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STUDY ON A RACE CAR AVAILABILITY

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ABSTRACT
In this study is presented a practical method to estimate the availability of a race car. Some data regarding to parameters of reliability and maintainability for the studied entity are taken from the technical literature. Simulation of operation /failure of the race car have been done using the RAPTOR 4.0s software.
Keywords:
availability, mean time between down events (MTBDE), mean down time (MDT)

1. INTRODUCTION

If one considers both reliability (probability that the item will not fail) and maintainability (the probability that the item is successfully restored after failure), then an additional metric is needed for the probability that the component/system is operational at a given time, *t* (*i.e.* has not failed or it has been restored after failure). This metric is *availability*. Availability is a performance criterion for repairable systems that accounts for both the reliability and maintainability properties of a component or system. It is defined as the probability that the system is operating properly when it is requested for use. That is, availability is the probability that a system is not failed or undergoing a repair action when it needs to be used.

2. ANALYSIS OF A RACE CAR

Consider a race car that competes in 200-mile races. Assume that the main components of the race car are 1) the engine, 2) the transmission, 3) the front and rear suspensions and 4) the brakes. All of these components can be considered to be in a reliability-wise series configuration and are correctively replaced upon failure. After each race, the brakes are preventively replaced while the other components remain on the car for the next race. If any one of the front or rear brakes fails during the race, all other brakes on the car are also preventively replaced. For this example, suppose that the performance of the race car needs to be analyzed for twenty consecutive races using the component failure and repair properties given in [4]. All corrective and preventive maintenance actions are assigned durations of 0.0 miles. This is done because the analysis of the race car is carried out in units of miles. Since no miles are accumulated while maintenance is performed on any of the components of the race car, these actions can be considered as instantaneous for the purposes of the analysis.

3. RELIABILITY BLOCK DIAGRAM APPROACH

The easiest approach to analyze the performance of the race car for the above scenario is to construct a reliability block diagram (RBD) of the race car using the component properties given in [1] (fig.1). Failure and repair properties of each of the components are entered into the block properties window of the block representing each respective component. Preventive maintenance actions for the brakes that are scheduled to occur every 200 miles are accounted for using the "Maintenance Information" window in RAPTOR 4.0s. The "Maintenance Information" option is selected and a common group number is assigned to all brake components in order to model the preventive replacement on all other brakes that occurs upon the failure of any one of the brakes.

A simulation is then run on the reliability block diagram with an end time setting of 4,000 miles to perform the required analysis for twenty consecutive races.

