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Implementation of Spring Parameters with Computer Based Simulation Process – A Review

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Abstract: T***his study was carried out to investigate the effect of computer simulation on various properties of spring. Spring parameters like spring constant, damping constant are subjected to computer simulation using mat lab and simulink and corresponding results are obtained and reviewed. This study gives us a unique blend on implementation of a physical concept into computer simulation. Corresponding papers are deeply analyzed and a framework is obtained to carry out the research work.***

Keywords: Simulation Technology, Matlab, Simulink, System Analysis, Professional Training

1. Introduction

Simulation Technology of System

Simulation technology is based on conform principle, information technology and the technique of its application fields, it is a new all-around technology which is adopting computer and other physical equipments, and make use of related model to do the experiments [1]. System simulation is an experimental method to acquire information through using the system model or assumed system. The basic actions of system simulation are modeling, simulation modeling and simulation experiments and experimental analysis. It not only can offer us advanced methods to do the research working of analysis, decision-making, designing and training, but also in- crease the cognitive ability for the extension inherent rule. It will promote the progress of the subject form qualitative analysis to ration. Now System simulation technology is widely used in the following research areas [2]. Releasing the marble somewhere off from equilibrium results in oscillations along the horizontal direction. The corresponding equation of motion is a nonlinear differential equation. The issues concerning the solution of the equation will be discussed later. Nonetheless, it is worth- while mentioning not only we solve the equation

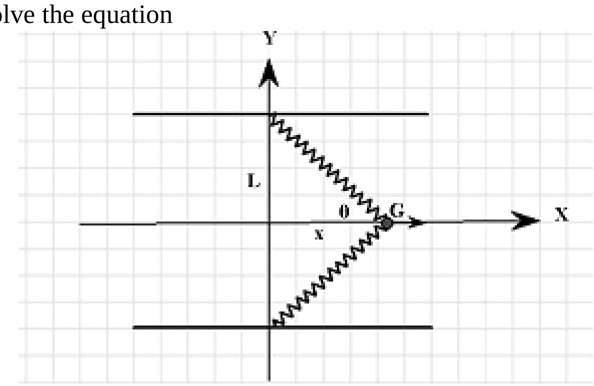

Figure 1: Two-spring arrangement leading to cubic and quintic oscillations

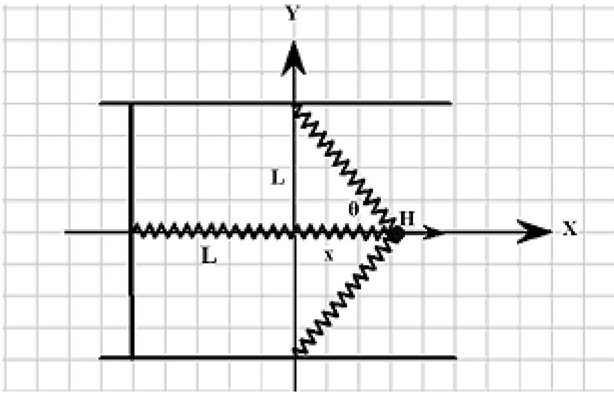

Figure 2: Three-spring arrangement leading to a combination of linear, cubic and quintic oscillations

2. Application of System Analysis and Design

The system simulation technology could do the argumentation and feasibility analysis for the unfounded system, and do the basic work for system design. In the course of the system designing it can do help in building the model, and optimization designing work; when the system is built, we could look for optimal control law for the system through analysis results of the system.

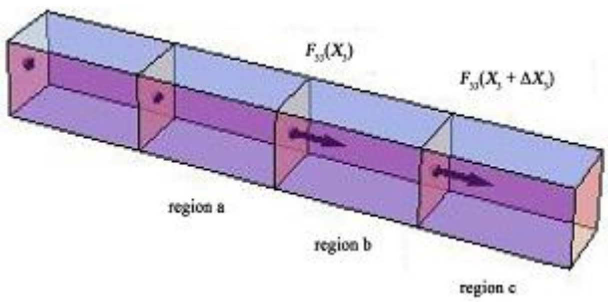

Figure 4

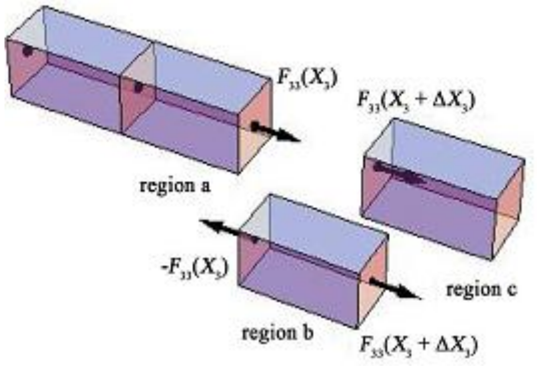

Figure 4 and figure 5 shows the simulating masses applied to spring under test for varying spring parameters.

