
**Ergonomics of human-system
interaction —**

Part 940:
**Evaluation of tactile and haptic
interactions**

Ergonomie de l'interaction homme-système —

Partie 940: Évaluation des interactions tactiles et haptiques



This document is a preview generated by EMS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, 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
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Conformance	4
5 How to use ISO 9241-940	4
5.1 Structure.....	4
5.2 Uses of this document.....	5
5.3 Evaluation in the design and development lifecycle.....	5
5.4 Planning activities.....	6
5.5 Initial assessment.....	6
5.6 Unique aspects of haptic interaction.....	7
6 Types of evaluation methods	8
6.1 General.....	8
6.2 Physical measurements against requirements.....	8
6.3 Inspection by an expert.....	8
6.4 Usability test.....	8
6.4.1 General.....	8
6.4.2 Measurement context.....	8
6.4.3 Evaluation data.....	9
7 Quality of haptic interaction	10
7.1 Quality model.....	10
7.2 Haptic system attributes.....	11
7.2.1 Quality attributes.....	11
7.2.2 Haptic device attributes (see Annex A).....	11
7.2.3 Haptic user interface attributes.....	12
7.3 Usability attributes.....	12
7.3.1 Context of use (see Annex D).....	12
7.3.2 Specific usage qualities (see Annex E).....	13
7.3.3 Human-centred quality (see Annex F).....	14
7.4 Evaluation matrix.....	14
7.4.1 Types of attributes.....	14
7.4.2 Measures of haptic quality.....	14
8 Guide to the annexes	17
Annex A (informative) Haptic device attributes	19
Annex B (informative) Haptic effect design principles	27
Annex C (informative) Haptic effect task elements	32
Annex D (informative) Context of use	37
Annex E (informative) Specific usage qualities	39
Annex F (informative) Human-centred quality	46
Annex G (informative) Gesture attributes	55
Annex H (informative) Examples of evaluation of device attributes	65
Annex I (informative) Unique aspects of haptic interaction	77
Annex J (normative) Evaluation by usability walkthrough or usability task test	79
Bibliography	100

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 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

A list of all parts in the ISO 9241 series can be found on the ISO website.

Introduction

Tactile and haptic interactions are becoming increasingly important as interaction modalities in special purpose computing environments and assistive technologies. This document explains how to evaluate attributes of the haptic device and the user interface, and the outcomes of interaction with a haptic device, along with an assessment of human-centred quality and other and more specific usage qualities.

This document can be used to identify the measures to be used when establishing requirements for haptic interaction, and to evaluate haptic interactions to identify problems, to establish benchmarks or to evaluate whether a haptic system meets requirements.

A haptic interaction involves sensory or motor activity in the skin, muscles, joints and tendons; a tactile interaction refers specifically to touch (sensory activity in the skin).

In a haptic interaction, a user typically employs a device to manipulate objects in the virtual world of the computer and also to feel the result of the manipulation through sensors in the skin and joints. This is the bidirectional sense of haptics. Haptics is important in the design of switches in traditional keyboards and mice, but here, we consider computer interaction by means other than keyboard, mouse and passive joysticks.

Haptic interactions can also work in a passive unidirectional sense, conveying information to the skin without active motion or exploration on the part of the user. A cell phone on vibration mode is one such unidirectional tactile device. They can also work in an active unidirectional sense, as the user makes gestures that send commands or data to a device.

Tactile and kinaesthetic haptic interactions are being developed in university and industrial laboratories in many countries, and a variety of commercial products exist that incorporate tactile and kinaesthetic interactions. Both the developer and the prospective purchaser of such interactions and their associated devices and software need a means of making comparisons between competing choices.

Other International Standards are cross-referenced in order to understand and point out the specific differences in evaluating haptic interactions. The nature of these interactions, whether bidirectional, unidirectional from the device to the skin or body of the user, or unidirectional as gestures from the body of the user to the device, sets them apart as a group of interactions that needs special consideration in relation to the forms of evaluation which are appropriate.

ISO 9241-910 provides a common set of terms, definitions, and descriptions of the various concepts involved in designing and using haptic interactions. It provides an overview of the range of haptic applications, objects, attributes, and interactions.

ISO 9241-920 provides basic guidance in the design of haptic interactions.

ISO 9241-960 provides guidance for the definition of gestures in human-machine interactions. It explains how to describe their features and what factors to take into account when defining gestures.

This document provides evaluation processes specific to haptic interactions and the devices that enable them. It shows how requirements set out in ISO 9241-910, ISO 9241-920 and other International Standards can be applied to actual haptic systems and specific interactions. In a parallel way, it shows how the usability of a haptic system can be evaluated, taking into account quality attributes such as effectiveness, efficiency, user satisfaction and avoidance of harm from use.

Ergonomics of human-system interaction —

Part 940: Evaluation of tactile and haptic interactions

1 Scope

This document

- describes the types of methods that can be used for the evaluation of haptic devices and of systems that include haptic devices,
- specifies a procedure for the evaluation of haptic interactions by a usability walkthrough or usability test (see [Annex J](#)), and
- provides guidance on the types of methods that are appropriate for the evaluation of specific attributes of haptic systems, cross-referenced to the guidance in the relevant clauses of other International Standards (see [Annexes A, B, C, D, E, F and G](#)).

It applies to the following types of interaction:

- augmented reality — information overlaid on a real scene, e.g. vibrating belt indicating distance;
- gesture control of a device or a virtual scenario;
- unidirectional interaction such as a vibrating phone or a vibrating belt;
- virtual environment — virtual space with which a user can interact with the aid of a haptic device.

This document applies to the following types of devices:

- gesture sensor, e.g. video that discerns 3D hand movements, touch screens that sense 2D touches;
- kinaesthetic haptic device, e.g. desktop haptic interface;
- tactile display, e.g. vibrating phone.

This document is not applicable to standard input devices such as keyboards, mice or track balls.

NOTE ISO 9241-400 covers standard input devices, and ISO 9241-411 applies to the evaluation of input devices such as keyboards and mice.

This document can be used to identify the types of methods and measures for

- establishing benchmarks,
- establishing requirements for haptic interaction,
- identifying problems with haptic interaction (formative evaluation), and
- use of the criteria to establish whether a haptic system meets requirements (summative evaluation).

2 Normative references

There are no normative references in this document.