TECHNICAL REPORT

ISO/TR 21974-1

First edition
2018-11

Naturalistic driving studies — Vocabulary —

Part 1: Safety critical events

Études naturalistiques de conduite — Vocabulaire —

Partie 1: Événements critiques de sécurité

Reference number
ISO/TR 21974-1:2018(E)

© ISO 2018



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
Annex A (informative) **Conceptual Framework for Categorizing Safety-critical events (SCEs) in Naturalistic Driving Data** **5**
Annex B (informative) **Principles of Conflict Classification** **11**
Annex C (informative) **Additional Conflict Attributes** **28**
Bibliography **52**

© ISO 2018 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 39, *Ergonomics*.

A list of all parts in the ISO 21974 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2018 – All rights reserved

Introduction

A better understanding of driver behaviour is critical to future improvements in transportation safety. Naturalistic Driving Studies (NDSs), which observe driver behaviour in a "natural" or uncontrolled driving environment, offer unique insight into drivers' typical behaviour under both "normal" driving conditions and during the critical seconds before a crash or other safety-critical event (SCE). Much of the value and power of NDSs lies in the video that is recorded of the driver and the environment surrounding the vehicle. Although rich in information, video should be manually reviewed and coded by trained data coders before it is scientifically analyzed. Given the potential for human error and interpretation, coding protocols that are well-designed, thoroughly tested, and standardized across studies are essential.

Naturalistic driving data sets, such as the Second Strategic Highway Research Program (SHRP 2), are becoming more available to a diverse group of researchers. As a result, it is important to have a common terminology for monitoring, coding, and analyzing data to allow research protocols to be replicated and results to be compared across studies. In fact, the research community has called for the development of fully tested, common coding protocols for use in NDSs. This document addresses that need by providing a standard vocabulary for coding SCE characteristics in NDSs. The foundation for this document came from the SHRP 2 naturalistic driving study annotation effort and subsequent revisions to the SHRP 2 dictionary to accommodate heavy vehicles (trucks and buses)[1]. Substantial improvements have been made to this document in both content and structure. However, large parts of this document are largely verbatim with the original foundational documents.

It is recommended that vehicles in these studies be instrumented with at least a forward-looking view and an in-vehicle view capturing the driver's face and upper body. Rear- and side-facing views are often helpful when interpreting conflicts that occur behind or next to the instrumented vehicle. A view capturing the steering wheel, driver's hands and/or dashboard can be helpful for additional analyses (which are outside the scope of this document). However, equipment and labor costs may make these additional views unfeasible. In addition, basic measurements of the kinematics of the instrumented vehicle should be available, including at least longitudinal acceleration, lateral acceleration, and vehicle speed. Other kinematic measurements that help assess conflict situations (if feasible) include brake and throttle pedal application and/or pressure, proximity to and speed of surrounding non-instrumented vehicles (e.g., via radar), latitude and longitude, and activation of key vehicle safety systems (e.g., anti-lock brakes).

The main objective of this document is to define different types of SCEs based on a taxonomy of general conflict classes and a set of basic variables for characterizing the events. The definitions supplied here apply to data collected from light and heavy vehicles [i.e., category M and N according to *Classification and definition of power-driven vehicles and trailers: Council Directive 70/156/EEC* (as amended by 92/53/EEC), *Annex 2*]. However, this does not preclude the definitions specified in this document from, with caution, being adapted for use with data collected from other vehicle types such as powered two-wheelers or an infrastructure-based (rather than vehicle-based) data collection system.

This document does not address methods for identifying candidate SCEs (also referred to as triggers), a complete set of annotations for these SCEs (e.g., driver distraction), or the recommended approach to analyzing this data. This document also does not address the definition, extraction, or annotation of controls. These controls, often called baselines in transportation literature, are selected for comparison to events of interest in epidemiological as well as other analyses. Since the definition, extraction, and annotation of these controls are highly dependent on the research question of interest, they have been excluded from the scope of this document. The scope of the present document is graphically illustrated in Figure 1.

