



HAL
open science

Review of "Optimization of a dynamic absorber with nonlinear stiffness and damping for the vibration control of a floating offshore wind turbine toy model"

Pierre-Olivier Mattei, Renaud Côte, Kevin Dekemele, Olivier Thomas

► To cite this version:

Pierre-Olivier Mattei, Renaud Côte, Kevin Dekemele, Olivier Thomas. Review of "Optimization of a dynamic absorber with nonlinear stiffness and damping for the vibration control of a floating offshore wind turbine toy model". 2023. hal-04082019

HAL Id: hal-04082019

<https://hal.science/hal-04082019v1>

Submitted on 1 Jun 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Identifiers

Open Review

OAI hal-04082019v1

Reviewed Article

DOI 10.46298/jtcam.10123

History

Review 15 Dec 2022

Rebuttal 9 Feb 2023

Licence

CC BY 4.0

©The Authors

Review of “Optimization of a dynamic absorber with nonlinear stiffness and damping for the vibration control of a floating offshore wind turbine toy model”

✉ **Pierre-Olivier MATTEI**¹, ✉ **Renaud CÔTE**¹, ✉ **Kevin DEKEMELE**^{2,R}, and ✉ **Olivier THOMAS**^{3,E}

¹ Aix Marseille Université, CNRS, Centrale Marseille, LMA UMR 7031, 4 impasse Nikola Tesla, Marseille, France

² Department of Electromechanical, Systems and Metal Engineering, Ghent University, Tech Lane Ghent Science Park - Campus A, Technologiepark 125, B-9052, Ghent, Belgium

³ Arts et Métiers Institute of Technology, LISPEN, HESAM Université, F-59000 Lille, France

^R Reviewer

^E Editor

Review of version 1

Permalink: hal-03792459v1

Authors The authors are very grateful to the reviewers’ critical comments and thoughtful suggestions. Based on the comments and suggestions, the authors have made careful modifications on the original manuscript. The following are the responses to the reviewers’ comments.

Reviewer 1 (Anonymous)

Reviewer The paper addresses important and acute topic – optimization of the nonlinear energy sinks in order to avoid the disastrous detached resonance branches. The authors offer very reasonable optimization strategy (albeit its computational price remains unclear). It would be instrumental to understand whether such dangerous branched might appear beyond the used 1:1 resonance assumption – some of them can remain unattended. My other major concern is a language – the grammar in many places is poor, and professional help is definitely required to make the paper readable. I recommend the revision with subsequent additional review.

Authors By construction, we have never observed detached resonances when solving numerical equations once nonlinear damping have been optimized to cancel it. The 1:1 resonance assumption have been simply used to construct analytical solution. This analytical solution have been used to verify that accounting for nonlinear damping does not change the very essence of Targeted Energy Transfer. The fact that obtained values for the optimal nonlinear damping are almost identical for the analytical and numerical solution is an indication that the 1:1 resonance assumption is suffices to describe well Targeted Energy Transfer. The computational cost of the optimization had been indicated in the text and the English grammar had been carefully revised.

Reviewer 2 (Kevin DEKEMELE)

Reviewer This paper studies a nonlinear energy sink for wind turbines. In particular, the goal is to cancel the detrimental ‘detached’ resonance curve and as such make a nonlinear energy sink efficient over a large energy range. The authors attribute previous work that achieve this by proposing a nonlinear damping. The research is well done, and the paper deserve publication after some modifications.

Reviewer The authors should better stress how their paper is novel compared to the previous work that

proposed this damping.

