International Standard

ISO/IEC 24956

Information technology — 3D printing and scanning — Phantom-based evaluation methods for 3D printing modeling software

First edition
2026-09

Reference number
ISO/IEC 24956:2026(en)

Contents

Page

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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 or www.iec.ch/members_experts/refdocs).

ISO and IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and https://patents.iec.ch. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of 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 www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

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

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 and www.iec.ch/national-committees.

Introduction

This document was developed in response to the needs of quality management of 3D printing and scanning technology by taking full advantage of information and communication technology (ICT).

3D scanning is the process of scanning a real-world object or environment to collect data on its shape and possibly its style attributes. The main purpose of 3D scanning is for generating high-precision digital 3D models by non-destructive, 3D scanning of internal and external geometries.

A 3D scanner can be based on many different technologies, each with its own purposes and targets, limitations, and advantages. There can be many limitations in each type of target object that will be digitized. For example, optical technology can encounter many difficulties with dark, shiny, reflective, or transparent objects. Another example is the use of computed tomography (CT) scanning, structured-light 3D scanners, and LiDAR technology, which highlights the need for non-destructive internal scanning methods to generate digital 3D models.

Despite the rapid growth of 3D scanning applications, the accuracy, precision, and reproducibility of 3D models generated from 3D scanned data have not been thoroughly investigated. When scanned data are used for 3D printing, their accuracy and precision are critical. Inaccuracies may arise during imaging, segmentation, postprocessing, and printing. The overall accuracy, precision, and reproducibility of 3D printed models are influenced by the cumulative errors introduced at each step in the model creation process.

For the continued expansion of 3D printing applications, it is necessary to review and evaluate the various factors in each step of the 3D model printing process that contribute to 3D model inaccuracy, including the intrinsic limitations of each printing technology.

— In this context evaluation of the overall process of data processing is critical.

— For minimization of cumulative errors of 3D printing life cycles using 3D scanned data, the initial error should be assessed and corrected.

— The assessment methods of 3D scanned data for 3D printing are essential.

Establishing a reliable and practical evaluation method for 3D modelling software is crucial for ensuring the quality and dependability of 3D models used in 3D printing. Standard CT performance evaluation phantoms and existing phantoms make evaluating the performance of 3D printing modelling challenging. A dependable and practical approach to evaluating the performance of 3D modelling software for 3D printing is essential and would benefit a wide range of stakeholders, including developers of 3D modelling software, manufacturers, and researchers. A phantom-based evaluation method can provide a reliable and practical way to evaluate the performance of 3D modelling software in the context of 3D printing. This would serve as a valuable tool for assessing the quality and dependability of 3D modelling software, which is crucial for ensuring the precision and safety of 3D printing applications.

This document proposes evaluation methods for 3D modelling software that use CT phantoms to assess quality enhancement and error minimization in 3D printed model.

Information technology — 3D printing and scanning — Phantom-based evaluation methods for 3D printing modeling software

1 Scope

This document defines an evaluation procedure and evaluation methods for assessing the accuracy and precision of 3D modelling software for designing 3D printing models using phantoms.

This document is not intended to evaluate the 3D-printed product itself.

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/ASTM 52920, *Additive manufacturing — Qualification principles — Requirements for industrial additive manufacturing processes and production sites*

Bibliography

[1] ISO/IEC JTC 1-N13604, *Study Group Report on 3D Printing and Scanning*

[2] ISO 9000:2026, *Quality management systems — Fundamentals and vocabulary*

[3] ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results - Part 1: General principles and definitions*

[4] ISO/IEC 23510:2021, *Information technology — 3D printing and scanning — Framework for an Additive Manufacturing Service Platform (AMSP)*

[5] ISO/IEC 3532-1:2023, *Information technology — Medical image-based modelling for 3D printing — Part 1: General requirements*

[6] ISO/IEC 3532-2, *Information technology — Medical image-based modelling for 3D printing — Part 2: Segmentation*

[7] ISO/IEC 8803, *Information technology — 3D Printing and scanning — Accuracy and precision evaluation process for modelling from 3D scanned data*

[8] ISO/IEC 16466, *Information technology — 3D printing and scanning — Assessment methods of 3D scanned data use in 3D printing*

[9] ISO/IEC 25040:2024, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Quality evaluation framework*

[10] ISO 12749-2:2022, *Nuclear energy, nuclear technologies, and radiological protection — Vocabulary — Part 2: Radiological protection*

[11] ISO 29661:2012, *Reference radiation fields for radiation protection — Definitions and fundamental concepts*

[12] ISO 13322-1, *Particle size analysis — Image analysis methods — Part 1: Static image analysis methods*

[13] ISO 19136-1:2020, *Geographic information — Geography Markup Language (GML) — Part 1: Fundamentals*

[14] IEEE 610.12-1990, *IEEE Standard Glossary of Software Engineering Terminology — Description*

[15] Metrics for evaluating 3D medical image segmentation: analysis, selection, and tool. BMC Medical Imaging (2015) 15:29

[16] Powers DMW. Evaluation: From precision, recall and F-factor to ROC, informedness, markedness correlation. J Mach Learn Technol. 2011;2:37–63.

[17] A coefficient of agreement for nominal scales. Educ Psychol Meas. 1960;20:37–46.

[18] N-D linear time exact signed Euclidean distance transform. The Insight Journal. 2006. http://hdl.handle.net/1926/171.

[19] On the usage of average Hausdorff distance for segmentation performance assessment: hidden error when used for ranking. European Radiology Experimental (2021) 5:4

[20] A formal method for selecting evaluation metrics for image segmentation. DOI:10.1109/ICIP.2014.7025187

[21] Generalized overlap measures for evaluation and validation in medical image analysis. IEEE transactions on medical imaging (2006) 25:1451-1461

[22] A function for quality evaluation of retinal vessel segmentations. IEEE transactions on medical imaging (2011) 31:231-239

[23] ISO 17296-4, *Additive manufacturing — General principles — Part 4: Overview of data processing*

[24] ASTM E2339-21, *Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE)*

[25] Jumyung Um & Matthieu Rauch, Jean-Yves Hascoët, Ian Stroud Int STEP-NC compliant process planning of additive manufacturing: remanufacturing *J Adv Manuf Technol (2017) 88:1215–1230*

[26] https://www.laserdesign.com/ct-scanning

[27] https://www.qualitymag.com/articles/96088-computed-tomography-for-nondestructive-testing

[28] https://www.zeiss.com/metrology/products/systems/computed-tomography/metrotom.html