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Specifikacija formatov datotek za 3D tisk (AMF), različica 1.2 (ISO/ASTM FDIS 52915:2019)

Specification for additive manufacturing file format (AMF) Version 1.2 (ISO/ASTM FDIS 52915:2019)

Spezifikation für ein Dateiformat für Additive Fertigung (AMF) Version 1.2 (ISO/ASTM FDIS 52915:2019)

Spécification normalisée pour le format de fichier pour la fabrication additive (AMF) Version 1.2 (ISO/ASTM FDIS 52915:2019)

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Specification for additive manufacturing file format (AMF) Version 1.2

Spécification normalisée pour le format de fichier pour la fabrication additive (AMF) Version 1.2

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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).

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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.

This document was prepared by Technical Committee ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM F 42.91, *Terminology*, on the basis of a partnership agreement between ISO and ASTM International with the aim to create a common set of ISO/ASTM standards on Additive Manufacturing.

This second edition cancels and replaces the first edition (ISO/ASTM 52915:2016), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Harmonization of the terminology definition shared with ISO/ASTM 52900 in 3.8;

— Corrections to Figures 1 to 6 in 7.1, 8.1.2, 9.1.1, 11.4 and 12;

— Corrections of typographic issues in Table A.1 and Table A.4.

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.

Introduction

This document describes an interchange format to address the current and future needs of additive manufacturing technology. For the last three decades, the stereolithography (STL) file format has been the industry standard for transferring information between design programs and additive manufacturing equipment. An STL file defines only a surface mesh and has no provisions for representing colour, texture, material, substructure and other properties of the fabricated object. As additive manufacturing technology is evolving quickly from producing primarily single-material, homogeneous objects to producing geometries in full colour with functionally defined gradations of materials and microstructures, there is a growing need for a standard interchange file format that can support these features.

The Additive Manufacturing File Format (AMF) has many benefits. It describes an object in such a general way that any machine can build it to the best of its ability, and as such is technology independent. It is easy to implement and understand, scalable and has good performance. Crucially, it is both backwards compatible, allowing any existing STL file to be converted, and future compatible, allowing new features to be added as advances in technology warrant.

Specification for additive manufacturing file format (AMF) Version 1.2

1 Scope

This document provides the specification for the Additive Manufacturing File Format (AMF), an interchange format to address the current and future needs of additive manufacturing technology.

This document specifies the requirements for the preparation, display and transmission for the AMF. When prepared in a structured electronic format, strict adherence to an extensible markup language (XML)[1] schema supports standards-compliant interoperability.

NOTE A W3C XML schema definition (XSD) for the AMF is available from ISO from http://standards.iso.org/iso/52915 and from ASTM from www.astm.org/MEETINGS/images/amf.xsd. An implementation guide for such an XML schema is provided in Annex A.

It is recognized that there is additional information relevant to the final part that is not covered by the current version of this document. Suggested future features are listed in Annex B.

This document does not specify any explicit mechanisms for ensuring data integrity, electronic signatures and encryptions.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
AMF consumer
software reading (parsing) the Additive Manufacturing File Format (AMF) file for fabrication, visualization or analysis

Note 1 to entry: AMF files are typically imported by additive manufacturing equipment, as well as viewing, analysis and verification software.

3.2
AMF editor
software reading and rewriting the Additive Manufacturing File Format (AMF) file for conversion

Note 1 to entry: AMF editor applications are used to convert an AMF from one form to another, for example, convert all curved triangles to flat triangles or convert porous material specification into an explicit mesh surface.

3.3
AMF producer
software writing (generating) the Additive Manufacturing File Format (AMF) file from original geometric data

Note 1 to entry: AMF files are typically exported by computer-aided design (CAD) software, scanning software or directly from computational geometry algorithms.

3.4
attribute
characteristic of data, representing one or more aspects or descriptors of the data in an element

Note 1 to entry: In the XML framework, attributes are characteristics of elements.

3.5
comments
all text elements associated with any data within the Additive Manufacturing File Format (AMF) to be ignored by import software

Note 1 to entry: Comments are used for enhancing human readability of the file and for debugging purposes.

