INTERNATIONAL STANDARD

ISO/IEC 29159-1

First edition
2010-09-01

Information technology — Biometric calibration, augmentation and fusion data —

Part 1: Fusion information format

Technologies de l'information — Étalonnage biométrique, données d'augmentation et de fusion —

Partie 1: Format d'information de fusion

Reference number
ISO/IEC 29159-1:2010(E)

© ISO/IEC 2010

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2010

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

 © ISO/IEC 2010 – All rights reserved

Contents

Page

Foreword v
Introduction vi
1 Scope 1
2 Conformance 1
3 Normative references 1
4 Terms and definitions 1
5 Symbols and abbreviated terms 2
6 Fusion information format (FIF) 3
6.1 Overview 3
6.2 Byte ordering 4
6.3 Numeric values 4
6.4 Fusion header block 4
7 Common elements 8
7.1 General 8
7.2 Parameter kind 8
7.3 Parameter origin 9
7.4 Distributions present 9
7.5 Number of comparisons 9
7.6 Pre-normalization flag 9
8 Type 1 record 10
8.1 Purpose 10
8.2 Format 10
8.3 Use case (Informative) 11
9 Type 2 record 12
9.1 Purpose 12
9.2 Format 12
9.3 Use case (Informative) 13
10 Type 3 record 13
10.1 Purpose 13
10.2 Format 14
Annex A (informative) **Document Overview** 16
Annex B (informative) **Example Cumulative Distribution Functions** 18
Annex C (informative) **Use of pre-normalized data** 20
Annex D (informative) **Source for evaluation of spline** 22
Bibliography 23

Figures

Figure 1 — Schematic representation of fusion information format usage vii
Figure B.1 — Example CDFs and their spline representations 19
Figure C.1 — Example CDFs of internal comparison scores and pre-normalized scores 20

© ISO/IEC 2010 – All rights reserved

Tables

Table 1 — Fusion information format record structure **3**
Table 2 — Fusion header block structure **3**
Table 3 — Type 1 record structure **3**
Table 4 — Type 2 record structure **4**
Table 5 — Type 3 record structure **4**
Table 6 — Textual representation of numerical value **4**
Table 7 — The fusion header block **5**
Table 8 — CBEFF Product Identifiers **6**
Table 9 — Database identifiers **6**
Table 10 — Database quality values **7**
Table 11 — Score sense codes **8**
Table 12 — Identifiers for statistical quantities **8**
Table 13 — Origins of statistical data **9**
Table 14 — Distribution information present **9**
Table 15 — Pre-normalization codes **10**
Table 16 — Subtype A format **10**
Table 17 — Type 1 record format **10**
Table 18 — Subtype B format **12**
Table 19 — Type 2 record format **12**
Table 20 — Subtype C format **14**
Table 21 — Type 3 record format **14**
Table A.1 — Fusion information format type taxonomy **16**

© ISO/IEC 2010 – 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO/IEC 29159-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

ISO/IEC 29159 consists of the following parts, under the general title *Information technology — Biometric calibration, augmentation and fusion data*:

— *Fusion information format*

© ISO/IEC 2010 – All rights reserved

Introduction

Biometric systems embed disparate technologies and comparison algorithms. Although some of these have been published, most are entirely proprietary. Most current verification or identification applications employ a single biometric modality. That is, information is acquired from a body part or an exhibited behavior with the intent of more or less uniquely identifying the individual. For example, an access control system can image the hand and use geometrical features. A social benefits program can collect fingerprints from applicants as input to a one-to-many duplicate search. Different biometric modes offer varying amounts of discriminative information and have different acquisition related problems. The effect is that biometric systems are to some extent fallible and, moreover, they exhibit different failure modes. This affords opportunities to combine technologies or algorithms to improve performance and/or usability. Such combination is known as fusion. Fusion can be multi-modal (e.g. observing the biometric characteristics, face and finger), multi-algorithmic (e.g. face recognition algorithms A and B), multi-instance (e.g. index finger and thumb), multi-sensorial (e.g. optical and ultrasound fingerprint sensor) or multi-presentation (e.g. three images of a user's face).