© ISO 2018 – All rights reserved

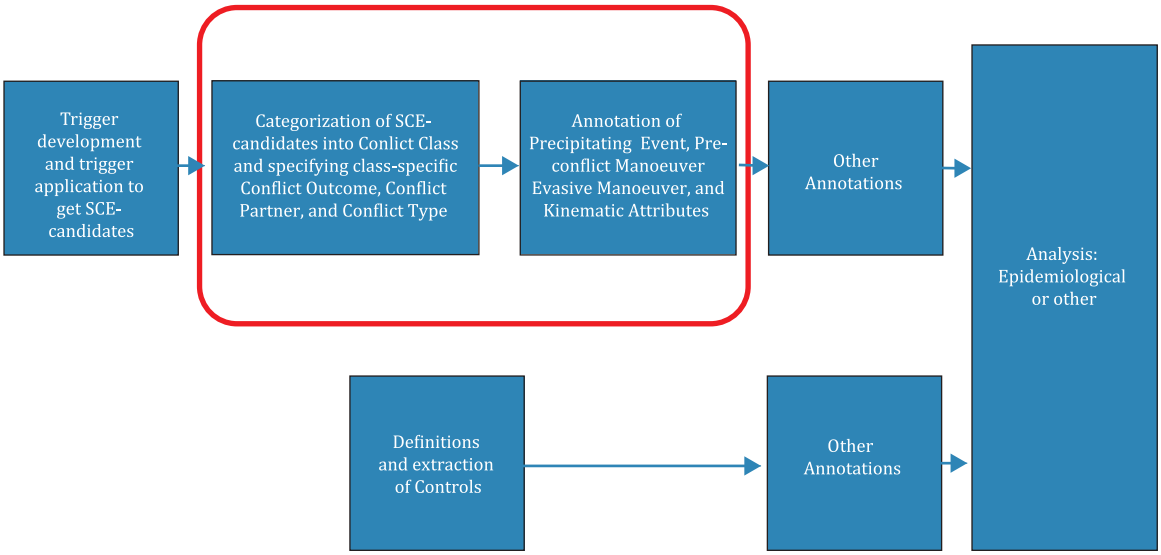

Figure 1 — Document scope

© ISO 2018 – All rights reserved

Naturalistic driving studies — Vocabulary —

Part 1:
Safety critical events

1 Scope

This document defines terms and definitions commonly used for the annotation of video from NDSs collected during real-world driving in an uncontrolled setting.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following URL addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
combined avoidance capacity
total response capacity of all responding *conflict partners* (3.3)

Note 1 to entry: The capacity of a responding conflict partner takes into account both the abilities and limitations of the vehicle or road user as well as any environmental or infrastructural constraints, if present.

Note 2 to entry: Conflict partners that do not exhibit an observable response are not included in this construct.

3.2
conflict
situation where the trajectory(ies) of one or more road users or objects (*conflict partner*; 3.3) led to one of three results: 1) a *crash* (3.4) or *road departure* (3.12), 2) a situation where an *evasive manoeuvre(s)* (3.5) was required to avoid a crash or road departure, or 3) an unsafe proximity between the conflict partners

Note 1 to entry: The key concept underlying the present framework is that of conflict.

Note 2 to entry: Three general classes of traffic conflict are of interest in naturalistic driving analyses: *trajectory conflict* (3.2.1), *single-vehicle conflict* (3.2.2), and *proximity conflict* (3.2.3).

3.2.1
trajectory conflict
crash course between at least two *conflict partners* (3.3)

3.2.2
single-vehicle conflict
conflict (3.2) involving loss of vehicle control (e.g., horizontal and/or lateral skidding or rotation) or proximity to the road edges (e.g., *road departure*; 3.12) rather than proximity to another entity

© ISO 2018 – All rights reserved

3.2.3
proximity conflict
conflict (3.2) involving two or more entities that are not on a crash course but nevertheless come in close temporal and/or spatial proximity to a *crash* (3.4)

3.3
conflict partner
any entity that is part of a *conflict* (3.2)

Note 1 to entry: This may include other *vehicles* (3.18), *pedestrians* (3.10), *pedal cyclists* (3.9), other *non-motorists* (3.8), other road users, animals, and objects (including roadside barriers that exceed the ground clearance of the affected vehicle).

Note 2 to entry: If a *conflict partner* (3.3) is present, then the conflict is either a *trajectory conflict* (3.2.1) or a *proximity conflict* (3.2.3).

Note 3 to entry: Low roadside barriers (e.g., curbs) within the ground clearance of the vehicle are not considered conflict partners.

3.4
crash
situation in which the subject vehicle (i.e., *instrumented vehicle*; 3.14) has any contact with at least one other *conflict partner* (3.3) either on or off the *trafficway* (3.15), either moving or stationary (fixed or non-fixed), that is observable or in which kinetic energy is measurably transferred or dissipated

Note 1 to entry: This excludes *roadway* (3.11) features meant to be driven over such as speed bumps and low roadside barriers (curbs, medians, etc.) within the ground clearance limitations of the vehicle.

Note 2 to entry: A crash may also be a *single-vehicle conflict* (3.2.2) that includes at least one of the following conditions: vehicle rollover, airbag deployment, injury, more than 90° degrees of horizontal vehicle rotation, or all four tires leaving the trafficway.

3.5
evasive manoeuvre
any action performed by any *conflict partner* (3.3) to change its trajectory or speed in an attempt to avoid or reduce the severity of a *potential crash* (3.4), avoid or reduce the severity of a *road departure* (3.12), or regain vehicular control after a loss of control

Note 1 to entry: Examples include steering, braking, accelerating, running, stopping, or a combination of these.

Note 2 to entry: At least one of the manoeuvres exceeds normal vehicle control inputs.

3.6
metadata
information that provides a description about the structural content of its referenced dataset or the methods with which the data were collected

Note 1 to entry: Examples of metadata include location (e.g., country, region) of data collection, sampling methods, units of measure, etc.

