

Review for Physica D

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Title: Potential well metamorphosis of a pivoting fluid-filled container

Reviewer: Mate Antali

The paper investigates the behaviour of a cylindrical container similar to a test tube partly filled with liquid. The container can rotate around a pin which is perpendicular both to the symmetry axis of the cylinder and to the direction of the gravitational space. The investigation follows the steps of the usual method of statics of one degree-of-freedom conservative mechanical systems, namely deriving the potential function, finding the equilibrium points, determine their stability and examine the bifurcation of the equilibrium points.

The authors start with an introduction with the practical importance of the phenomenon and the existing published papers. For the goal of the paper creating a more general description is appointed.

In the second section the definition of the model. It is a bit confusing that some parameters are defined at the beginning of the paper, however some other similarly basic parameters are introduced during the derivation. The limitation of the liquid to an inviscid fluid is unnecessary, the difference between viscid and inviscid fluids appears in only dynamical description and the paper deals with only statics. Therefore a general fluid could be considered.

The authors derive the potential energy for the (statically) one-dimensional system, which is a complicated derivation due to the changing shape of the fluid. The authors divide the variable range to intervals corresponding to the structurally different shapes of the fluid due to the finite height of the container. This is made by a elegant way and the nice figures helps understanding a lot. The potential function is derived to each interval. Long formulae are obtained, I have not checked the whole integration but the results seems credible.

After that the authors find the equilibrium positions and examine their stability with using the first and second derivative of the potential function. For one of the intervals exact analytical formulae are derived, the other interval is examined with numerical methods due to the algebraic complexity of the potential function.

At the bifurcation analysis the high number of parameters are a bit disturbing. Picking values for 6 parameters and making conclusions from varying only the other two seems a bit ad hoc, and neither the fact that these are only example parameters is not emphasized in the text, nor the genericity of these bifurcation is not proved. This is a hard task because there are 8 independent parameters in the model, but this number could be reduced to 5 using dimensionless quantities. The five parameters seems still too many to examine the parametric dependence, but it would be already easier, and would make the figures of the paper more understandable if there would not be values of all the 8 parameters under diagrams in the whole paper.

At the end of the paper an experiment is introduced with a given parameter system varying the height of the fluid. The experiment data points fit nicely to the theoretical bifurcation diagram, which is a great support to accept the relevance of the model axioms and the exactness of the deduction.

Considering all circumstances I suggest submitting of the publication.