

Research on the Path Planning for Deep-seabed Mining Vehicle

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ABSTRACT

The deep-seabed mining vehicle works in the high pressure, unknown and complex environment. How to use the mix-sensors system to describe the working environment correctly and real-time is the precondition and foundation of the vehicle's path planning. The operation performance and exploiting efficiency of the whole deep-seabed mining system are decided by path planning technology. In this paper, a path planning algorithm based on a fast grid search and rolling optimization strategy is presented. The path planning simulation platform for mining vehicle is developed. Then the simulation of path planning algorithm is presented. The simulation result proves the validity of algorithm.

KEY WORDS: deep-seabed mining vehicle; path planning; rolling optimization

INTRODUCTION

Deep-seabed mining vehicle is a kind of autonomous robots, this kind of robots can do a lot of heavy work under bad condition which the human beings can not do (Peng and Yang, 2004). It is required the mining vehicle to walk on the seabed at a depth of about 6000m and collect polymetallic nodule depositing in the seabed when the mining vehicle is working. Therefore, as the dynamic center of deep-seabed mining system, deep-seabed mining vehicle is the key equipment of the whole system, and charges with the most complex and dangerous task. In allusion to the mining vehicle's own needs and the unknown but time-varying special environment, the vehicle must have the capacity to plan the point-to-point and coverage-type path, and identify the obstacles in advance, then go around them safely when appearing insurmountable obstacles.

The mining vehicle works in the dynamic and time-varying environment, only relying on undersea environment information for routine and off-line global path planning but neglecting to track the change of environment, even based on the best planning, which can not guarantee the mining vehicle meet the performance indicators during actual running process. In this paper, a path planning algorithm based on a fast grid search algorithm and rolling optimization strategy is presented. The algorithm overcomes high complexity of the existing local path planning, and can meet the real-time requirement of the mining vehicle when working in complex, unknown and dynamic environment.

ENVIRONMENT GRID MODELING BASED ON MULTI-ULTRASONIC SENSORS

Establishment and transition of the coordinate

The environment information of the mining vehicle mainly consists of the environment structure and layout, and the distribution of obstacles. The two coordinates must be established respectively: global coordinate and bodywork movement coordinate, the transition relation is shown in Fig.1.

The transition relation of global coordinate and bodywork movement coordinate is shown as following:

$$x = n + x' \times \cos \theta + y' \times \sin \theta \quad (1)$$

$$y = m + y' \times \cos \theta - x' \times \sin \theta \quad (2)$$

Here θ is direction angle of the mining vehicle's movement in global coordinate.

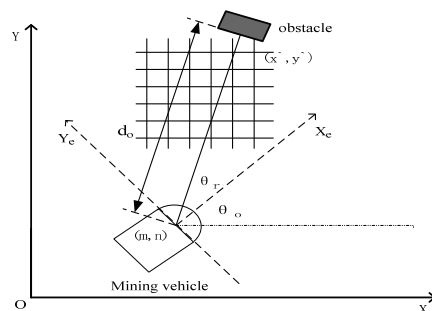


Fig.1. Transition of bodywork movement coordinate to global coordinate

When the ultrasonic sensors measure the distance of obstacles is d_0 , then the obstacles information can be mapped to the global environment coordinate through the formula (3).