.

VI. ACKNOWLEDGMENTS

The autor thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for foundingthisresearch.

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