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General Safety Regulation: Overview of the approach for Driver Drowsiness and Attention Warning (DDAW)

1 July 2020
MVWG

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Automotive and Mobility Industries Unit

Internal market, Industry, Entrepreneurship and SMEs

GSR (EU) 2019/2144 Definition

- *DDAW 'means a system that assesses the driver's alertness through vehicle systems analysis and warns the driver if needed'*

Revised approach (reminder)

- It became apparent that it is not possible to create a single test procedure that can be used to assess all DDAW systems. Because of this a different approach was chosen.

Solution

- Manufacturers will have to submit a comprehensive dossier which fully documents how their system works and how it was tested and validated to yield the predicted results
 - Both the documentation and testing must meet specific standards and thresholds, e.g.
 - when the system should alert the driver,
 - the system human machine interface (HMI)
 - specific requirements that ensure valid and robust validation testing carried out by the manufacturer and/or supplier

Outcomes of phase 2

- Areas regulated in Annex 3 of the technical draft:
 - System HMI
 - System performance
 - Drowsiness scale
 - Statistical analysis (additional graph in annex slides)
 - Validation testing (additional details in annex slides)
 - Data management (not presented – info in annex slides)

System HMI

General

- Visual and audio alerts activated when drowsiness threshold is reached
- Alerts are presented simultaneously

Visual warning

- Visible, recognisable day and night
- Steady or flashing (1-5 Hz, 50-70% duty cycle)
- No abbreviated text
- Symbols and contrast with ISO references
- List of forbidden colour combination

Audible warning

- Easy to recognise
- 200-8000 Hz, 50-90 dB
- Continuous or intermittent (1-8 Hz)
- If speech alert, shall be coherent with text (of the visual warning)
- Audio warning should last long enough to be understood by the driver

System performance

Deactivation

- **manual**: only warnings
- **auto**: list of situations to be provided (reactivate once situation ends)

Activation speed – 70 km/h
(deactivate at 65 km/h)

Time-to-Activation - Immediate

Re-activation – ignition, door open

Time of day - all

Scope M1, M2, M3, N1, N2, N3
Exemption Not ambulances, slow and local transit vehicles

Weather – all (EU weather)

Road type – at least multilane with/without central divide

Trigger behaviour – [list of known strategy] and [possibility for new ones with document package]

Self check & failure warning

PTI provisions

Drowsiness scale

Karolinska Sleepiness Scale: Drowsiness threshold [7]

Rating	Verbal descriptions	
1	Extremely alert	
2	Very alert	
3	Alert	
4	Fairly alert	
5	Neither alert nor sleepy	
6	Some signs of sleepiness	
7	Sleepy, but no effort to keep alert	DDAW alert required
8	Sleepy, some effort to keep alert	
9	Very sleepy, great effort to keep alert, fighting sleep	

- Self-reported by the test participant
- Participants are trained to use the scale (same training, to be documented)
- Updated every 5 min

Statistical analysis

Similar to UN literature review on metrics to evaluate A.I. performances
AC.1-133-05 Annex

Statistical tools

- Sample size: number of participants to reflect 95% of possibilities/variation
- True positive (TP): participants rate 7, DDAW gives alert
- True negative (TN): participants rate 5, DDAW silent
- False positive (FP): participants rate 6, DDAW gives alert
- False negative (FN): participants rate 8, DDAW silent
- Sensitivity: $TP/(TP+FN)$. Calculated for each participants
- Specificity: $TN/(TN+FP)$. Calculated for each participants

Optional

- Average sensitivity: sum of sensitivities divided by sample size
- Average specificity: sum of sensitivities divided by sample size
- Variance requirement: [TBD] to include the high majority (ex: 95%) of participants around the average value

Example graph with acceptance criterion in annex slide 15

Validation testing 1/2

Verification and testing

Test samples

- Human participants (no pro drivers or DDAW engineers)
- real world conditions with safety back-up
- **[10]** participants to estimate the sample size of participants needed to get 95% binomial proportion confidence interval

Conditions

- Day and night (ISO references for light)