This part of ISO/IEC 29159 addresses the most common and most readily implemented method of fusion: score-level fusion. This is implemented after two or more systems have processed and matched an individual's biometric information to one or more enrolled samples and produced scalar comparison scores as output. The scores can be either genuine (same-person) or impostor (different-person) scores and a fusion scheme is designed to combine such scores so that the class boundary between genuine and impostor scores is refined.

Distributions of comparison scores are unique to each biometric comparison subsystem. Score ranges and the shapes of the distributions can differ greatly. Fusion is often implemented in two ways.

— In classification-based processes, the available comparison scores are combined directly to produce an output decision or score.

— In normalization-based processes, fusion is preceded by a transformation of each score to a common domain. Simple normalization techniques based on statistical parameters such as the mean and standard deviation are sometimes effective, but more sophisticated techniques utilize detailed knowledge of the entire score distribution. The fusion information format (FIF) defined in this part of ISO/IEC 29159 is intended to flexibly support any of the popular transformations. By establishing a standardized means of data exchange, this part of ISO/IEC 29159 supports a modular approach to biometric systems integration in which both the comparison and fusion algorithms remain protected as black-box pieces of intellectual property. Thus this part of ISO/IEC 29159 envisages an application in which two (or more) underlying acquisition and comparison technologies (hand geometry and fingerprint, for example) each generate a score which is fed to a fusion module which has been initialized with an appropriate instance of the FIF defined herein.

Figure 1 depicts the logical role of the records in a (notional) multimodal fusion process.

This part of ISO/IEC 29159 defines containers for the distributional score information from a comparison subsystem. It does not allow for joint distributional data that can fully capture the statistical properties of multivariate scores (i.e. those from two or more vendors' subsystems or modalities). This means that multimodal fusion is not supported by a description of the joint distributions of the biometric scores. This is often a minor limitation because different modalities are often assumed to be independent. Even when the scores are not independent, as is the case for multi-algorithm applications, score-level fusion techniques often remain effective, even if they are not optimal.

This part of ISO/IEC 29159 is intended to support interoperability and data interchange among biometrics applications and systems. As such it specifies requirements that solve the complexities of applying biometrics to a wide variety of personal recognition applications, whether such applications operate in an open systems environment or consist of a single, closed system. Open systems are built on standards based, publicly defined data formats, interfaces, and protocols to facilitate data interchange and interoperability with other

 © ISO/IEC 2010 – All rights reserved

systems, which can include components of different design or manufacture. A closed system can also be built on publicly defined standards, and can include components of different design or manufacture, but inherently has no requirement for data interchange and interoperability with any other system.

Biometric data interchange format standards and biometric interface standards are both necessary to achieve full data interchange and interoperability for biometric recognition in an open systems environment. The biometric International Standards developed within JTC 1/SC 37 form a layered set of International Standards consisting of biometric data interchange formats and biometric interfaces, as well as application profiles that describe the use of these International Standards in specific application areas.

