# Linear dynamics system essay

ASSIGN BUSTER

Linear Dynamics Design To understand fully the chaos theory, one must first understand the basic principle of simple linear dynamics system.

Linear dynamics is a sub branch of dynamics that deals with the study of those system that is affected by parameters like mass, stiffness, viscosity, and hysteretic damping in which the force increases linearly. From the references, the best way to explain the linear dynamics is by examining the motion of an object in an oscillating spring. In this given example, the force on the spring changes as the displacement or the change in position change also. And there is an observe increase linearly with the displacement by a factor k. the factor k is known as the spring constant. Motor Vehicle Design using Linear Dynamics System There are many factors to be considered in designing a motor vehicle. But the center of discussion will be on the role of linear dynamics system in designing a motor vehicle. MassFirst to consider is the role of mass in the design.

From the equation force is equal to mass multiply by the acceleration of the body; this means that mass is directly proportional to the force exerted by the body given its acceleration; F = mawhere: F is the force exerted by the object (newtons)m is the mass of the object (kg)a is the acceleration of the object (m/s2). In designing a motor vehicle, the mass of the vehicle must not be too small event though it will lessen the force of friction into the wheels and the surface of the road but because this will lessen the stability of the vehicle when the vehicle is at high velocity. The mass of the vehicle must not be too large because it will create a large resistance to the surface of the road. Because mass has direct relationship with the force developed by a moving object, the mass must be designed in

such a way that the mass of the vehicle will create constant force acting on the vehicle thus making the vehicle stable while the motor is running.

Stiffness The most important consideration in designing a vehicle motor is the safety.

In this consideration, the most appropriate factor to consider is the stiffness of the motor. Stiffness is the resistance of an object to deflection due to the applied force, the material maybe elastic in nature. Stiffness of a material can be measured by dividing the force applied over the displacement of the material from its original position; F = kxwhere: F is the force exerted by the object (newtons)k is the stiffness ratio (Newton per meter)x is the displacement from the original position (meter). Stiffness has direct relationship to the elasticity of a material. The stiffness ratio using the elasticity of a material which is also known as the modulus of elasticity can be examined from the equation below; k = AE/Lwhere: k is the stiffness ratio (Newton per meter)A is the area of the object (meter2)E is the modulus of elasticity of the materialL is the length of the material (meter)Knowledge in the stiffness of a material is a basic consideration in many engineering applications. The stiffness of a structure is of importance in many engineering works like the selection of the right material.

A high stiffness property of a material is required when deflections are undesirable while low stiffness is needed when the purpose of the designer is to produce a flexible material. In designing the right stiffness in motor vehicle design, the designer must consider the force that may act on the motor while the motor is moving. The designer must take in to account the

different internal as well as the external forces on the motor. The material must resist any form of deformation due to the internal forces like tensile, compressive, shear and torsional stresses.

These forces may also be in combination with other forces. ViscosityViscosity is a property of a fluid material to resist the flow. In fluid mechanics, a simple viscous flow which is characterized usually by a uniform flow will have a possible condition if only the formula of the Reynolds's number is less than 60. Re = rvL/h < 60where: r is the density of the retarding fluid, v is the speed of the object relative to the fluid, L is a characteristic dimension of the object, h is the viscosity of the fluid. This is a prerequisite for the viscosity to be uniform and it is not usually met generally for oscillators, and some of the recent studies show that the damping of air drag is directly proportional to the square of the velocity of the moving air. This is just one example of how two or more damping types must sometimes be folded into an adequate model of dissipation. (Peters, 2007)Hysteretic Damping Damping materials are used primarily on reducing the vibration of a material.

It is used primarily on vehicle parts to control the oscillation or vibration of the vehicle parts to minimize the damage brought by vibration. This kind of material is usually utilized in structures where vibration due to the outside forces must be minimized. The dynamic linear system, the system becomes more complicated when damping or a driving force is applied to the system.

A Damping alone will cause the particle to sit down in the potential well or " attractor." A When the system is forced, the system will oscillate at one frequency determined by the relative strengths of the forcing and damping.

A If the forcing is too weak or too strong, the system may oscillate at the forcing frequency. A In this case, the free movement of the system is essentially drowned by the forcing and damping and the amplitude of oscillation is weak. There is a given frequency of the system were the maximum oscillation of amplitude will be experienced. And this is a basic characteristic of a linear dynamic system were the resonant frequency is known by determining the damping force and the natural frequency of the system. (Peters, 2007)Natural Frequency Natural frequency is the vibration of a material when an outside force acts on the material.

When a motor moves, the motor experiences natural frequency due to the action of several forces like the reciprocating motion of the piston in the cylinder. In designing a motor vehicle considering the natural frequency, one must understand the relationship of natural frequency on the acting forces. From the equation below, the damping ratio will determine how much will the material vibrates or oscillates due to the external forces toward a steady state. And the undamped natural frequency is the measure of how fast will the materials will vibrate after the application of the external forces. (2000)where: x(t) = Response of the System, u(t) = Input to the System, z = Damping Ratio, wn= Undamped Natural Frequency, Gdc= The DC Gain of the System. Natural frequency has a direct relation to forces acting on a material. The higher is the force, the higher is the natural frequency of the material. There are many ways to decrease the natural frequency of a material; one is the application of insulators or damping material to minimize the vibration created on the material.

