INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

AIDE

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DVE Model Validation Tests: data analysis and results

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Activity No.	**A1**	Activity Title	**Identification, validation and tests of driver's model in DVE framework**
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Executive Summary

This document aims at illustrating the activity carried out in the WP1.3 of AIDE-SP1 sub-project, about the tuning and validation of specific driver's model parameters (i.e. Task Demand and Distraction), as detailed in the Driver-Vehicle-Environment framework (see D1.1.3, D1.1.4). Such parameters are used to describe driver's behaviour in different conditions, including the effects of IVIS' interactions on driving task. In order to pursue these validation and tuning goals, we have applied some machine learning techniques, to guess a model for the variables, characterising Task Demand (TD) and Distraction (DIS) parameters, and their relationships. At the beginning of the project (as stated in D1.1.4), a fuzzy-logic (FL) approach had been proposed to model TD and DIS; however, two main drawbacks exist using FL:

- Relationship among arbitrarily definition of the membership functions;
- Membership functions tuning has to be done manually.

In order to cope with these problems, we have considered systems able to automatically make the membership functions modelling, starting from an input / output dataset and through a self-learning mechanism. In this context, we have selected two machine-learning techniques:

- ANFIS (Adaptive Neuro-based Fuzzy Inference Systems);
- Neural Networks.

A description of the theoretical content of these approaches is provided in the main body of the text.

The methodology for such an evaluation phase is based on the following procedure: starting from a defined *model of the parameter* (e.g. the fuzzy model of the Distraction) the process continues following an *input/output correlation matrix* step. Here, a correlation analysis between models inputs and outputs is applied; if correlations between inputs and outputs are found, a more efficient mapping between inputs and outputs will be possible. Otherwise, new combinations of inputs or outputs should be considered. After that, the process continues with:

- ANFIS approach;
- Neural Network approach.

In the former, the model is tuned, validated and tested following an ANFIS technique, while in the latter the model is submitted to a Neural Network.

Achievements are briefly summarised here. An absolutely interesting and positive result has been achieved for DIS parameter, where predicted data well fit the real data used for testing and also the RSME value is narrow enough as recommended by literature. This can be considered as a relevant achievement, since DIS is mainly related to the driver's distraction caused by IVIS, that is the main topic of AIDE-IP investigation. Moreover, DIS is strictly related to Situation Awareness, whose low levels can lead to high probability of error risk.

According to these results, and based on the model developed here, it is possible to estimate and assess DIS via parameters that are easily collectable directly from the on-board vehicle CAN bus architecture, establishing a strong link with the work done in SP3 as mentioned among the IP objective.

In addition, and over what planned in AIDE, a specific support to display how this parameter works, an ad-hoc application has been implemented on the base of the SSDrive simulator framework. This represents a good step in the direction to provide a kind of design tool for stakeholders in this domain, to predictively evaluate the impact of IVIS in different driving scenarios.

Concerning the TD, results obtained using both approaches are characterised by a relevant error's value (RSME in our case) and a not wide capability of generalisation. In this way, deeper analyses are required and they could offer the base for future researches. Moreover, many other relevant points and stimuli can be offered to future researches. They concern the extension of this procedure to the other parameters characterising driver's behaviour, as stated in D1.1.4, and the porting of these parameters into SSDrive.