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Limitation between linear and nonlinear models for surge motion of TLP

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Abstract
A Tension-Leg Platform (TLP) is a vertically moored floating structure. The platform is permanently moored by tendons. Surge equation of motion of TLP is highly nonlinear because of large displacement and it should be solved with perturbation parameter in time domain. This paper compare the dynamic motion responses of a TLP in regular sea waves obtained by applying three method in time domain using MATLAB soft ware. In this paper Lindstedt- Poincare method (L-P method) is used to solve nonlinear differential equation of surge motion considering first-order perturbation. Also modified Euler method (MEM) is used for solving nonlinear equation of motion as numerical method and ordinary differential equation is used for linear equation of motion (without nonlinear term). The results were obtained as responses represent good accordance between results of L-P method and MEM.

1-Introduction

Compliant offshore structures are used for oil exploitation in deep water. The surge motion equation of tension leg platform has nonlinear term. The high nonlinear surge motion equation must be solved in time domain by rising force on TLP. The hydrodynamic forces are calculated using the Morison equation according to Airy's linear wave theory for different waves condition. The responses obtained from linear motion equation and those achieved from analytical method via perturbation method for nonlinear status are compared with numerical results. Perturbation techniques [1, 2] are used to solve nonlinear motion equation in time domain. Many studies have been carried out to understand the structural behavior of a TLP and to determine the effect of several parameters on the dynamic response and average life time of the structure [3-5]. A comprehensive study on the results of tension leg platform responses in random seas, considering all structural and excitation nonlinearities, is presented by Tabeshpour et al. [6]. First order perturbation solution for axial vibration of tension leg platforms, is presented [7]. An analytical heave vibration of a TLP with radiation and scattering effect for damped systems has been presented [8]. Surge motion analysis of TLP under linear wave via perturbation method is presented [9]. Many of the phenomena around us are inherently non-linear and are expressed or described as nonlinear equations. Since the advent of digital computers, each day is easier to solve linear equations and this is while there is no exact answer for many nonlinear equations. In many cases, finding the analytical solution of nonlinear equations is much more difficult than obtaining the numerical solutions. But now with advances in computer hardware and having very powerful software such as Maple, Mathematica and MATLAB which are working with symbolic variables it is