A Study on the Driving Performance of a Tracked Vehicle on an Inclined Plane according to the Position of Buoyancy

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ABSTRACT

This paper is concerned with a numerical simulation of tracked vehicles for studying of driving performance on an inclined plane. In this paper, a tracked vehicle model of a miner of a deep-sea mining system is selected as an example for a numerical analysis model. Cohesive soft soil model and hard soil model are used in this paper. In order to investigate and analyze dynamic responses of tracked vehicles with respect to the change of the buoyancy position, the numerical simulation of the tracked vehicle was performed using commercial software. The numerical model of the tracked vehicle is composed of chassis module, track subsystem module and buoyancy module. Teramechanics of the soil model is implemented using the user defined subroutine of commercial software. Hydrostatic forces of the tracked vehicle are included in the simulation model. A series of dynamic simulations is conducted with respect to driving velocities, soil properties, gradient of inclined plane, and position of buoyancy and so on.

KEY WORDS: Buoyancy objects; Tracked vehicle; Driving Performance; Numerical simulation; Inclined plane.

INTRODUCTION

Because of depletion of the land mineral resources, interest in deep-seabed mineral resources is increasing. Especially, in recent years, according to increases of expectation value about SMS deposits, research and development work has been performed to occupy SMS deposits in advance around advanced country (J.P.Feenan. 2009, J.W.van Bloois et al. 2009, Y. Fouquet et al. 2009). However, at present, there are only few reports about the development for the technology of driving mechanisms suitable for SMS deposits.

KORDI developed the deep-seabed self-propelled miner (MineRo®) (as shown in Fig. 1). Also analysis models for dynamic simulations of mining systems have been developed (Hong et al. 2002, Kim et al. 2003, Choi et al. 2003, Kim et al. 2005). However, the earlier model was developed for flat ground, so driving performance of a tracked vehicle model at inclined ground for SMS mining is unknown.

In this paper, for the purpose of dynamic performance analysis of a two tracked vehicle, a model that is similar to MineRo® model is used for SMS deposits. The numerical simulation of tracked vehicle is modeled by using commercial software. In this paper, the climbing ability of the tracked vehicle model is considered and dynamic responses of the tracked vehicle with respect to the change of the buoyancy position are analyzed with various soil models.

TRACKED VEHICLE MODEL

Modeling of Tracked Vehicle Model with Buoyancy

In this paper, for the purpose of investigating the performance of a tracked vehicle model, a two-tracked vehicle is modeled by using commercial software, RecurDyn(2006) as shown in Fig. 2.

Table 1 shows specifications of the two-tracked vehicle model. Total weight is about 9 tons in air, about 6 tons in water. Contact pressure (mean) is about 37 kPa. Total mass center is located at 1/3 of height of the tracked vehicle model.

In this paper, a translational joint is located between chassis and buoy. The buoy can move forward and backward at the tracked vehicle along the X axis of the chassis as shown in Fig. 3. So the center of buoyancy can be changed.