2.1 Application of Theory Research

The theory research of the system mainly depends on theoretic deducing in the past. Simulation technology can offer us the useful tool in the theory research, the tool not only can verify the validity of theory, but also can discover the system conflicts between theory and reality.

2.2. Application of Professional Training and Education

It is an important characteristic of the system simulation adopted in training and education. Now, simulation training systems have been adopted in many complicated equipments (e.g., chemical equipment electricity station, electricity netting) and carrying systems Virtually all modern theories of elasticity [1]-[4] build the equations to describe elasticity using stress and/orstrain. Hardy [5] proposed to return to the approach of Euler, Lagrange, and Poisson [6] to build the equations of elasticity using point locations and forces instead of stress and strain. Hardy called these equations the equations of Euler-Lagrange elasticity. The equations of Euler-Lagrange elasticity are appropriate for quasi-static deformations, but do not include dynamics. Dynamics will be added in this paper. Hardy defined an elastic material as one which when deformed, stores energy; and when it is returned to its original state, the stored energy is returned to its surroundings. This is known as hyper-elasticity [7]. Hardy followed the notation of Spencer [8] by defining the initial position of each point in an elastic material to be 1 X , 2 X , and 3 X corresponding to the *x*, *y*, and *z* coordinates of that point. The parameters, 1 x , 2 x , 3 x were defined as the *x*, *y*, *z* coordinates of the corresponding point after the deformation. The shape change of the deformed component after unloading is called the elastic recovery. This behavior is been named as the spring-back in sheet metal stamping. The spring-back is defined in different words by many researchers. The geometrical change in the part after form-ing when the force from the forming tools was removed is denotes as spring-back [1]. This behavior is most common in sheet metal formed components in which the one or two dimensions are much larger than the other ones. [1] The dimensional inaccuracy in the stamped part is due to the spring-back. Some studies shows that the final shape of the parts depends on the amount of elastic energy stored in the part during the sheet metal forming process [2]. The amount of elastic energy stored is a function of many parameters thus spring-back prediction is a complicated task. The shape error due to the spring-back considers as the manufacturing defect in sheet metal forming process. Another definition of the spring-back is referred to as the undesirable change of part shape that occurs upon removal of constraints after forming [3]. It can be considered a dimensional change which happens during unloading, due to the occurrence of primarily elastic recovery of the part. Spring-back depends on the amount of draw-in during deformation. More the draw-in, more dominant will be the spring-back. Other process parameters which tend to give more spring-back were larger corner radius of the die set and lower clamping force [4,5]. It has also investigated that the spring-back also depends on the material and process parameters. The influencing parameters for the strong spring-back were in descending order: punch corner radius, die corner radius, blank holding force, sup-porting force and lubrication [6]. The study of spring- back behavior on ultra high strength steel sheet in bend-ing was performed under controlled condition using CNC servo press. The spring-back amount measured for the steel sheets was almost proportional to the ratio of tensile strength to the elastic modulus. The spring-back was lit-tle sensitive to the forming speed and the holding time at the end of the process [7]. Spring-back is a common occurrence due to bending of the sheet during forming whereas curl was observed in the sheet due to material sliding over the die radius [8]. Curl is also the closest influential factor for spring-back. The non-linear relation predicted between curl height and the back tension [8]. This understanding and prediction would not be clear without the investigation of hardening models. Some of the numerical studies tried to predict the spring-back behavior for experimental comparison and several work-hardening models were evaluated in order to determine their influence on the numerical prediction of the spring-back phenomenon [9]. Based on the set of experimental results the constitutive parameters identification was performed [10]. Generally the spring-back results showed the sensitivity on the work hardening models. Due to the high level of equivalent plastic strain achieved in the U-shape channel the differences in theamount of spring-back prediction was not higher [9]. However the differences found in the study where the strain level was quite low compared to the previous mentioned literature. The study performed [9] on the work hardening models the differences exist with experimental comparison and were associated with the predicted through thickness stress levels. The accurate pre- diction of the spring-back through the numerical methods depends on the materials hardening rule [4,5]. The constitutive equation for stress-strain curve for non-linear combined hardening rule was proposed depend on the non-linear kinematic hardening theory of Lemaitre and Barlat89's yielding function. It was found that the isotropic hardening rule over predicts the spring- back behavior compared to the proposed model. It was also observed that Barlat89's and Hill48's yielding function gave the better co-relation with experiments than the von-Mises yielding function [13]. This tells that the spring-back was sensitive to the work-hardening model. In the forming of U-shape channel it was identified that the strain path changes and was associated with the bending-unbending of the channel during forming. It was also noted that the strain achieved in each strain path are equally important as the strain path changes during the forming [9]. It was also shown that one model predicted larger spring-back angles for some materials and smaller for other ones according to the predominant strain-paths and strain-path changes. The comparison on the influence of the work-hardening models on spring-back, different trends was expected depending on the selected sheet metal formed part as well as the process conditions [9]. The numerical prediction of the spring-back was strongly dependent on definition of the constitutive model for the sheet metal mechanical behavior under the change in strain-path and the occurrence of the stress reversal during the bending to unbending transition on the die radius [14]. In addition the investigation on number of integration points through thickness has done by many researchers to understand the accuracy in prediction [1].. Previous studies performed on the influence of change in elasticity during plastic deformation noted quite interesting outcomes found that some simulation results was in low precision when compared to the experiments. It was found that the E-value varies after plastic deformation .