Double mounting and VibrationA good engine mount must be able to lessen the shock brought by the vibration of the engine when it is working. With this requirement, the dynamic stiffness and damping force of the engine mount should be dependent on the amount of frequency generated by the engine as well as the amplitude of the engine. Because of these considerations, the design of engine mounting systems focused on the improvement of the recent designs in making the engine more dependent on the frequency and amplitude characteristics. The conventional elastomeric mounts which is the usual design that is used in mounting system cannot met the requirements in the mounting system of an engine, a new mounting system that will met the demands in the mounting system of an engine.

Passive hydraulic mounts are use because when compared to the conventional elastomeric mounts, the former can provide more dependence on the frequency. While an active engine mounting system can be used in rigid engines and at low frequency.(Yu, 2004)Suspensions
Suspensions are the materials used in a vehicle like spring, shock absorbers and linkage that connects the vehicle body to the wheels of the vehicle. The main purpose why suspensions are built for a vehicle is that, to contribute to the vehicle’s handling and braking purposes so that a good quality and safe driving will be attained and also to make the occupants feel comfortable while they ride in to the vehicle.

There are two kinds of suspension, the front and rear suspension. These two are different because of the difference in the load of the front and rear part of a vehicle. Spring rate or the suspension rate is a main ingredient in making the vehicles ride height or the location in the suspension stroke.

Spring rate is the ratio means to measure how the spring will resist on the force exerted by the load. The force can be tensile or compressive force. The wheel rate is another form of spring rate. Wheel rate is based on the effectiveness of the spring rate located on the wheel of the vehicle. From experiment, the wheel rate is somewhat less than the spring rate.

In the design of the right kind of spring, the designer must know the maximum load that the vehicle may experienced so that the right material will be chosen. The designer must take into account also the difference in the loading of front and rear part of the vehicle. Then is the distribution of the load so that the designer may know where to put the suspensions. Also, the designer must consider that different forces are constantly changing as the vehicle moves.

These forces maybe internal or external are dependent on the motion of the vehicle. They are directly proportional thus the higher is the velocity, the higher is the force experienced by the vehicle. Noise control Noise in a vehicle while moving is always observed.

This is because on the resistance of the moving internal parts of the vehicles on friction. Examples of these moving parts are the piston and cylinder. The reciprocating motion of the piston on the cylinder produces some noise. The designer must take in to account on how to minimize the noise by minimizing the friction.

This can be achieved by applying lubrication system to the piston and cylinder system. Another noise that is created in a vehicle is the vibration on

the motor body of the vehicle. The noise can be accounted from the integral part of the engine like the gears. A good design can be characterized by application of insulation or shock absorbing material to lessen the noise produce from this event.

As the motion of the vehicle change, there is also a corresponding creation of noise due to the interaction of the different parts of the vehicle like the casing, engine and some peripheral parts. Methods of Experimental Model Analysis on Vehicle Components In designing a vehicle component, one must consider the safety, engineering and material science properties, quality, cost and effectiveness. Some of the experimental modeling can now be done using computer software. One is the ADVISOR (Advanced vehicle simulator) is based on MATLAB modeling tool which enables a designer to simulate a conventional, hybrid vehicle. Some of the characteristics of the output of ADVISOR are the performance of the model vehicle. The program can predict the fuel economy, emissions, battery power, heat generated, and other necessary measurements that are needed to determine the performance and efficiency of the vehicle.

In the engineering and materials science part of the design, the first thing to consider is the strength of the materials to be used in the fabrication of the parts. From Hooke’s Law, stress and strain are directly proportional from the point of origin until to the elastic point. The designer must take into account the different force acting on the materials so that the designer can compute the maximum stress that the materials can be experienced. From here, the designer can choose from a catalog let say steel that is most appropriate

from the given stresses. Lightweight of the material is also a consideration in designing a motor vehicle.

The designer must know the right weight of the material to be used considering the constraint of cost, economy and weight produce by these materials. A simple simplex method can be done to find the optimum weight to be used for the vehicle. Another factor to consider is the possible effects of the produced heat due to friction to the engine parts. As the vehicle moves, the engine parts generate heat due to friction.

The material must resist the heat build up in the engine or a cooling system must be made to help the engine dissipate the heat. The transmission and gearbox must also be examined so that efficiency can be achieved as the vehicles moves. Friction must be minimized as the gear moves. This can be achieved by applying lubrication system as well as cooling system.

References:(2000) An Introduction To System Dynamics – Second Order Systems. PETERS, R.

D. (2007) DAMPING. Mercer University. YU, Y. (2004) Review of automotive vehicle engine mounting systems.

International Journal of Vehicle Design.