Measure drowsiness

- KSS recommended, every 5 min

Acceptance criterion – **MVWG input needed**

- **Solution 1:** 95% of sample size above **[TBD]** sensitivity threshold and **[TBD]** specificity threshold
- **Solution 2:** average sensitivity above **[TBD]** and average specificity above **[TBD]** with a variance under a **[TBD]** requirement

Validation testing 2/2

Documentation package requirements

System functionality

- A list of all the system inputs and metrics (for technical service only). How they function and monitor driving behaviour
- Description of the trigger behaviour and relation to drowsiness.
- Activation, re-activation, deactivation and HMI explanations and compliance

System validation

- Number and demography of participants (gender and other criteria used)
- Tests conditions, weather, methodology and rationale behind it
- Statistical analysis technique used, analysis and description of results, Data of the statistical anomalies and proof of DDAW triggering a KSS [7] or before,

Assessment by the technical service

- Check that performance meet the requirements and Review test report
- Audit test report
 - By checking performance adequacy, ex: assessing # of outlier
 - By checking raw data, selection of test drives, performing parts of the validation drives

Actions to complete the text

MS and Stakeholder input required for:

Annex 3.6.7

- Choosing the **acceptance criterion** (solution 1 or 2)
 - **95% of the participants of the test runs (direct sampling)**
 - **Average results and variance requirement (statistical)**
- Set the acceptable **threshold** for **sensitivity** and **specificity**
- Comments on the draft text

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for

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Thank you for your attention

ANNEXES

- Scope and exemptions (slide 14)
- Statistical analysis graphic (slide 15)
- Detailed validation testing (slide 16-19)
- Data management (slide 20)

Scope & exemptions

- Scope
 - vehicles of Category M1, M2, M3, N1, N2 and N3.
 - The on-board system has to:
 - Assess the driver's alertness through vehicle systems analysis, and
 - Warn the driver if needed
- Exemptions
 - Special vehicles (type approval authority discretion)
 - Ambulances
 - Slow moving special-purpose vehicles (e.g. refuse/ recycling trucks)
 - Local transit vehicles that operate in environments that are not likely to meet the requirements