3. Literature Review

Mass is traditionally interpreted as the inertia content of a body. The greater the parameter named mass (*m*), the more difficult it is for a given force *F* to produce a change in the objects state of motion. Newton's Second Law describes this effect as $F = ma$, which serves as a formal definition for mass. However, the parameter mass is part of other dynamic quantities like momentum and energy. The measurement of such quantities in place of force and acceleration *a* can be advantageous in both experimental and theoretical grounds, in such a way that it may become convenient to adopt an alternative definition for mass based upon other dynamic quantities. In the present paper we describe how the establishment of a particular mathematical relation between mass and energy can lead to a neat *new* magneto-dynamic definition for the mass of an object, involving standardized constants of Nature. We shall be interested in systems consisting of a macroscopic object in some way attached to an environment or device capable of producing over it some restitution force. That is, if the object is initially at rest and is suddenly subjected to an external force there will be a reaction against such force tending to restore the object to its initial location. We will specialize in the well known . Here *vm* is the maximum velocity of the load, given by 12*Fkm*. We note the following. Firstly, the form of Equations in depends on the particular expression for *F*, as well as it in depends on the details of the restitution force, which is simply taken as linear in the displacement. Cellular responses to external mechanical stimuli, such as gravity, stretch and shear flow, and ultrasound, play important roles in expressing cellular physiological functions . For example, cardiac or smooth muscle cells respond to the stretch induced by elevated blood pressure and alter their mechanical properties to modulate blood pressure to maintain adequate blood circulation . In addition, bone cells respond to ultrasound by increasing cellular growth rate and extracellular matrix secretion . Such controlled cellular growth and matrix secretion is expected to be available in the clinical field. Thus, cellular response to external mechanical stimuli is not only a fundamental cellular function, but it is also adaptable for medical usage. Therefore, investigation of the types of available mechanical stimulus and their resulting cellular responses are of great interest in both cell biology and biophysics. Mechanical stretch has the ability to change cellular physiological functions, such as differentiation and cellular morphology. In the case of a single step-like stretch, this mechanical stimulus also keeps cells stretched, *i.e.*, mechanical stimulus continues to be impressed to cells; however, cellular responses to a single step-like stretch are different from responses to cyclic stretches. To use mechanical stretch more effectively for cell regulation, it is important to consider its application pattern. Our previous work showed that cellular elasticity could be regulated by mechanical stretch . Briefly, application of only a single step-like stretch increased cellular elasticity, while more than 30 sets of cyclic stretch before the single step-like stretch inhibited the increase in cellular elasticity. These results indicate that adequate patterns of mechanical stretch are available to regulate cellular elasticity. However, the stretch patterns for effective regulation of cellular elasticity are not clear as yet. The purpose of this study was to determine the number of cyclic stretches that are sufficient to inhibit the in- crease in cellular elasticity after the single step-like stretch. We examined the cellular elasticity response by changing the number of cyclic stretches from 1 to 10 sets. In addition, we examined signaling cascades known to be involved in the regulation of cellular elasticity following cyclic stretches. Cellular elasticity is known to be related to actomyosin based contractile force . As candidates for regulating contractile force under mechanical stretch, we examined changes in phosphorylation of myosin regulatory light chain (MRLC) and intracellular Ca2+. Our results indicated that the number of cyclic stretches regulated phosphorylation of MRLC and resulting cellular elasticity.