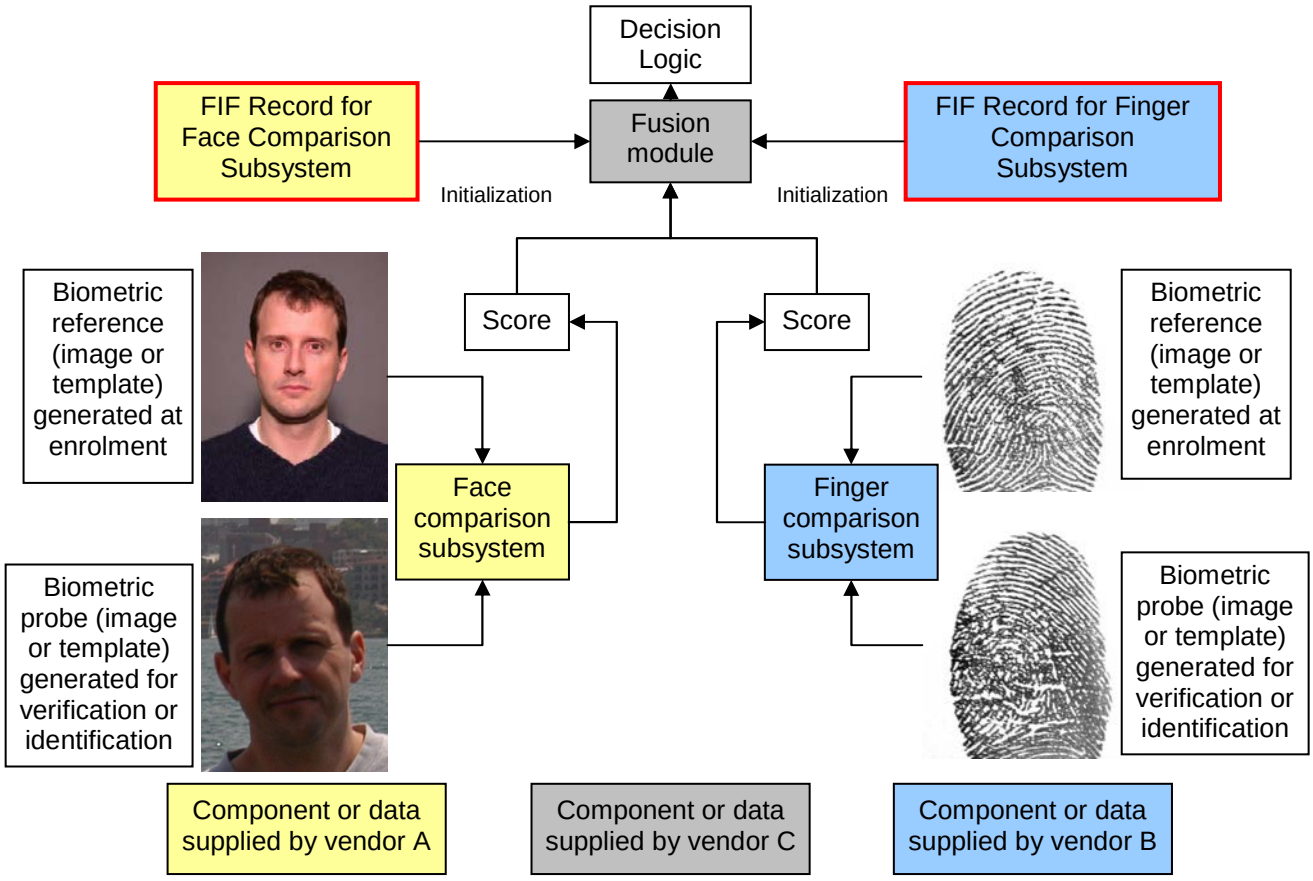


Figure 1 — Schematic representation of fusion information format usage

© ISO/IEC 2010 – All rights reserved

Information technology — Biometric calibration, augmentation and fusion data —

Part 1:
Fusion information format

1 Scope

This part of ISO/IEC 29159 specifies a biometric fusion information format that establishes machine readable data formats to describe the statistics of comparison score inputs to a fusion process.

This part of ISO/IEC 29159 does not

— standardize comparison-score normalization processes, nor

— standardize or define fusion processes.

2 Conformance

Records are conformant to this part of ISO/IEC 29159 if they conform to all normative requirements of Clause 6. This requires conformance to either Clause 8, 9, or 10, each of which requires conformance to the stated subclauses of Clause 7.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEEE 754-2008, *IEEE Standard for Floating-Point Arithmetic*

ISO/IEC 19785-1:2006, *Information technology — Common Biometric Exchange Formats Framework — Part 1: Data element specification*

ISO/IEC 19794-1:2006, *Information technology — Biometric data interchange formats — Part 1: Framework*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19794-1 and the following apply.

4.1
biometric sample
analog or digital representation of biometric characteristics prior to biometric feature extraction

NOTE A biometric capture device is a biometric capture subsystem with a single component.

© ISO/IEC 2010 – All rights reserved