3.6
element
information unit within an XML document consisting of a start tag, an end tag, the content between the tags and any attributes

Note 1 to entry: In the XML framework, an element can contain data, attributes and other elements.

3.7
extensible markup language
XML
standard from the WorldWideWeb Consortium (W3C) that provides for tagging of information content within documents offering a means for representation of content in a format that is both human and machine readable

Note 1 to entry: Through the use of customizable style sheets and schemas, information can be represented in a uniform way, allowing for interchange of both content (data) and format (metadata).

[SOURCE: ISO/ASTM 52900:2015, 2.4.7]

3.8
STL
file format for model data describing the surface geometry of an object as a tessellation of triangles used to communicate 3D geometries to machines in order to build physical parts

Note 1 to entry: The STL file format was originally developed as part of the CAD package for the early STereoLithography Apparatus, thus referring to that process. It is sometimes also described as “Standard Triangulation Language” or “Standard Tessalation Language”, though it has never been recognized as an official standard by any standardization organization.

[SOURCE: ISO/ASTM 52900:2015, 2.4.16]

4 Key considerations

4.1 General

4.1.1 There is a natural trade-off between the generality of a file format and its usefulness for a specific purpose. Thus, features designed to meet the needs of one community may hinder the usefulness of a file format for other uses. To be successful across the field of additive manufacturing, the file format described in this document, the AMF, is designed to address the concerns listed in 4.1.2 to 4.1.7.

4.1.2 Technology independence. The AMF describes an object in such a general way that any machine can build it to the best of its ability. It is resolution and layer-thickness independent and does not contain information specific to any one manufacturing process or technique. This does not negate the inclusion of features that describe capabilities that only certain advanced machines support (for example colour, multiple materials), but these are defined in such a way as to avoid exclusivity.

4.1.3 Simplicity. The AMF is easy to implement and understand. The format can be read and debugged in a simple text viewer to encourage comprehension and adoption. Identical information is not stored in multiple places.

4.1.4 Scalability. The file size and processing time scales well with the increase in part complexity and with the improving resolution and accuracy of manufacturing equipment. This includes being able to handle large arrays of identical objects, complex periodic internal features (for example meshes and lattices) and smooth curved surfaces when fabricated with very high resolution.

4.1.5 Performance. The AMF enables reasonable duration (interactive time) for read-and-write operations and reasonable file sizes for a typical large object. Detailed performance data are provided in Annex B.

4.1.6 Backwards compatibility. Any existing STL file can be converted directly into a valid AMF file without any loss of information and without requiring any additional information. AMF files are also easily converted back to STL for use on legacy systems, although advanced features will be lost. This format maintains the triangle-mesh geometry representation to take advantage of existing optimized slicing algorithms and code infrastructure already in existence.

4.1.7 Future compatibility. To remain useful in a rapidly changing industry, this file format is easily extensible while remaining compatible with earlier versions and technologies. This allows new features to be added as advances in technology warrant, while still working flawlessly for simple homogeneous geometries on the oldest hardware.

4.2 Guidelines for the inclusion of future new elements

4.2.1 Any new element proposed shall be applicable across all hardware platforms and technologies that could conceivably be used to generate the desired outcome.

4.2.2 In support of the consideration above, new elements proposed for this document shall describe the final object, not how to build it. For instance, a hypothetical future element `<hollow>` might be allowed to tell an additive manufacturing system to leave the volume empty if possible. However, an element `<objectLayerFillPath>` that describes how to build a hollow volume shall not be included since it assumes a particular fabrication process.

5 Structure of this specification

5.1 Format. Information specified throughout this specification is stored in XML 1.0 format. XML is a text file comprising a list of elements and attributes. Using this widely accepted data format allows for the use of many tools for creating, viewing, manipulating, parsing and storing AMF files. XML is human-readable, which makes debugging errors in the file possible. XML can be compressed or encrypted or both if desired in a post-processing step using highly optimized standardized routines.

5.2 Flexibility. Another significant advantage of XML is its inherent flexibility. Missing or additional parameters do not present a problem for a parser as long as the document conforms to the XML standard. Practically, the use of XML namespaces allows new features to be added without breaking old versions of the parser, such as in legacy software.