International Standard

ISO/IEC 5152

First edition
2024-07

Information technology — Biometric performance estimation methodologies using statistical models

Technologies de l'information — Méthodologies d'estimation des performances biométriques à l'aide de modèles statistiques

Reference number
ISO/IEC 5152:2024(en)

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Published in Switzerland

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Foreword

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

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Introduction

This document provides a methodology for measuring the accuracy of biometric verification systems based on the statistics categorized as the extreme value theory.[1] The methodology is particularly useful when estimating the false match rate with a relatively small sample set. The methodology is an alternative to empirical accuracy measurement.

In order to measure the false match rate of biometric verification systems, evaluators need to prepare a dataset with a sufficiently large number of non-mated attempts in order to observe a sufficient number of false match cases for a reliable estimation of the false match rate. For highly accurate systems the quantity of attempts required to test the false match rate is likely to be extremely large. As performance of biometric verification systems improves dramatically, acquiring representative data of non-mated attempts in sufficient quantity becomes increasingly difficult in terms of the time, cost and practicality of creating datasets. Policy considerations that apply to biometric data collection and use can pose further constraints.

If no false match case is found within the evaluation samples, metrics based on statistics known as “the rule of three” (as is defined in ISO/IEC 19795-1) are widely used in the biometric industry. However, the rule of 3 is only applicable when no false match case is observed within the tested sample set and do not give any indication of the accuracy and confidence levels expected if more than zero false matches were tested. Only if at least 30 false matches were observed, the “rule of thirty” applies, i.e. the true error rate is with 90 % confidence within ± 30 % of the observed error rate.

In this document, two major statistical methods are introduced to estimate the false match rate with a relatively small number of samples. Both methods are widely used in a variety of industries including civil engineering, meteorology, hydrology and financial engineering. Both methods are proven to be highly reliable techniques to estimate the probability of the occurrence of rare, extreme events such as maximum wind velocity or tsunami heights. These statistical methods are applied to similarly rare events of false match cases in biometrics and used to estimate the probability of occurrence of such cases if a larger non-mated sample set is not available. The estimated false match rate is available in the form of cumulative distribution function (CDF) and its interval of confidence.

This document defines procedures for extrapolating performance metrics in technology evaluations. These procedures can also be applied in scenario evaluations and operational evaluations if comparison scores are obtained. This document defines the methodology to be used by evaluators to reliably estimate the false match rate in case of a limited number of false match cases or even no false match case at all. This document does not address certification or conformance.

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Information technology — Biometric performance estimation methodologies using statistical models

1 Scope

This document provides statistical methodologies to estimate false match rates (FMRs) from small biometric sample sets.

This document intends to:

— lay out a methodology for biometric performance estimation based on extrapolation using extreme value statistical models;

— provide statistical methodologies to estimate FMRs of biometric verification systems;

— be applicable to systems that include algorithms that produce likelihood dissimilarity or similarity scores;

NOTE Throughout the document, if not otherwise specified, scores refer to similarity scores.

— specify the methodology for data recording and result reporting;

— introduce metrics for the estimated biometric performance.

The following are not within the scope of this document.

— Estimation of false positive identification rates for one-to-many implementations.

— Estimation of false accept rates for verification transactions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO/IEC 19795-1:2021, *Information technology — Biometric performance testing and reporting — Part 1: Principles and framework*

ISO/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37 and the following apply.

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

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

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

3.1
extrapolated false match rate
extrapolated FMR
false match rate (FMR) that is estimated by using any statistical models such as those used in extreme value theory

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