A Test and Evaluation Method for Smart Fully Mechanized Mining Robot Production System

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Research

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Abstract

A test and evaluation method for smart fully mechanized mining robot production system is proposed. Based on the actual operation data of the geology and equipment of a particular working face, the kinematic models between equipment and coal seam are established. The virtual off-line operation system of fully mechanized coal mining face is constructed. The mining situation of virtual operation of working face reproduced and the simulation initial data and virtual scene operation data are determined. The perception operation model is added to the virtual equipment and AI robot analysis system is constructed. Based on sensor error analysis, execution error analysis and other error analysis, the equipment and geological exploration means are input according to the parameters of smart development and operation in the future. The operation evaluation system of fully mechanized coal mining face which considers cutting track, straightness, working space and dynamic coal seam is constructed. The operation of fully mechanized mining robot in the future is simulated, the development trend is determined and the robot operation performance is tested. The related prototype system is developed, and the testing of the overall operation of the working face was improved from the aspects of smart equipment and digital sensing elements. It shows that this method realizes the reappearance of fully mechanized mining operation process based on actual operation data and operation parameters. The current level of smart mining and some local or a small aspect of technological progress on the overall operation of the working face are analyzed and evaluated. The test and evaluation method points out the direction for the development of coal mine robot and smart mining.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures
Figure 1

Overall framework of test and evaluation method
Figure 2

System software interaction

(a) Support monitoring interface  (b) Shearer monitoring interface  (c) Video surveillance

(d) Real scene of working face  (e) Central control center

Figure 3
Figure 4

Relevant equipment data and coal seam data of 100 cycles

Figure 5

Composition of virtual perception system
Figure 6

Off-line operation simulation system
Figure 7

Working face coordinate system
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Construction method of coal seam cutting floor based on Mesh grid
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The general framework of AI operation of the virtual synthesis mining robot

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(b) Action reappearance of shearer
(c) Real-time comparison of cutting curves
(d) Monitoring of single hydraulic support

Figure 10

Initial scenario construction and offline simulation results

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Figure 12

Evaluation method

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Straightness information extraction of scraper conveyor and hydraulic support group
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Three dimensional schematic diagram of workspace of fully mechanized mining equipment with three cutting schemes