Definition of 3D mesh format used in *Anatomist*

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1 Introduction

This document describes the main format used by *BrainVISA* and *Anatomist* to represent surfaces (composed of polygons such as triangles) and segment set. The aimed audience is programmers who wish to generate surfaces and/or segments with their own software and use them with *BrainVISA*/*Anatomist* [1].

2 Syntax

The format description is written with the following elements. A ***field*** (written in bold and italics) represent an element that can be splitted in other elements. All fields are described in section 4. In *ascii* mode fields can be separated by one or more ***space***.

Characters strings are represented in `verbatim` between quotes. For example, `'string'` represent six *ascii* characters (each one coded on one byte).

3 Format description

A *mesh* file contains the following fields :
mode
textureType
polygonDimension
numberOfTimeSteps
timeSteps

4 Fields description

mode*:** The format can be written either as an *ascii* text file or as a *binary* file. The ***mode is used to identify the representation it can have three values :

[1] See `http://brainvisa.info` for more information about *BrainVISA*/*Anatomist*.

- `'ascii'`: the file is in text format.
- `'binarABCD'`: the file is in binary format and uses *big-endian* byte order for numbers (such as Motorola or Sun processors for example).
- `'binarDCBA'`: the file is in binary format and uses *little-endian* byte order for numbers (such as Intel processors for example).

textureType*:** The file format was created with the possibility to include a texture. But this is *never used* since textures are represented in a separate format. In *ascii* mode his field should always contain `'VOID'` or, in *binary* mode, a ***U32 containing 4 (which is the size of the following string) followed by the four characters `'VOID'`.

polygonDimension*:** This field is an ***U32 containing the number of points of each polygon. The following values are supported in *Anatomist* and *Aims*:

3: Polygons are composed of three points (they are triangles). This is the recomanded value for surfaces because other values may not be supported by all *BrainVISA* processing tools.

4: Polygon are composed of four points. This is supported in *Anatomist* but may not be supported in every *BrainVISA* processing tools.

2: This value is used to represent segments in a 3D space. Each "polygon" is composed of two 3D points.

numberOfTimeSteps*:** The mesh format can represent several meshes at different time steps. This is a ***U32 representing the number of time steps.

timeSteps*:** This field contains ***numberOfTimeSteps times the following structure :

instant*:** a ***U32 representing a time instant.

***vectorOf*<*vertex*>:** contains all the vertices which are used to build polygons.

***vectorOf*<*normal*>:** contains the normals of the surface at each vertex. It must have the same size as ***vectorOf*<*vertex*>** or be empty.

vectorOf*<*texture*>:** must be an empty vector (i.e a ***U32 containing 0).

***vectorOf*<*polygon*>:** contains the polygons which represent the surface.

vertex*:** is 3D a point. In *ascii* mode it has the following syntax: `'('` ***FLOAT `','` ***FLOAT*** `','` ***FLOAT*** `')'`. In binary mode it is represented by three ***FLOAT***.

normal*:** is a normalized vector. In *ascii* mode it has the following syntax: `'('` ***FLOAT `','` ***FLOAT*** `','` ***FLOAT*** `')'`. In binary mode it is represented by three ***FLOAT***.

polygon*:** is a set of ***polygonDimension points. Each point is represented by a ***U32*** which is an index in ***vectorOf*<*vertex*>**. The first vertex index is *zero*, the second is one, etc. In *ascii* mode it has the following syntax: `'('` ***U32*** `','` ***U32*** `','` ... `','` ***U32*** `')'`. In binary mode it is represented by a series of ***polygonDimension*** elements of type ***U32***.

U32*:** A 32 bits wide unsigned integer (between 0 and 4294967295). In *ascii* mode it is written as a decimal number. In *binary* mode it is represented on four bytes with the choosen byte order (see ***mode above).

FLOAT*:** A 32 bits wide real number (maximum 3.40282347e+38). In *ascii* mode it is written as a decimal number. In *binary* mode it is represented on four bytes with the choosen byte order (see ***mode above).

vectorOf*<field>:** where ***field is a field type. It represents a fixed length vector of elements of type ***field***. It contains the size of the vector (i.e. the number of elements) as a ***U32*** followed by the elements.

***space*:** A byte with one of the ascii value for a space, a tabulation or a carriage-return.

5 Examples

Here is an example of an *ascii* mesh file containing a tetrahedron.

```
ascii
VOID
3
1
0
4 (-0.8,0.8,0) (0.8,8e-1,0) (-1,-1,0) (0,0,1)
4 (-0.8,0.8,0) (0.8,8e-1,0) (-1,-1,0) (0,0,1)
0
4 (0,1,2) (0,3,1) (1,3,2) (2,3,0)
```

Here is an example of an *ascii* mesh file containing a linear spiral.

```
ascii
VOID
2
1
0
16
(10, 0, 0) (7.07, 7.07, 0.4) (0, 10, 0.8)
(-7.07, 7.07, 1.2) (-10, 0, 1.6) (-7.07, -7.07, 2.0)
(0, -10, 2.4) (7.07, -7.07, 2.8) (10, 0, 3.2)
(7.07, 7.07, 3.6) (0, 10, 4.0) (-7.07, 7.07, 4.4)
(-10, 0, 4.8) (-7.07, -7.07, 5.2) (0, -10, 5.6)
(7.07, -7.07, 6.0)
0
0
15
(0,1) (1,2) (2,3) (3,4) (4,5) (5,6) (6,7) (7,8) (8,9)
(9,10) (10,11) (11,12) (12,13) (13,14) (14,15)
```