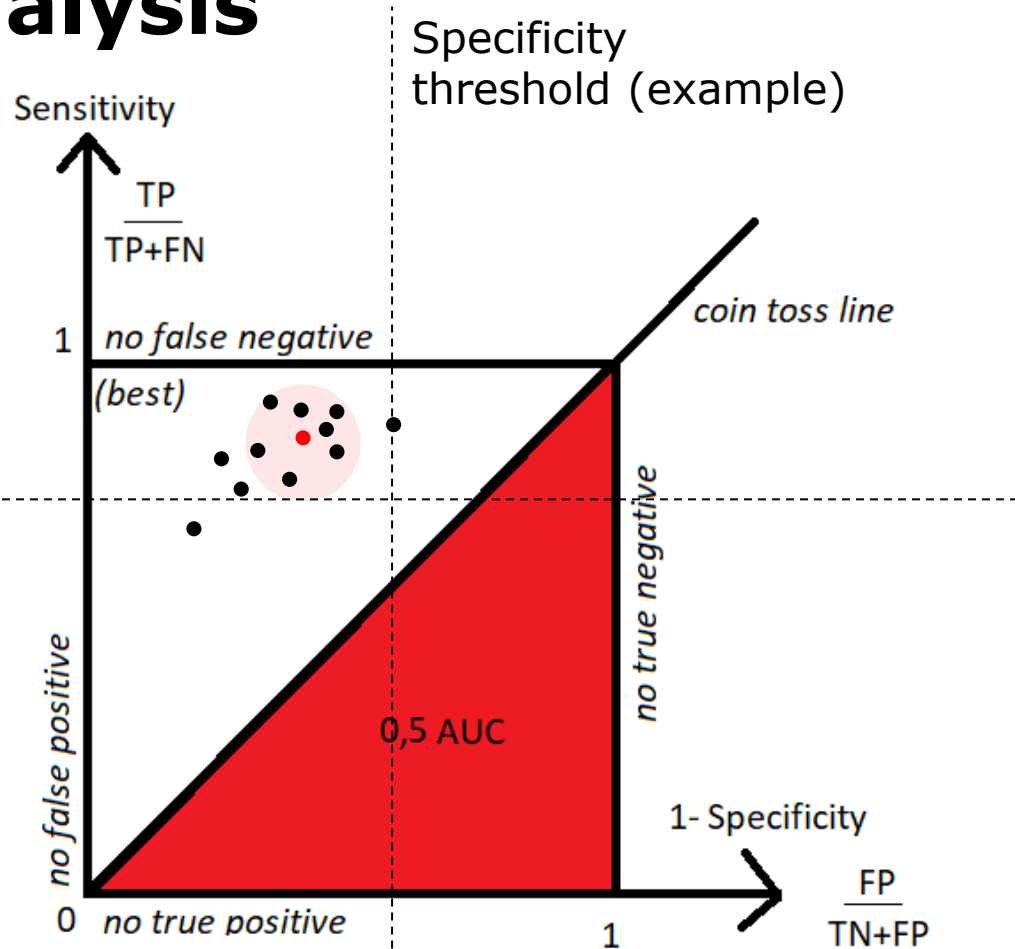
Statistical analysis

Receiver Operating Characteristic (ROC)

Sensitivity
threshold (example)

- Individual participant
- Average participant

 Variance req.



Validation testing 1/4

General validation requirement

- By OEM or supplier - robust, accurate and scientifically
- Dossier of evidence to be documented according to the requirements

Verification and testing

Test samples

- Human participants
- real world condition with safety back-up
- [10] participants to estimate the sample size of participants needed to get 95% binomial proportion confidence interval
- No affiliation to the DDAW system dev, gender split not worse than (65/35)
- Night shift worker and pro drivers are to be documented

Conditions

- Day and night (ISO references for light)

Measure drowsiness

- KSS recommended, every 5 min
- Edge cases
 - 6-8 record – the system can return 6-7-8
 - 6-8-6 record are considered **unreliable**
 - 6-7-6 record are **outlier** and must be documented (no false answer possible for the system)

Validation testing 2/4

Verification and testing measurements

- **alternative:** Direct measurement (ex: EEG/PERCLOS), KSS relation to be documented, can be continuous (5 min collection interval not applied)
- **complimentary:** Additional evidence to relate to KSS (sleep expert video analysis or driving behaviour data) and information on how the data was collated to assess the DDAW
- If KSS not used, equivalence to KSS required for alternative and complimentary measurements.

Test results

- **Discard:** if error, if unreliable, if insufficient data collection – to be documented

Acceptance criterion – **input needed**

- **Solution 1:** 95% of sample size above [TBD] sensitivity threshold and [TBD] specificity threshold
- **Solution 2:** average sensitivity above [TBD] and average specificity above [TBD] with a variance under a [TBD] requirement

Validation testing 3/4

Documentation package requirements

System functionality

- A list of all the system inputs stating the primary and secondary metrics (for technical service only), how they function and monitor driving behaviour
- Description of the trigger behaviour monitored by the system and its relation to drowsiness. System drowsiness threshold
- Activation, re-activation, deactivation explanations
- HMI functionality details – evidence of compliance to the requirements

System validation

- number, demography of participants (gender and other criteria used)
- Tests conditions, weather, methodology and rationale behind it
- Statistical analysis technique used (and equivalence to the one proposed if different)
- Analysis and description of results, proof that DDAW set of at 7 on KSS or before
- Data of the statistical anomalies

Validation testing 4/4

Assessment by the technical service

- Check that performance meet the requirements
- Review test report (if criteria are indeed respected)
- Audit test report
 - By checking performance adequacy, ex: assessing # of outlier
 - By checking raw data, selection of test drives, performing parts of the validation drives

Data management

- Close loop system – data collected for system performance only
- Data not accessible, or available to 3rd party. Only held long enough for assessing drowsiness and during activation/deactivation cycle
- Default operation functional without biometric information or facial recognition
- Personal data processing must be GDPR compliant
- Data collected by DDAW may only be used by the OEM for the purpose of monitoring the current state of the driver