3.7
naturalistic driving study
NDS
any driving study where research subjects are recruited to drive on public roads (not in a simulator or on a test track), where there is no in-vehicle experimenter or confederate vehicles, and where driving conditions are not experimentally controlled or manipulated

Note 1 to entry: Subjects are not instructed to drive differently than they normally would, and the data collection instrumentation is unobtrusive.

Note 2 to entry: Typically, these studies last a minimum of several weeks for each subject and can go much longer.

© ISO 2018 – All rights reserved

3.8
non-motorist
non-motorized conveyance
person is being transported by a non-motorized conveyance, other than a *pedaled cycle* (3.9)/a human-powered device by which a non-motorist may move or may move another non-motorist

EXAMPLE Baby carriages, coasters, wagons, ice skates, roller skates, push carts, push scooters, skateboards, skis, sleds, non-motorized wheel chairs, rickshaws, etc.

3.9
pedal cyclist
person on any type of manually propelled pedaled cycle, as either the driver or the passenger, including bicycles, tricycles, and unicycles

Note 1 to entry: This category includes pedal cyclists holding on to a motorized vehicle.

Note 2 to entry: This category also includes power-assisted pedaled cycles that have limitations on speed (i.e., pedelecs). Pedaled cycles that are capable of propelling themselves and do not require pedaling for propulsion are not included in this category (see "Motorcycle or moped").

3.10
pedestrian
any person who is on or near a *roadway* (3.11) or a sidewalk, path, or other space that is contiguous with a roadway, or on areas beside the roadway into which a vehicle can travel, and who is not in or on either a motorized or a non-motorized conveyance

Note 1 to entry: This includes persons who are in contact with the ground, roadway, etc., but who are holding on to a vehicle.

3.11
roadway
portion of a *trafficway* (3.15) that is designed and ordinarily used for vehicular travel, including all designated or implied travel lanes (through lanes, turn lanes, acceleration and deceleration lanes), but not shoulders, painted (whether usable or not), medians of any type, roadsides, gore areas, etc., that are of a similar road surface to the parking lanes, parking areas, or driveways

3.12
road departure
conflict (3.2) in which the *subject vehicle* (3.14) is on a path toward and crosses, or is at risk of crossing, the road edge

Note 1 to entry: The road edge is the outside edge of the shoulder (if present) or a physical raised curb or median on the left or right side of the trafficway, including low barriers such as curbs and curb-style medians that are within the ground clearance of the vehicle.

3.13
safety-critical event
SCE
conflict (3.2) or series of related conflicts that involves the *subject vehicle* (3.14) either alone or in combination with another *vehicle* (3.18), *pedal cyclist* (3.9), *pedestrian* (3.10), object, or road edge

Note 1 to entry: This document describes the range of conflict types that may comprise an SCE, and an SCE may be composed of a single conflict type or multiple simultaneous or sequential conflict types. Conflicts should be non-intentional and non-premeditated (unplanned) by at least one *conflict partner* (3.3).

3.14
subject vehicle
vehicle (3.18) that has been instrumented and collects data

Note 1 to entry: Available videos will capture images from the subject vehicle's perspective.

© ISO 2018 – All rights reserved

Note 2 to entry: Kinematic data are typically available only from the subject vehicle or (in the case of radar data) the subject vehicle's perspective.

3.15
trafficway
any right-of-way designated for moving persons or property from one place to another, including the surface on which vehicles normally travel (i.e., the *roadway*; 3.11), plus the shoulders, painted medians, and painted gore areas at grade with the roadway

Note 1 to entry: The trafficway also includes parking lanes and parking areas (e.g., parking lots, driveways).

Note 2 to entry: The trafficway is bound by the outer edges of the shoulder or by raised roadside barriers (e.g., curb, guardrail, pylon) and thus does not include raised medians, grassy medians, sidewalks, etc.

3.16
trigger
data analysis method that includes the application of algorithms (e.g., acceleration thresholds) for searching time series driving data for key situational characteristics or thresholds in order to identify potential events of interest (e.g., kinematic threshold for potential *SCEs*; 3.13)

3.17
urgent response
urgency of response
situation in which the required *evasive manoeuvre* (3.5) approaches the *combined avoidance capacity* (3.1) of the responding *conflict partners* (3.3) required to prevent a crash

Note 1 to entry: Both the time available for response and the required response magnitude (e.g., level of deceleration) should be considered.

Note 2 to entry: While it may be possible to quantify the required urgency of the evasive manoeuvre (see Annex A for more discussion), the methods for doing so are not within the scope of this document. Quantification of the urgency is not required in order to use the concept as described in this document.

Note 3 to entry: The urgency of the response is independent of any evasive manoeuvres that are actually performed.

3.18
vehicle
any motorized means of transportation, excluding pedelecs, which are included in the *pedal cyclist* definition (3.9)

© ISO 2018 – All rights reserved