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ScienceDirect

Procedia Engineering 174 (2017) 385 – 391

Procedia Engineering

www.elsevier.com/locate/procedia

13th Global Congress on Manufacturing and Management, GCMM 2016

Research on Monitoring Force of Steel Wire Rope of Grab Dredger Base on Wireless Sensing

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Abstract

The article research on intelligent grab dredger. Work force mechanical model of steel wire is established during dredging Grab's flat digging working. Then, the theoretical calculation on stress of the steel wire is available. It's easy to get the result of dredging Grab's steel wire. Meanwhile, a way is put forward about changing the rotating shaft torque to the force of steel wire, which is based on detection of wireless sensor network technology in grab dredger's hoist. The ideal result on Real-time display of the curves of closing hoist and hoist rope's stress. The test result of real-time monitoring show that the theoretical calculation on stress of the steel wire is consistent with the test result of real-time monitoring, which provide the basis on the application of real-time monitoring of wireless sensor technology in the grab dredger's steel wire's stress.

Peer-review under responsibility of the organizing committee of the 13th Global Congress on Manufacturing and Management
Keywords: wireless sensing；grab dredger；linear excavation；steel wire rope force；real-time monitoring

1. Introduction

With the implementation of the "Marine potestatem" strategy, China has launched a series of significant movements on the development of the oceans, the use of the oceans, the protection of the oceans and the control of oceans. The construction of "Marine potestatem" has a critical impact on the healthy development of the national economy and will promote the rapid development of marine engineering. At the moment, large grab dredgers[1-2] are highly required to have flat digging function to excavate flat surface on the seabed for the caisson process in large - scale offshore engineering such as South China Sea construction project, Hong Kong - Zhuhai - Macao Bridge,

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Peer-review under responsibility of the organizing committee of the 13th Global Congress on Manufacturing and Management
doi:10.1016/j.proeng.2017.01.157

Nomenclature

F_i grab bucket body force， i values from 1 to 4
B grab edge width(m)
D blade thickness of the grab(m)
Y the depth of grab edge cut in material(m)
θ the bottom dorsal horn of grab edge (°)
v the speed of grab edge cut in material (m/s)
s Particle size (mm)
ρ material density（ t/m^3 ）
φ internal friction angle of material particles（ ° ）
f effect coefficient of the grab edge
k influence coefficient of material particle surface condition and shape on grasping resistance
Q_x the weight of the material Enter inside the hopper (kN)
l_Q the length aimed at A (m)
P Support force of the hoist rod (kN)
R the length of the hoist rod aimed at A (m)
G_B pressure which hoist rod stay on the bucket body(kN);
G_3 the weight of the bucket (kN)
S_1 tension of the closing rope (kN)
S_2 tension of the hoist rope（kN）
G_1 weight of upper sheave block (kN)
G_B pressure stay on the bucket body (kN)
F_1 cutting resistance on horizontal cutting edge (kN)
F_2 cutting resistance on lateral cutting edge (kN)
F_3 pushing resistance in Horizontal direction (kN)
F_4 the side friction resistance (kN)

Seabed pipelines and tunnels constructions etc. While, existing domestic and foreign equipment is difficult to meet the high precision construction requirements. Therefore, the flat digging process is of grab dredger is the hot and difficult problem in the research of large ocean engineering.

The dredging grab of the grab dredger, as shown in Fig.1, transfers the forces through ropes to reels' shafts in processes of digging, bucket closing and hoisting [3-4]. Using Wireless Sensor Technology, torque stresses on shafts of closing and hoisting reels are detected by the torque sensor on them which consists of resistance strain gauges. The closing ropes and hoisting ropes' tensions are calculated according to secondary data conversion which reflects the loads of the grab in dredging process.

Fig. 1. the appearance of the grab dredger.