

The DLR Alertness Management Program for Companies – Fit-for-Driving Tests

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Abstract

An alertness management program has been developed for transport companies. It presents a tool for preventing accidents and for increasing transport safety. The program takes all causes into consideration that can lead to fatigue in transportation. Different strategies are used to combat the problem of fatigue. The DLR alertness management program consists of a computer program for fatigue prediction, a training program for drivers and transport managers, medical screening of drivers, and fit-for-driving tests. The paper details a prototype of fit for driving tests programmed on a handheld computer. The fit-for-driving tests comprise a checklist, standardised sleepiness and fatigue scales, a reaction time test, and an unstable tracking task.

Introduction

According to conservative estimates, about 10 - 20% of all road accidents are caused by driver fatigue. Fatigue related accidents are characterised by large costs and a high number of fatalities. Sufficient and restful sleep has become a luxury in European societies. Drivers have to comply with the 24/7 society that requires too long hours of work, working on shifts and too short rest periods. In addition, sleep disorders have become more frequent in recent years. Also life style factors with unbalanced nutrition and too little physical activity may impair driver fitness and add to fatigue as well.

To combat driver fatigue and to improve transport safety, DLR has developed an alertness management program for companies. This program takes both the transport management as well as the drivers into consideration and consists of four main parts:

- (1) A computer program "Alert" for fatigue prediction has been developed on the basis of mathematical models of fatigue dynamics. Shift schedules can be analysed by this program and therefore the program can help drivers and transport managers to take fatigue into consideration when planning schedules and rosters.
- (2) A training program "SAFE-T" has been developed to teach drivers and transport managers about causes of fatigue and about strategies of prevention.

- (3) Medical screening studies (e.g. for sleep apnoea) are being carried out in groups of professional drivers that have a particularly high risk of being involved in a fatigue related accident. By using telematics drivers can be examined at home. This improves acceptance and reduces costs.
- (4) Fit-for-driving tests are being developed. The tests assess primarily fatigue, sleepiness and performance of a driver and indicate that his ability to drive is not restricted.

In the following, fit-for-driving tests are described in more detail. Firstly, the concept of the tests is presented and the intended target group is described. Then three different formats of the tests with some examples are referred and possibilities of evaluation of fitness-for-driving are discussed.

Concept of fit-for-driving tests

Fit-for-driving tests address a problem of fatigue related accidents. Fit-for-driving tests are means to avoid that a fatigued driver starts his duty. The tests assess primarily fatigue and sleepiness. They are presented to the driver before driving and have to be short to keep the costs low and to increase acceptance.

It is expected that the use of fit-for-driving tests can prevent traffic accidents and will increase traffic safety.

Target groups for fit-for-driving tests

Fit-for-driving tests are aimed at professional drivers, who are involved in high-risk transports, i.e. transports where the transported passengers or goods or the surroundings are at high risk due to a possibly fatigued driver. Passenger transport (e.g. bus charters), public transport as for example buses, trains, trams, or transport of dangerous goods like chemicals, pressurised gases or nuclear waste are examples of high-risk transport.

Professional drivers often work long hours, work on shifts and/or have irregular schedules. It often requires work against their internal body clock or simply causes that they do not get enough sleep.

Formats of fit-for-driving tests

A variety of methods to assess fatigue, sleepiness and performance exists, nevertheless not all of them are suitable as fit-for-driving tests. Many of them cannot be used in work environment (e.g. MSLT, pupillography), since they require a laboratory equipment, others are too long (Mackworth clock vigilance test), some are not validated and if all the conditions are fulfilled, they are not accepted by the drivers.

We are using three different formats of the tests:

- Checklist
- Standardised subjective fatigue and sleepiness scales
- Performance tests.

All fit-for-driving tests described in this paper are presented to the driver on a handheld computer. It makes the data storage and evaluation convenient and increases the acceptance of the tests by the drivers.

Description, examples and advantages and disadvantages of individual tests are given in the following.

A fit-for-driving checklist is a form documenting facts relevant to driver's fatigue. The most important data in fatigue assessment are the duration of the last sleep period and the time since this sleep. Also quality of sleep and activities in the time since the last sleep are helpful information.

