

INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME



AIDE IST-1-507674-IP

Requirements for HMI Design and Driver Modelling

Deliverable No.		D1.1.1b	
SubProject No.	SP1	SubProject Title	BEHAVIOURAL EFFECTS AND DRIVER-VEHICLE-ENVIRONMENT MODELLING
Workpackage No.	WP1.1	Workpackage Title	DVE MODELLING
Activity No.	A1.1.1	Activity Title	Review and synthesis of models for joint DVEE interaction
Authors		P.C.Cacciabue, L.Macchi, M.Martinetto, F. Saad, F.Tango, J.J. Cañas, M. Alonso	
Status		F	
File Name:		AIDE D1_1_1b.doc	
Project start date and duration		01 March 2004, 48 Months	

Contents

Contents	2
List of Figures	3
List of Tables.....	3
List of Abbreviations.....	4
1 Executive Summary.....	5
2 Requirements for DVE modelling	7
2.1 Requirements for Driver Model.....	8
2.1.1 Requirement 1: Condition Affecting Behaviour.....	8
2.1.2 Requirement 2: Perception.....	8
2.1.3 Requirement 3: Interpretation.....	8
2.1.4 Requirement 4: Execution	9
2.1.5 Requirement 5: Error Generation Mechanism.....	9
2.2 Requirements for Environment Model	9
2.2.1 Requirement 1:Traffic Conditions	9
2.2.2 Requirement 2: Road Characteristic	9
2.2.3 Requirement 3: Weather Conditions	10
2.3 Requirements for Vehicle Model.....	10
2.3.1 Requirement 1: Vehicle's motion in dynamic conditions.....	10
2.3.2 Requirement 2: ADAS effects.....	10
2.3.3 Requirement 3: IVIS effects.....	10
2.3.4 Requirement 4: Vehicle Signals	10
2.4 Requirements for Scenario.....	11
3 The Model Driver Vehicle Environment - Electronic.....	11
3.1 Background Models.....	11
3.1.1 Behavioural adaptation.....	11
3.1.2 Driver Modelling	12
3.1.3 Vehicle Modelling	12
3.1.4 Environment Modelling.....	12
3.2 E-DVE	12
3.2.1 General architecture to represent E-DVE model	13
3.2.2 Time frame of Model E-DVE.....	15
3.2.3 Preliminary conditions	15
3.2.4 Conditions Affecting Driver Behaviour.....	16
3.2.5 Simplified Model of Driver	16
3.2.6 Basic Structure of Frames.....	19
3.2.7 Error Generation Mechanisms.....	23
4 Conclusions	26
5 References	27
6 Annexes.....	28

List of Figures

FIGURE 1. THE SHELL CONFIGURATION (FROM HAWKINS, 1987).....	13
FIGURE 2. TIME REPRESENTATION.	15
FIGURE 3. EXAMPLE OF "ACTION EXECUTION FLOWCHART" FROM THE DOMAIN OF AVIATION MAINTENANCE (CACCIABUE, MAURI AND OWEN, 1993).....	21
FIGURE 4. ARCHITECTURE OF DVE MODEL.....	24

List of Tables

TABLE I. DISTRIBUTION OF VARIABLES ACCORDING TO TIME FRAME AND SHELL STRUCTURE	14
TABLE II. DRIVER MODEL AND RULES FOR IMPLEMENTATION.....	17
TABLE III. QUASI-STATIC FRAMES.....	20
TABLE IV. DYNAMIC FRAMES	22

List of Abbreviations

C	Complacency
COCOM/ECOM	COntextual COntrol Model/Extended COntrol Model
DIL	Driver Impairment Level
DVE	Driver-Vehicle-Environment
E-DVE	Electronic/Embedded Driver-Vehicle-Environment
FG	Frequency Gambling
FMEA	Failure Mode and Effect Analysis
G-DVE	GENERIC/GLOBAL Driver-Vehicle-Environment
PIPE	Perception, Interpretation, Planning and Execution
PL	Performance Limitations
RL	Risk Level
RT	Risk Taking
SA	Situation Awareness
SM	Similarity Matching
UCD	User Centred Design
VSMoC	Very Simple Model of Cognition

1 Executive Summary

This report describes the set of equations and correlations that may enable to represent in simple and fast running simulation the dynamic interactions between driver-vehicle-environment.

The basic correlations and variables that are utilised for the simple model of **Driver behaviour** are directly correlated to much more complex and accurate studies and experimental plans on behavioural adaptation and modelling paradigms selected for designing interfaces of integrated ADAS and IVIS systems.

The variables that characterise the models of the **Vehicle** and **Environment** are derived from studies and literature reviews and are representative of the models of vehicle and environment applied for designing integrated ADAS and IVIS systems.

This model is called E-DVE, for Electronic or Embedded Driver-Vehicle-Environment Model, and is proposed as linkage between the basic research activity carried out in Subproject 1 (“Behavioural effects and Driver-vehicle-environment modelling”) and the actual development of the AIDE system, carried out in Subproject 3 (“Design and development of an Adaptive Integrated Driver-vehicle Interface”).

In chapter 2 the Requirements for developing a DVE model are listed.

In Chapter 2.1 the Requirements for the Driver model according to the PIPE (Perception, Interpretation, Planning, Execution) model are presented. There is also a description of the requirements needed to model the Error Generation Mechanism.

In Chapter 2.2 the Requirements for the Environment model in terms of traffic conditions, road characteristic and weather conditions are briefly listed.

The third part of the Requirements description (Chapter 2.3) is dedicated to the Vehicle model. The car is taken into consideration in both its aspects of “moving object” and as the place where the interaction between Human and Machine occurs. For this reason the effects of ADAS and IVIS are considered.

Chapter 3.1 presents what is intended for behavioural adaptation in focusing on the two principal phases of long-term effects: *Learning* and *Appropriation* phase and *Integration* phase.

Chapter 3.2 presents the E-DVE model and simulation.

The model and the simulation aim to represent the interaction between Driver-Vehicle-Environment in a simple and fast running way, which retains the essential correlations between the fundamental independent variables and enables to predict driver behaviour in dynamic and rapidly changing conditions.

The model focuses on the way in which a process of interaction is influenced and can be simulated with respect to a single journey. The model intends to deal with dynamic and adaptive characteristics of a driver, driving environment and vehicle, and can in principle be continuously updated and

modified. In this Chapter the Requirements, briefly listed and explained in Chapter 2, are described in more detail.

In Annex 1 are presented:

- The Vehicle model parameters;
- The main vehicle signals that could have an influence on drivers' behaviour;
- An overview of Driving Simulators.

In Annex 2 the Environmental model parameters are described. The characteristics of the driving environment and the driver's scanning strategies are deeply explained.