- Authors** The main originality have been proposed in the last lines of the abstract and conclusion.
- Reviewer** The context of this paper is a wind turbine. However, except for the introduction, the discussion is quite generic. Why stress the wind turbine application? Does it come in certain forcing terms?
- Authors** We agree with this remark, but as this study deals with parameter and forcing range characteristic of FOWT and because it addresses an important and actual problem of renewable energy we wanted to keep this application.
- Reviewer** Content: how much control does the mechanism of "Andersen 2012" allow in the variable v_N , the nonlinear damping? If I look at that paper, it seems that v_N , and the nonlinear coefficient of the stiffness are not independent. How does this affect performance limits? Are there other mechanisms that allow separate optimization of the v_N and nonlinear spring?
- Authors** All NES parameters are independent, we added the figure 1 to show it more clearly. While not obvious because we explain the nonlinear damping coefficient as a product between the linear damping coefficient and a multiplicative factor, the two parameters are independent. This way to proceed allows very interesting results such as the particular value of that factor $v_N^0 = 3/2K_N/(1 - \delta_N)$ that keep the SIM shape independent of the linear damping.
- Reviewer** Section 3: Equation 6 takes into account 0 to maximal forcing amplitude. A minimal forcing amplitude would also make sense, as a small amount of vibrations is acceptable. Would the result of the optimization in 3.2 be different if a A_{min} is incorporated into the optimization functional?
- Authors** We have mistaken, we have not precised that the minimal value can not be zero, as without forcing, no motion is been possible. This is corrected.
- Reviewer** Section 4: An analytical 'frequency response' is obtained. Could you obtain the same result from this analytical plot as the 'brute force' methods of section 3 ? This would save a lot of numerical optimization steps.
- Authors** The results obtained are comparable over the whole frequency range except in the vicinity of the main resonance where they significantly differ. This is shown in the new figure 9 where we compare analytical and numerical FRF.
- Reviewer** Section 4: Figure 5 only shows the stable parts of the frequency response. Why are the unstable not included? Unstable does not mean there is an infinite amplitude, there is just no fixed value for the amplitude, it is quasi-periodic/SMR. If the authors include them, the detached resonance curve would be clear. Now this is not the case, yet this seems to be a very important aspect of this paper.
- Authors** This figure becomes figure 6 and we added the unstable branches. Please note that the curves had been normalized by $\sqrt{2}$ to keep the same amplitude as the numerical values (+3 dB shift).
- Reviewer** Section 4: An important figure is missing, in where a frequency response obtained from simulation is compared to the analytical frequency response. This should be done in section 5 to compare an optimal configuration numerically and analytically.
- Authors** This comparison had been added in section 4.3, figure 9.
- Reviewer** Language: Sometimes 'optimisation' is used, other times 'optimization'. The first one is British English, the other one American. Please choose one of the two.
Abstract & intro: p2 End of 4th sentence first paragraph: 'by the community and industrial' => 'by the academia and industry' ?
In the abstract you call the system a 'mass-stiffener-damper' and in p3 3rd paragraph 'mass-spring-damper'. One should be chosen (mass-spring-damper) is more common.
p3 5rd paragraph: "2 passes procedure" => "2 step procedure", in the same paragraph 'pass' should be replaced by 'step'
- Authors** All suggestions have been taken into account.

Reviewer 3 (Anonymous)

Reviewer This paper focus on the optimisation of a NES (cubic nonlinearity and nonlinear damping). State of the art is very well presented and analysed. The paper is detailed and educational, authors have done a very good job. The main contribution is about the influence of the nonlinear damping, with very interesting conclusion.

I will recommend the paper for publication in international Journal of Theoretical, Computational and Applied Mechanics (JTCAM), if all the following corrections are incorporated in the manuscript.

Reviewer The entire manuscript should be thoroughly proofread, because it contains some typing mistakes, and References will be checked. For example: "which is the best way yo dissipated", "NES constituted by of a mass", on the references replace "pages=" by "pp.", remove [SW]...

Authors We corrected the mistakes, Please note that [SW] can not be removed as it depends on the bibliographic style chosen by JTCAM

Reviewer What seems a minor matter, but one that distinguishes a very well-presented paper from a moderately good one, is the use of 3rd person (impersonal). Could you remove the excessive "we" from the text, and replace them by impersonal.

Authors It has been done.

Reviewer Another detail, a stiffness is by definition linear, but "nonlinear stiffness" is not correct. Replace "nonlinear stiffness" by "nonlinear behavior", or "cubic nonlinearity", or other wording.

Authors We prefer to keep nonlinear stiffness as this wording is usual in the literature (see eg the book "The Duffing Equation" by I. Kovacic and M. J. Brennan, 2011, John Wiley & Sons.)

Reviewer On Section 2, can you add a figure with a schematic of the model to make the link with the Floating Offshore Wind Turbine.

Authors We added figure 1 that depicts the model.

Reviewer The use of classical tool (fixed point and SIM), need to add references at the beginning of section 4.1 and 4.2. It's important for the reader, in order to show the contribution.

Authors We added a reference for the calculation of fixed points, SIM and principle of CX-A method at the beginning of paragraphs 4.1 and 4.2.

Editor's assessment (Olivier THOMAS)

The paper proposes a method to optimize a nonlinear passive vibration absorber called a NES (Nonlinear Energy Sink) in the literature. This kind of absorber received a great amount of attention since the first publication of the concept in 2001. Because of its strongly (and intentional) nonlinear features and dynamic response, its optimization is often intricate and no general results are available as it would be expected for a linear system. In particular, this kind of system can produce detached resonances, meaning that some high amplitude vibratory behaviour can be observed in practice. The present paper proposes a method to optimize a NES in order to avoid and master possible detached resonance using a nonlinear viscous damping element.

The paper was reviewed by three independent experts in the field of NES, who agreed on the quality of the study provided minor revisions. After this first round, the editor readily accepted the paper for publication. However, just before final typesetting, the authors noticed a mistake in some of the computations. In accordance with the editor, they proposed a corrected version of the article. Before finally accepting the article for publication, the editor asked a new review from one of the reviewers, which was strongly positive.

Open Access This review is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the authors—the copyright holder. To view a copy of this license, visit creativecommons.org/licenses/by/4.0.