The first assumption is "justified" when the mass of the object outweighs the spring. The linearity for a coiled-shaped spring for most of the time is enforced by not stretching the spring be-yond its plastic limit. Under these assumptions the equation describing the motion of the object is a second order linear differential equation; it is trivially solved with analytic sinusoidal solutions. This scenario is modified slightly when a nonlinear mass-less spring is considered. For instance, some 90 years ago, initiated the notion of the nonlinear vibrator. Accordingly, an equation is proposed to describe the state of one such oscillator. Equation is given by, where, in addition to the linear spring term. The notion of initiated nonlinear vibrator has found its applications in a wide range of scientific fields. Reference for instance has sections devoted to the description of the equation. The latter reference also contains a wealth of bibliographic listed related articles. Recently, an electronic website posted an animated description of the related issues. However, neither these references nor the author's thorough literature search could identify a source describing the oscillations of an *ideal perfect* mass-less mechanical vibrator. The article that "best" aligns with one such mechanical oscillation is a suggested experiment given in. The authors of the latter reference have claimed their proposed experiment would produce data that is compatible with the description of the equation. However, a careful analysis of their setup and suggested analysis reveals the mass of the elastic metal strip is ignored. This leads to expect disconnect between the data and the proposed theory. Motivated with identifying the missing practical design of mechanical oscillations of an *ideal/perfect* mass-less oscillator, the author designed a spring made of a static electric field, and called it an electric-spring. The point is a spring made of an electric field is a mass-less spring.

4. Objectives of the PTPER

1. To analyze and model the data driven approach in computer simulation.
2. To model standard spring equations in computer modeling.
3. To review and study the previous work done on spring elasticity and computer simulation.
4. To draw conclusions on how user defined input values affect the output of simulation process.

5. Tools Used

1.MATLAB
2.SIMULINK

6. Comparative Outputs of 2 Systems

Comparative output curves are shown in figure 1 and 2. Figure 1 shows the uniform distribution of spring fuction being simulated and system 2 shows the simulation curve of spring under stress test.

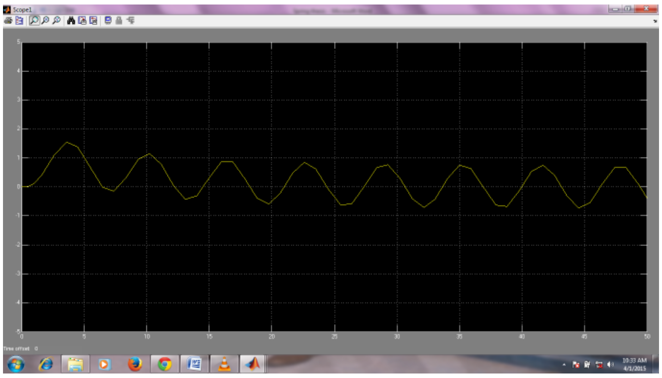

Figure 1

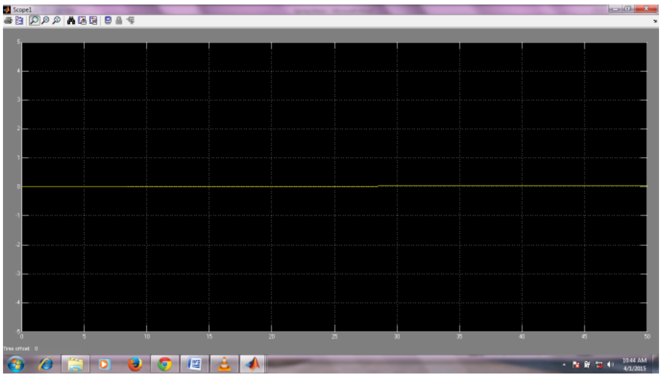

Figure 2

7. Result and Conclusion

The normalized spring had more strength, was harder and was much tougher than as received springs. The water quenched springs were the hardest of all the heat treated springs, were very brittle and had the lowest percentage elongation. Their strength was also lower than that of the normalized and as received springs. The tempered water quenched springs had better mechanical properties required for spring making, they had the optimum combination of hardness, strength and toughness when compared with the other heat treated springs.

8. Acknowledgment

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