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DEVELOPMENT OF THE BEST PREVENTIVE MAINTENANCE POLICY FOR FULLY AUTOMATED SHIP-TO-SHORE CRANE

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ABSTRACT

The aim of this work is to develop a maintenance policy that can integrate online monitoring information of the automated ship-to-shore crane. This policy, described as dynamic, makes it possible to develop a planning method adapted to the actual use of the crane. This dynamic planning ensures an optimal use of this automated system which is mandatory for the transhipment field.

Keywords: maintenance policy, dynamic planning, automated ship-to-shore crane, transhipment.

INTRODUCTION

To ensure an optimal operation time of the automated ship-to-shore crane it is important to develop a maintenance policy which can use the online monitoring information to adapt the maintenance intervention. Indeed, the different sensors and automation in this crane allow relevant information about the health state of the different crane components also the system health state in general.

This work will have interested to exploit the CMMS (Computerized Maintenance Management System) database and the online monitoring information to define a maintenance interventions grouping methodology.

We will propose a policy adapted to the multi-component system structure, especially systems with elementary structures consisting of non-repairable components.

1st hypothesis: For these systems, only changing defected components is allowed. We also supposed that these replacements allow the component to return to its original state and performance.

We will express mathematically this problem using the principal of MFOP (Maintenance Free Operating Period) and the MFOPS (Maintenance Free Operating Period Survivability):

$$MFOPS(t) = \frac{R_{syst}(t + t_{MFOP})}{R_{syst}(t)}$$

where:

Rsyst(t): the system's reliability at the t instant (in our case the system is the crane).

tmfop: units of time corresponding to the length of the MFOP.

After that, we will introduce a constrained optimization problem to make the right choice of component replacement:

$$\min_{\{X\}} J_w(X) \quad \text{avec } MFOPS(X,t) > NC$$

where:

X: a set of components to replace for a given solution

Jw: the maintenance decision criterion with w the decision criterion index studied

MFOP (X,t): the $MFOPS$ of the system to t after the replacement

NC: the confidence level to reach on the next MFOP.

Then, we suggest developing a genetic algorithm to resolve the maintenance optimization issue (exposed above).

Finally, we'll evaluate the impact of this dynamic maintenance policy on the optimization of the cost of the preventive maintenance and the increasing of the operational time of the Ship-to-shore crane.

RESULTS AND CONCLUSIONS

The target of developing this dynamic preventive maintenance policy for this automated crane is to reduce the cost of the maintenance by 20% and to enhance the operational availability of this equipment.

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