# Dynamic actuation model for vibration reduction in offshore cranes

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**Abstract**. The handling of offshore payloads is a critical operation that presents numerous challenges, in particular related to the required precision in controlling their oscillations in a safely and accurate manner. This study presents a preliminary approach to an anti-sway control conceived to mitigate such problems and possibly to automate some of the operations concerning the payload sway control that are currently done manually. In particular, a system consisting of a translating trolley actuated through a PID controller is taken into consideration to mitigate the oscillations induced by the vessel's rolling motion onto a simplified two-dimensional and 4 degrees of freedom double-pendulum model representing the hanging payload. A three-dimensional double-pendulum model is also taken into account, in order to have a more representative case with respect to the two-dimensional one.

## Introduction

The uncontrolled payload oscillations induced by the rolling movement of the vessel have been historically mitigated by the experience of on-deck operators by means of taglines [1, 2]. The availability of experienced personnel is not always present and a manual control operation still presents inconsistent performances and a high risk for the safety of men and machines. A similar problematic, although for offshore container cranes types has been already addressed by [3], but the different characteristics between the equipment used to perform the lift requires for a dedicated modeling (e.g. Figure 1).

## Results and discussion

In this context, a white-box Simulink model generated in order to provide a realistic framework for testing the control of the crane setup is also presented. Furthermore, a three-dimensional double-pendulum model is analyzed in order to understand the control capabilities of the system when affected by oscillatory components originated by the pitching motion of the vessel. The study is completed through an analysis aimed to characterize the bandwidth and frequency response of the controlled closed-loop system and highlight all the potential areas of interest for which further characterization is needed.

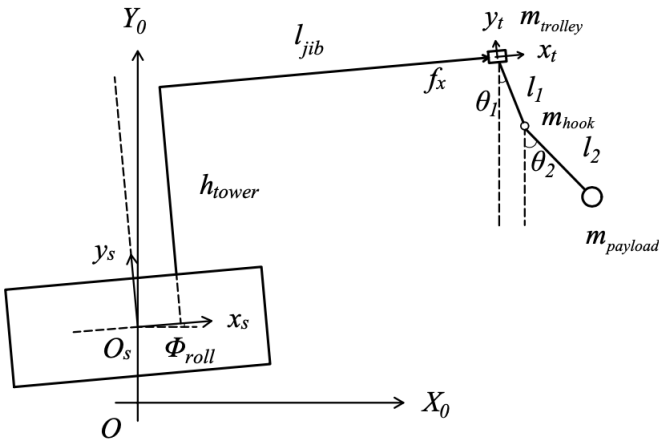


Figure 1: Two-dimensional double-pendulum offshore crane model.

## References

[1] Dianwei Qian (2018) Anti-Sway Control for Cranes, Design and Implementation using MATLAB. De Gruyter.
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[3] You-Gang Sun, Hai-Yan Qiang, Junqi Xu, Da-Shan Dong (2017) The nonlinear dynamics and anti-sway tracking control fo offshore container crane on a mobile harbor. *Journal of Marine Science and Technology* **656**:656-665.