# COMMON PROBLEMS WITH MATHEMATICAL MODELS AND LAGRANGE'S EQUATIONS FOR VELJKO MILKOVIC'S TWO-STAGE OSCILLATORS

Jovan Marjanovic, B.Sc. in Electrical Engineering

e-mail: jmarjanovic@hotmail.com

November 25, 2009, Novi Sad, Serbia

## ABSTRACT

This document will discuss two basic problems with mathematical models of the two stage mechanical oscillator of Veljko Milkovic www.veljkomilkovic.com:

- Problem with dynamical usage of input energy,
- Problems with soft connection between members of the system.

## INTRODUCTION

This document is written in order to describe the common problems scientists have in modeling this system and also the wrong conclusions that come out as the consequence of the usage of Lagrange's equations which fail to describe all the facts correctly.

These common errors are the outcome of an easy approach to a seemingly simple machine, which consists of one pendulum and a lever fixed to work like a seesaw. Only people who build this machine and test it can have a real understanding of the various problems connected with it.

## DYNAMIC USAGE OF INPUT ENERGY

The original idea of Mr. Veljko Milkovic for the usage of the two stage oscillator is to use it dynamically and for longer period of time. It means that after the initial raising of the pendulum into a starting position and allowing it to swing, it is necessary to invest a small input energy in order to keep the pendulum swinging. Because the two the stage oscillator was supposed to be used for long period of the time, the energy spent for the initial raising can be disregarded. The same logic can be applied to Diesel engines, where it is necessary for them to achieve working temperature before measuring their efficiency. Also, nobody would include the energy spent for the magnetization of permanent magnets in an electric motor for calculation of efficiency ratio of his electric motor.

It is necessary to measure the small amount of energy continuously added to maintain the pendulum's swinging and also to measure the output energy of the lever in order to calculate the quotient of efficiency. Unfortunately all models seen so far were calculated using only the initial energy necessary for raising the pendulum into its starting angle and the behavior of the oscillator until the pendulum stops its swinging. This is not the way the oscillator should be used.

## SOFT CONNECTIONS BETWEEN MEMBERS OF THE SYSTEM

It is obvious that in order to start moving the lever of the oscillator it is necessary to start swinging the pendulum. If the pendulum doesn't move then the lever will not move either. However, the pendulum will not be able to move the lever with mass *M* (see *picture 1*) until it comes into Position 2 as on *Fig 1* below. This is soft input connection between the pendulum and the lever. If the lever was pressed by a hand and stopped to move the pendulum will continue to move without interruption. This is soft output connection between the lever and the pendulum. Although a return influence of the lever towards the pendulum is not easy to see it does exist. The lever keeps spending energy of the pendulum through movement of the pivot point of the pendulum. In order to influence the pendulum visibly by the movement of the lever it must be done at specific time and in a specific rhythm. It has been described by Dr Colin Gauld (University of New South Wales, Australia) [1].

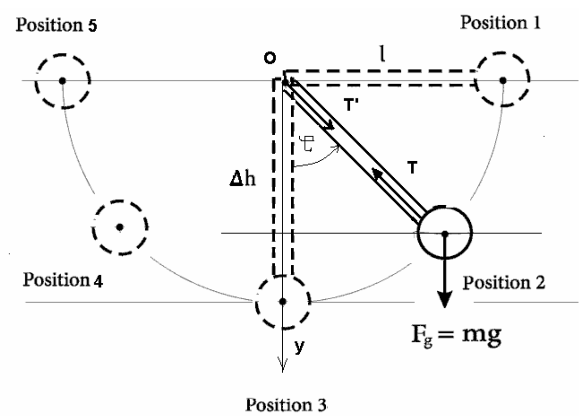
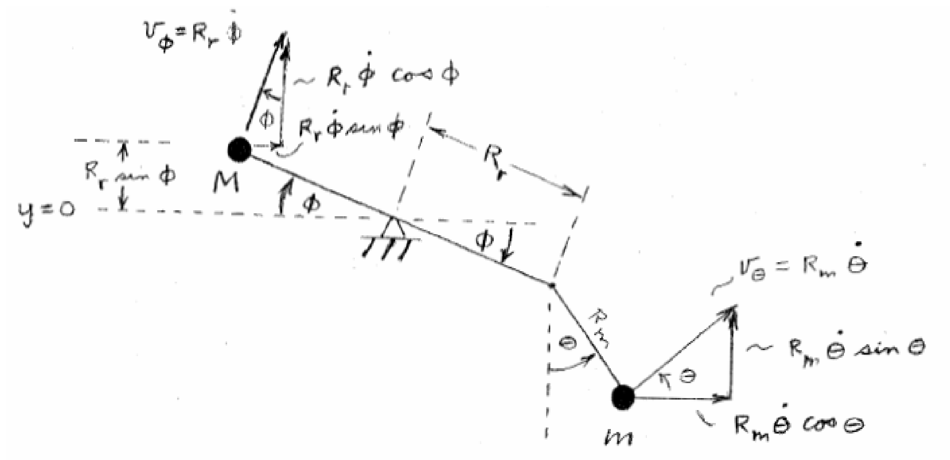



Fig. 1

To understand the problems with mathematical models of the oscillator, below will be presented Rocker-Pendulum model by Dr Harold E. Puthoff (Institute for Advanced Studies at Austin, USA) [2]. Kinetic energy *T* and potential energy *V* are given below.