Possible questions for fit-for-driving checklist are listed below:

- When did you fall asleep?
- When did you wake up?
- How long were you awake in between?
- How refreshing was your sleep?
- How demanding was the time since your last sleep?
- How fatigued do you feel right now?
- How fit do you feel for driving?
- Do you think you will become too tired during driving?
- How much is your performance influenced by alcohol?
- How much is your performance influenced by drugs or pharmaceuticals?

Answers to the relative questions can be marked on a five-point scale

1 – Not At All

2 – A little

3 – Somewhat

4 – Quite a bit

5 – Very much

Fit-for-duty checklists can be manipulated by the drivers. Nevertheless the questions given in the checklist have an educational value. They can make the drivers aware of the issues that affect their performance. Filling in a checklist is not time consuming.

Standardised subjective fatigue and sleepiness scales are used to reveal fatigue or sleepiness of the driver. For fit-for-driving tests we are using Karolinska sleepiness scale and Samn-Perelli fatigue scale.

The Karolinska sleepiness scale, shown in the Fig. 1, is a semi-quantitative standardised 10-point scale, on which the driver has to mark his sleepiness during the previous 10 minutes. The scale has a known threshold for the occurrence of microsleeps. The threshold has been validated by simultaneous recordings of EEG and EOG signals from which microsleep can be assessed. If the driver's sleepiness is beyond this threshold, he should not start his duty.



Fig. 1. Karolinska sleepiness scale on Palm handheld

In the Samn-Perelli fatigue scale, shown in the Fig. 2, the driver has to mark his relation to all of the ten statements given on the screen. Fatigue assessed by this scale has a score between 0 and 20. The Samn-Perelli scale is standardised and has been used mainly in aviation for years.

Both the Karolinska sleepiness and the Samn-Perelli fatigue scales can be manipulated by the drivers towards better results, especially when it is known, which results can restrain the driver from starting his duty. Subjective scales are more demanding than filling in the checklist, but are usually completed in a shorter time.



Fig. 2. Samn-Perelli fatigue scale on a Palm handheld

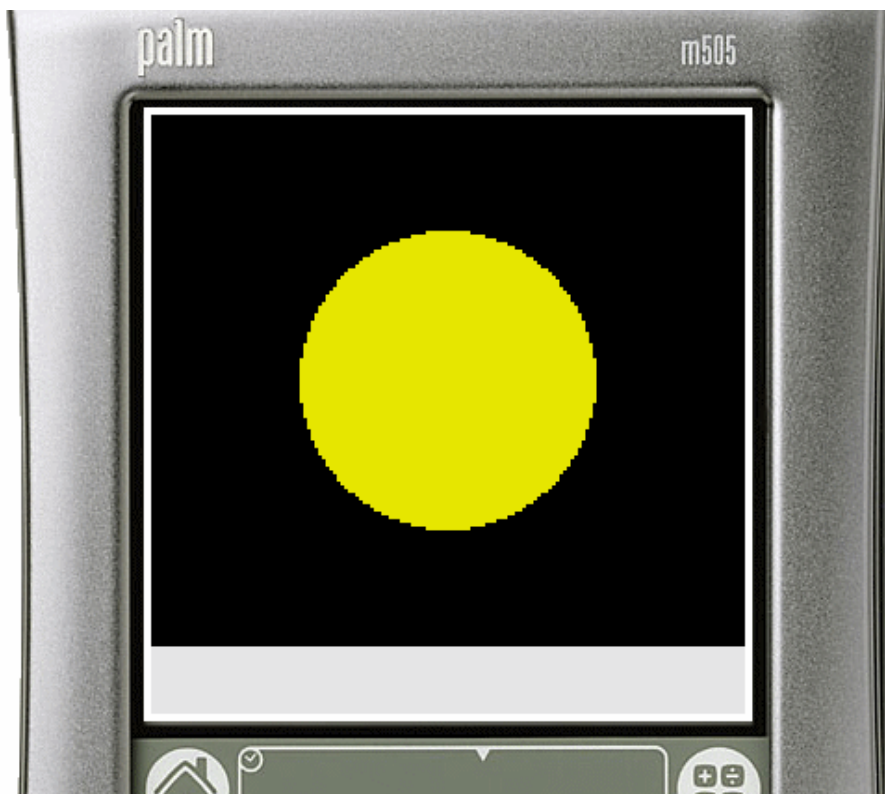


Fig. 3. Simple reaction time test on Palm handheld

The performance tests we are using for fit-for-driving testing consist of a simple reaction time test and an unstable tracking task.

