Advances in Mechanical Engineering

Advances in Mechanical Engineering
2024, Vol. 16(1) 1–13

DOI: 10.1177/16878132231220353
journals.sagepub.com/home/ade
Sage

Modeling and analysis of static and dynamic behavior of marine towed cable-array system based on the vessel motion

Mohammad Reza Gharib, Ali Heydari and Mohammad Reza Salehi Kolahi

Abstract

Towing cables are playing a key role in maneuverability of moving or submerged vessels and the supporting vehicles in the ocean. This investigation evaluates the tension strength of the various parts of the marine towing cable and its geometric form under various operating conditions. Thus, the governing equations of the problem are introduced and analyzed first, followed by an examination of the method of solving the problem. We evaluate the cable's static and dynamic behavior under different operating conditions using a continuous cable method. Then, we introduce and analyze the governing equations of the problem. The static mode comprises three operating conditions: a two-dimensional mode for constant vessel length, a two-dimensional mode for constant hydrophone depth, and a three-dimensional mode for different vessel motion and seawater directions. Dynamic mode operating conditions include vessel acceleration, vessel rotation, and cable tightening. The results show that, if the velocity of the seawater flow is zero, changing the angle of the vessel motion has little effect on the tension force of the cable-array and the length of the cable in the steady-state. It is also found that assuming a constant depth of the cable-array, the maximum tension force of the cable will increase to almost 35 times. However, if the length of the cable-array remains constant, the maximum tension force of the cable increases by around 13 times as the vessel's speed increases by 5 times.

Keywords

Cable-array system, marine towing cable, vessel motion, vibration isolation module

Date received: 26 July 2023; accepted: 24 November 2023

Handling Editor: Pietro Scandura

Introduction

Towing cables are frequently used in the ocean environment and play a key role in supplying power and correspondence among moving or submerged vessels and the supporting vessel.[1] Nevertheless, the operation and connection of the towing cable and the drag relative to the flow of water limit the maneuverability of these vehicles. Thus, measuring the resulting impact generated by the towing cable and the flow would help assess the vehicle's maneuvering behavior.[2] Many scientists are neglecting the impact of the towing cable since its effect would make the computational model quite complex and impossible to solve. Ergo, just a handful of researchers address these problems by including the

Department of Mechanical Engineering, University of Torbat Heydarieh, Torbat Heydarieh, Iran

Corresponding author:
Mohammad Reza Gharib, Associate Professor, Department of Mechanical Engineering, University of Torbat Heydarieh, Torbat Heydarieh, 9178836179, Iran.
Email: m.gharib@torbath.ac.ir