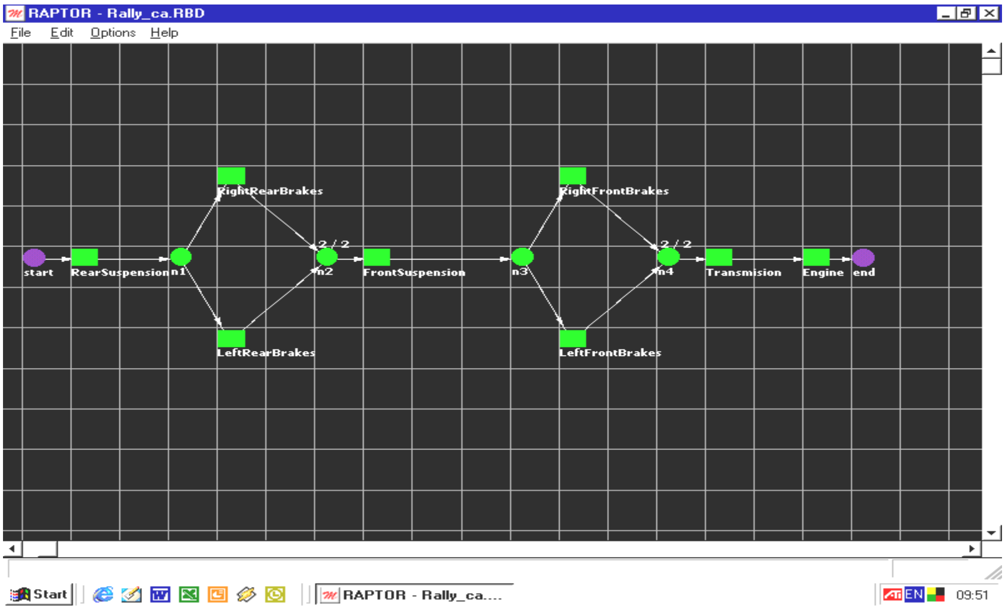

FIGURE 1. Reliability block diagram of a race car

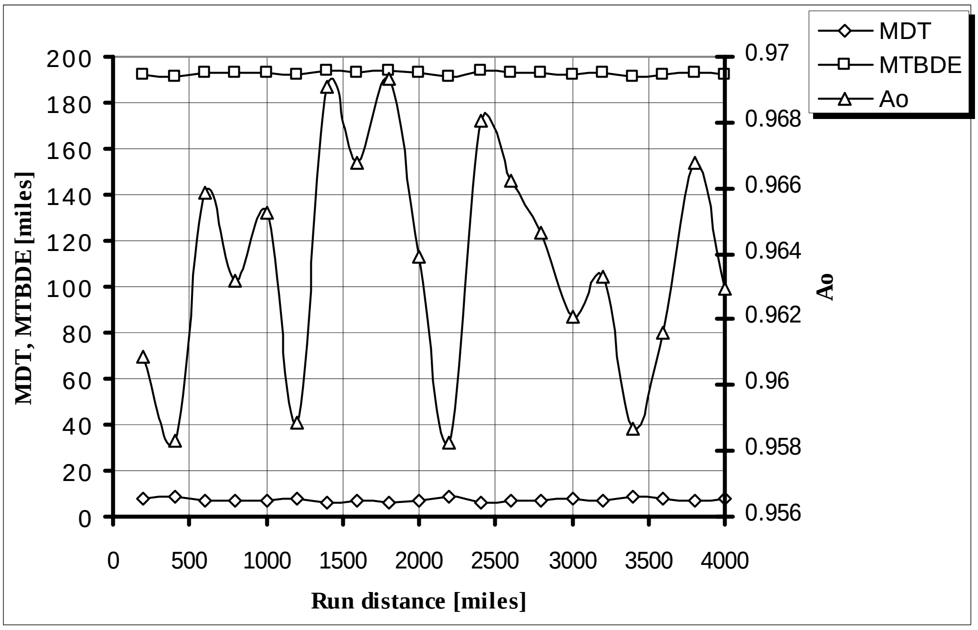

FIGURE 2. Results of simulation for the race car operation

Simulation results comprise the values of Ao availability, the mean time between down events (MTBDE) and the mean down time (MDT) for each stage of 200 miles. Their graphical representation shows the race car behavior for all the twenty race stages (fig.2).

4. CONCLUSIONS

From fig. 2 are ascertained relative high values of the availability (between 0.958 and 0.97), which is a positive fact to finish each stage of the race in proper conditions. This fact was expected because MTBDE has values close to 200 miles (stage finish). However there is the possibility for the last 6 – 8 miles of the stage to not be run, this fact being indicated by MDT. Tough MDT has relative low values; they can never be zero certainly. Reduction of MDT can be done only using components with high reliability and/or proceedings of rapid replacement of elements and parts failed during the race.

REFERENCES

[1.] ADAMANTIOS, M., Reliability allocation and optimization for complex systems, Proceedings of the Annual Reliability & Maintainability Symposium, 2000, pp. 216.
[2.] JODEJKO, A., Model of system availability caused by spare parts inventory level, International Journal of Reliability, Quality and Safety Engineering, Vol. 13, No. 1 (2006), pp. 37–45.
[3.] VASIU T., Creşterea fiabilităţii utilajelor de preparare, Teză de doctorat, Petroşani 1996.
[4.] www.barringer.com.