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Referee Report on the PhD thesis

The Effect of Horizontal Oscillations of the Beam on the Collective Dynamics of n Pendula Hanging from this Beam

by

Piotr Koluda

Piotr Koluda intends in this thesis to study synchronous states of coupled self-excited pendula. Although this looks like a classic problem, it is one of high actuality. This is mainly due to the fact that due to the construction of this system multistable solutions exist here. Therefore these are very difficult problems, which could offer new perspectives for further research in nonlinear dynamics as well as its application to various fields.

The thesis is subdivided into two main parts: first a rather compact introduction and overview and second three papers of the candidate which were already published in well-known peer-reviewed journals.

Part 1 starts with a very concise but instructive introduction to some basic motivation of this work, then in 6 lines the main objectives and then,

fortunately in more detail, a description of the two main models and the main results from the bifurcation analysis and the numerical studies of these models. Here the own contributions of the candidate become very clear. Finally some conclusions are given.

This part is very important for the understanding of the whole thesis. However, the bad English, in particular the use of articles, makes it very hard to understand. Sometimes the reader has to bring in a lot of phantasy to understand what the candidate could have meant. To give only one example: «The proper choice of beam´s mass parameter one can ensure that only selected solutions are stable.».

The three papers are much better written and here all intentions, methods and results are clearly presented.

Piotr Kaluda has studied two basic types of models: a van der Pol type damping and a system with a clock escapement mechanism. The latter one is a even discontinuous system which is very hard to analyze. He has found via a subtle bifurcation analysis the basic types of solutions in these systems. Very important to mention that he has also included non-identical systems and up to 5 coupled pendula. He has also performed a series of numerical analysis.

The analytical and numerical analysis is very deep, with some originality in the analytical tools and very thoroughly performed. The results obtained are a substantial contribution to this field of research and I expect a long-standing impact for further theoretical as well as experimental studies.

Therefore, I very strongly recommend to accept the thesis of Piotr Kaluda.

However, I have some questions and recommendations which should be clarified or discussed:

- Almost nothing is said about possible experimental verification. I would like to see some specific designs for future experiments (not the experiments themselves).
- In part 1 there are no open problems given. Was all solved?
- In reading the abstracts of paper 1 and 3 (page 5, part 1) it looks like the only difference between both is the study of different masses in paper 1. However, in the abstract and later in chapter 4 the substantial differences between both papers become clear. This has to be clarified on page 5 too.
- Why are you sure that you have found all possible solutions?
- What could be the influence of unstable solutions, especially in experiments?
- Can you determine the basin of attraction of the stable solutions?
- What about possible influences of noise, additive as well as parametric one?

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