Simple reaction time test (Fig. 3) measures the response time to the occurrence of a visual signal. The user should react as quickly as possible to a circle that appears on the screen. The test repeats itself several times, while the time between signals varies randomly.

Unstable tracking task, shown in the Fig. 4, is a test in which a cursor moves horizontally on the screen according to an internal disturbance signal and according to the user's input. The user has to keep the cursor in the center of the screen. The measure of the test is the average distance of the cursor from the middle of the screen and the number of so called "control losses" when the cursor reaches the edge of the screen.

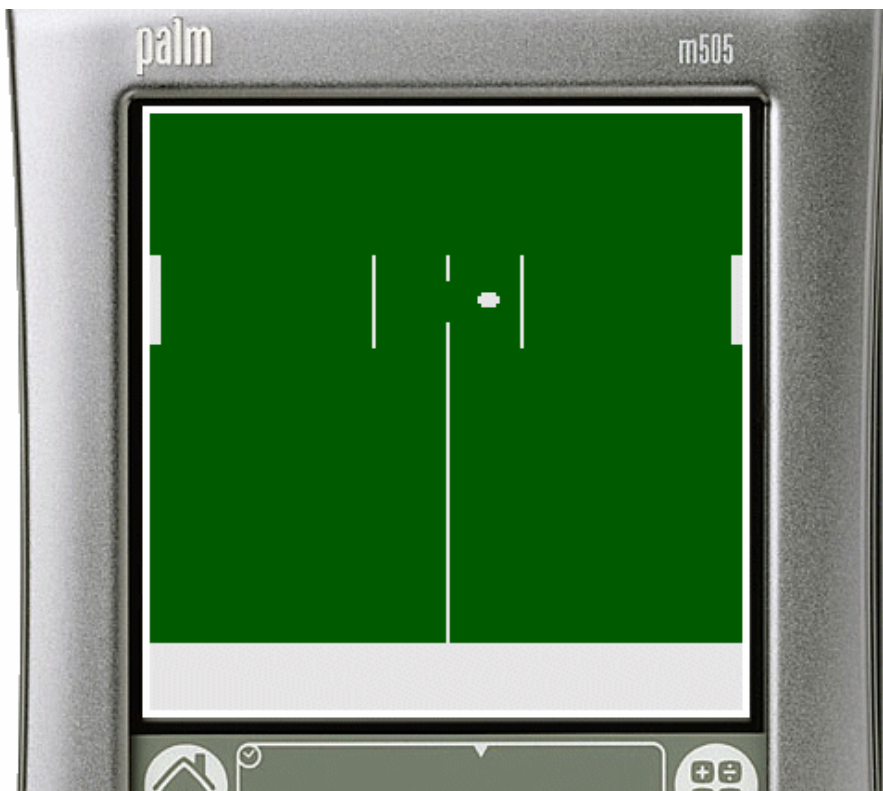


Fig. 4. Unstable tracking test on Palm handheld

Both performance tests are the most demanding in comparison with the fit-for-driving checklists and the fatigue and sleepiness scales. Unlike the subjective scales and the fit-for-driving checklists, the performance tests cannot be wilfully manipulated by the drivers towards better results, only towards worse ones. Their disadvantage is that the duration of the tests has to be quite long, since the longer the performance tests are the better they reflect driver's fatigue, as it is known that the results can be influenced by short-time motivation of the users. From an economical point of view the duration of the test should be kept as short as possible. Experiments are conducted to find the optimal duration of the test.

Evaluation of fitness-for-driving

Due to the large interindividual differences in the results of the tests, it is necessary to evaluate results of each driver separately. Current results are compared with previous ones to reveal differences in performance. Some of the outlier detection methods that have attracted much attention recently can be used here as well.

If possible, the simplest evaluation of the results is the comparison with an accepted threshold level. The thresholds are subject to current research.

Conclusion

Fit-for-driving tests are being developed by several groups. They have to be tailored to specific skills of different types of users and application areas keeping in mind the conditions, under which the tests have been validated.

The DLR alertness management program for companies is designed to increase transport safety. The fit-for-driving tests as a part of the alertness management program may contribute to the increase of transport safety. The DLR alertness management program is applicable to all transport modes (e.g. trucks, railway trains, public transport). Pilot investigations in a truck fleet as well as in public transport have started in 2003.