

Berlin, July 10th 2023

Review of the doctoral thesis of M.Sc. Anna Mackojć

Analytical approach to modelling, analysis and dynamics studies on parametrically induced payload pendulation in offshore lifting operations

The doctoral thesis of Ms. Mackojć deals with a challenging topic of both scientific and application interest. There are many instances, where in offshore context loads have to be carried by cranes. These lifting operations are highly susceptible to pendulation due to vessel's movement. In Mechanics, the pendulum with moving bearing point is one of the classical examples while introducing control and parametric excitation problems. Nevertheless, considering this in the application context of the thesis, i.e. modeling of complex movements of crane's base due to vessel's motion, refined modeling of payload and connection combined with corresponding semi-analytical solution methods of the

resulting equations of motion promise a highly interesting and well-rounded research topic.

This expectation is fully fulfilled by the thesis of Ms. Mackojć. The thesis has a cumulative character containing five publications with Ms. Mackojć as main or coauthor. These publications given in appendix II are added by an introductory and summarizing part with approximately 40 pages denoted as chapter 5. This part is added by several more formal information on CV and achievements probably following corresponding regulations of the doctoral procedure. Anyway, from this information it can be concluded that Ms. Mackojć has – considering here reached state in academic career – broad experience in teaching, presenting and publishing.

The overview in chapter 5 starts with the motivation of the thesis' work and gives a proper overview on the state of art both in application and scientific context. Research assumptions and objectives are formulated. Subsequently modeling of base excitation is introduced and therefore vessel's equations of motion are formulated.

Beside a very low number of typos in the text it stands out, that the chosen coordinate system in figure 9 is not a right-hand Cartesian one. The classical coordinate system in vehicle dynamics is x in traveling direction, y to the right and z going down, here z is going up. Also, in the hydrodynamic added mass matrix A physical units are missing as well there is a typo in equation (7) with the subscripts (66 -> 65). Anyway, this does not significantly diminish the impression of a well written thesis.

Vessel's modeling is followed by the description of the applied 3 DOF-model of payload and compensator. Results of numerical analysis are given followed by a section on the applied semi-analytical procedure based on the method of multiple scales. Results are analyzed, compared with the numerical ones and overall summarized.

In appendix II, the publications as base of the thesis are given. I found it confusing, that the order of the publications as described in section 4.2 is not the same as they are given in the appendix and that the literature list of the overview part (section 5) is not given in the main part but as an attachment in appendix II. If this is due to doctoral procedure

regulations it should be left like this, otherwise I suggest changing it to a more intuitive way.

In the first and the second paper in the appendix (A4 in 4.2, A3 in 4.2, respectively) the 3 DOF model motion used in thesis for the payload and vessel's motion are introduced and investigated by numerical methods. The third paper in appendix (A1 in 4.2) considers the semi-analytic method used for analysis of the parametric excitation problem. Papers 4 and 5 in appendix (A2 and A5 in 4.2) consider topics not directly related to the thesis' work but anyway demonstrate additional scientific interests and experiences of Ms. Mackojć.

The overall impression of the papers is, that they are thoroughly written and constitute a scientific progress.

With her thesis, Ms. Mackojć's has demonstrated her general theoretical and applicational knowledge for a doctoral degree in her discipline of Mechanical Engineering and her ability of independent conduction of scientific work to a large extent and in a very good manner. The subject of the doctoral dissertation is an original solution of a scientific and application problem of high technical interest.

I therefore recommend acceptance of the thesis with high emphasis and no hesitation whatsoever.

If possible, the addressed small shortcomings should be corrected in the published version.