$$T = \frac{1}{2}(M+m)R_r^2\dot{\phi}^2 + \frac{1}{2}mR_m^2\dot{\theta}^2 - mR_mR_r\dot{\theta}\dot{\phi}(\sin\theta\cos\phi + \cos\theta\sin\phi)$$

$$V = (M-m)gR_r\sin\phi - mgR_m\cos\theta$$




*Picture 1*

The problem with the above mathematics and model in *picture 1*, is that it can not describe the oscillator completely because of the soft connection between members. The position of angle *θ*, of the pendulum, is known at all times as the pendulum moves harmoniously. However, the position of the lever angle *Φ* is not unique. It doesn't exist until the pendulum comes to Position 2 (see *Fig. 1*) because the pendulum will have enough force to pull down the right side of the lever after position 2. The right side of the lever will keep moving down till pendulum comes to position 4. At that time pendulum force will become equal to the weight of the mass *M* on the left side of the lever. The left side of the lever will rapidly go down after position 4. It will stay down until pendulum move to position 5 and come back to position 4. Then everything repeats. So, the angle *Φ* exists only between position 2 and position 4 where it increases. It will also exist shortly after position 4 but will decrease to zero rapidly.

The conclusion is that model on *picture 1* can describe only situation between position 2 and position 4 and not complete reality.

## MODELS WITH SPRING ON OUTPUT SIDE

Some oscillators have a spring on the output side instead of mass *M*. They are interesting as there is no lag of the lever and the lever will start to move at the same time as the pendulum starts swinging. Mathematical models can much better describe such oscillators. However, the spring will cause unwanted oscillation of the lever after position 4 if no consumer was attached to such oscillator.

Below is a model presented by V. S. Sorokin (St. Petersburg State Polytechnical University, Russia) [3].

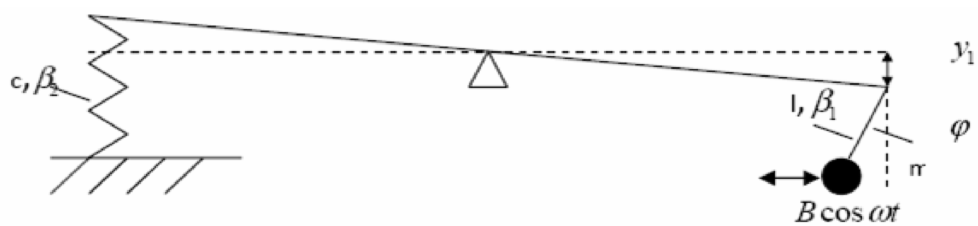



**Figure 2.** The model system.

The equations of motions, obtained using Lagrange's equations, have the form:

$$ml^2\ddot{\varphi} + \beta_1\dot{\varphi} + ml(g - \ddot{y}_1)\varphi = B\cos\omega t \qquad (1)$$

$$m\ddot{y}_1 + \beta_2\dot{y}_1 + cy_1 - ml(\varphi\ddot{\varphi} + \dot{\varphi}^2) = mg \qquad (2)$$

Here $y_1$ – the deflection of one pendulum, $\varphi$ – the angle of rotation of another

This model doesn't have a consumer of the energy and will have unwanted oscillation. However it is not a major problem. This model also describes the situation after the initial raising of the pendulum until it stops swinging. It doesn't include the above mentioned dynamically adding energy to the pendulum.

## CONCLUSION

Dynamic usage of input energy should be included in all models. It could be done by applying an impulse of a force in position 1. It would be even better to include a consumer of energy (damper), able to stop unwanted oscillations of the lever.

For models with mass *M* on the output side of the lever, a correct method should be to break the model into three models for each of the stages below:

1) From position 1 till position 2 there is no movement of the pivot of the pendulum and all formulas for a pendulum with fixed pivot can be correctly applied.

2) From position 2 till position 4 pivot point of the pendulum will go down and mass *M* will go up. Although tension force in the handle of the pendulum is strongest in position 3 the maximum height of the lever mass *M* is not in that position. Mass *M* will continue going up till position 4 when tension force become the same as weight of the mass *M*.

3) From position 4 till position 5 mass *M* will rapidly go down, strike the boundary pillar (not displayed on above pictures) and stay down until pendulum comes back from position 5 to position 4.

Starting variables for the next stage would be ending variables of the previous stage.

## REFERENCES

[1] Dr Colin Gauld, *THE PHYSICS OF THE TWO-STAGE PENDULUM OSCILLATOR*
http://www.veljkomilkovic.com/Docs/Colin_Gauld_Physics_of_Two-Stage_Pendulum_Oscillator.pdf

[2] H. E. Puthoff, Ph. D., *INVESTIGATION OF CLAIMS OF PROPOSED GRAVITATIONAL ENERGY CONVERTERS*, Private letter to Mr. Veljko Milkovic

[3] V. S. Sorokin, *DYNAMICS OF A NONLINEAR MECHANICAL SYSTEM CONTAINING PENDULUMS*
http://w3.uniroma1.it/dsg/euromech503/abstracts/Sorokin.pdf

Published in Novi Sad, Serbia
**November 25, 2009**

http://www.veljkomilkovic.com

**Jovan Marjanovic**
B.Sc. In Electrical Engineering

Jovan Marjanović