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Self-growing Colored Petri Net for offshore wind turbines maintenance systems

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Abstract.

The offshore wind turbines have been developed in a lot of aspects in the last years, but the big companies are still researching for new techniques that help improve the systems.

We propose a new methodology to implement the automatic maintenance system using self-growing colored Petri nets developed in Labview, extendable to other industry systems.

Key words

Wind power turbine, Self-growing Colored Petri Net, offshore, optimal maintenance, cost.

1. Introduction

In this article, an optimal management system for offshore wind turbines is presented. It has been developed based in Colored Petri Nets (CPN) implemented in Labview.

The system we present in an automatic maintenance system created with Colored Petri Nets and the subsystem that compose it, but also with the new methodology and libraries developed to fulfil the project requirements.

The objective of the system is to work automatically joining the diverse subsystems in order group the maintenance order and select the optimal solution, analyzing costs, shipment and other factors. The orders must be revised and accepted by authorized personal.

The main characteristic of the system is the possibility of work with any number of orders, and create and erase them during the execution of the program without affecting the system. This is possible due to the coordinated job of Labview and Excel.

2. Maintenance concepts

There are some aspects to consider if we want to design an optimal maintenance. The first parameter is the criticity of the task, calculated according to fail consequences, frequency, inactivity time, etc.

With the criticity and the available time to repair the failure, we determine the variable priority of the maintenance task, which should be updated during the program evolution. The priority is very important to determine the most restrictive tasks and also for the grouping system.

Another factor is the possibility of look up the information of the tasks in the corresponding data base. This system has been designed for offshore wind turbines, so another factor to consider is the shipment used to solve the maintenance task, which cost is really significant in the budgets. Moreover, we have to consider meteorological parameters in order to decide to send the ship or not. This consideration should be analyzed throughout the execution of the program.

The management systems work with at least a complete wind farm. That means a high load of maintenance tasks and parameters that increase even more if all the maintenance types are considered.

The system developed is able to manage all the active maintenance tasks, with the computational load that it supposes. We propose a system implemented using Colored Petri Nets in Labview, with a new characteristic: it can work with any number of maintenance tasks, and grow and decrease the size of the net according to the requirements of the system in every moment.

Commercial management systems have been developed to this kind of system, and are very qualified, but they have some lacks that our system is able to complete, working combined with specific maintenance systems, contributing with an engineer vision of the problem.

Two important aspects for the offshore maintenance are going to be analyzed: the grouping system of the available tasks and the optimization. The grouping system has to consider the aspects we have seen before, and calculate some different options to resolve the tasks. With these options, the optimization system decides which one is the optimal, according to economical and strategic parameters.

The objective of the article is to present an automatic system for the maintenance management, implemented in Labview using a new methodology for self-growing colored Petri nets.