

GML Data Manipulation in Autodesk Map

Zdena DOBEŠOVÁ*, Michal DOBEŠ**

*Department of Geoinformatics, **Computer Science Department
Faculty of Sciences, Palacký University

*Svobody 26, ** Tomkova 40, 771 46 Olomouc, Czech Republic
tel.: +420585634763 fax: +420585225737

E-mail: zdena.dobesova@upol.cz, michal.dobes@upol.cz

Abstract

GML (Geography Markup Language) version 2 is an OpenGIS® implementation specification that defines an XML encoding for the transport and storage of geographic information. The specification can be found at the OpenGIS Consortium web site at www.opengis.org. GML export/import is a part of installation of Autodesk Map from the version 2005. The new version of the Autodesk Map 2006 has the export/import possibility as well. In ArcGIS version 9 the GML export/import is possible only by adding the Data Interoperability extension.

You can import the following types of GML files into Autodesk Map: GML version 2 files and MasterMap GML version 2 files. You can export to GML version 2 except to the Ordinance Survey of Great Britain MasterMap GML version 2. Because the GML version 2 format is so flexible and allows you to specify your own schemas, semantics, and options, there are many variations of the GML version 2 format. Autodesk Map reads many of these, but some may not be compatible with the Autodesk Map GML driver and cannot be imported.

You can set the following option when exporting GML version 2 files: Mode FIXED to create a single GML file (.gml) or mode CREATE to produce 3 files: a GML file (.gml), an xfMap file (.xmp), and an application schema (.xsd).

We tested some possibilities of exporting data from Autodesk Map drawing to GML file. You can automatically select all geometric objects, or you can manually select the objects you want to export to GML. In addition, you can export objects on selected layers or in selected feature classes. You can also export objects from a polygon topology.

There is also a possibility to export attribute data that is associated with the geometric objects. You can export object data, block attributes, linked external data, object properties, and topology data. You can easily choose the data you want using the Expression tree. There is a limitation to export stylized map (thematic map).

Created stylizations cannot be exported to GML version 2 except the text stylizations.

We used sample drawing data of Autodesk Map and our own created drawing data for testing GML export and import. The import of GML data worked correctly in Autodesk Map 2005 version, but during the export of GML data the instability occurred. The version of the Autodesk Map 2006 was stable during the export. The stability and correctness of both versions depending of the size of the files are currently subject to testing.

Introduction

Geography Markup Language is an XML based encoding standard for geographic information developed by the OpenGIS Consortium. GML is based on the abstract model of geography developed by the OGC. This describes the world in terms of geographic entities called features. Essentially a feature is nothing more than a list of properties and geometries. Properties have the usual name, type, value description. For simplicity, the initial GML specification is restricted to 2D geometry, however, extensions will appear shortly which will handle 2 1/2 and 3D geometry, as well as topological relationships between features.

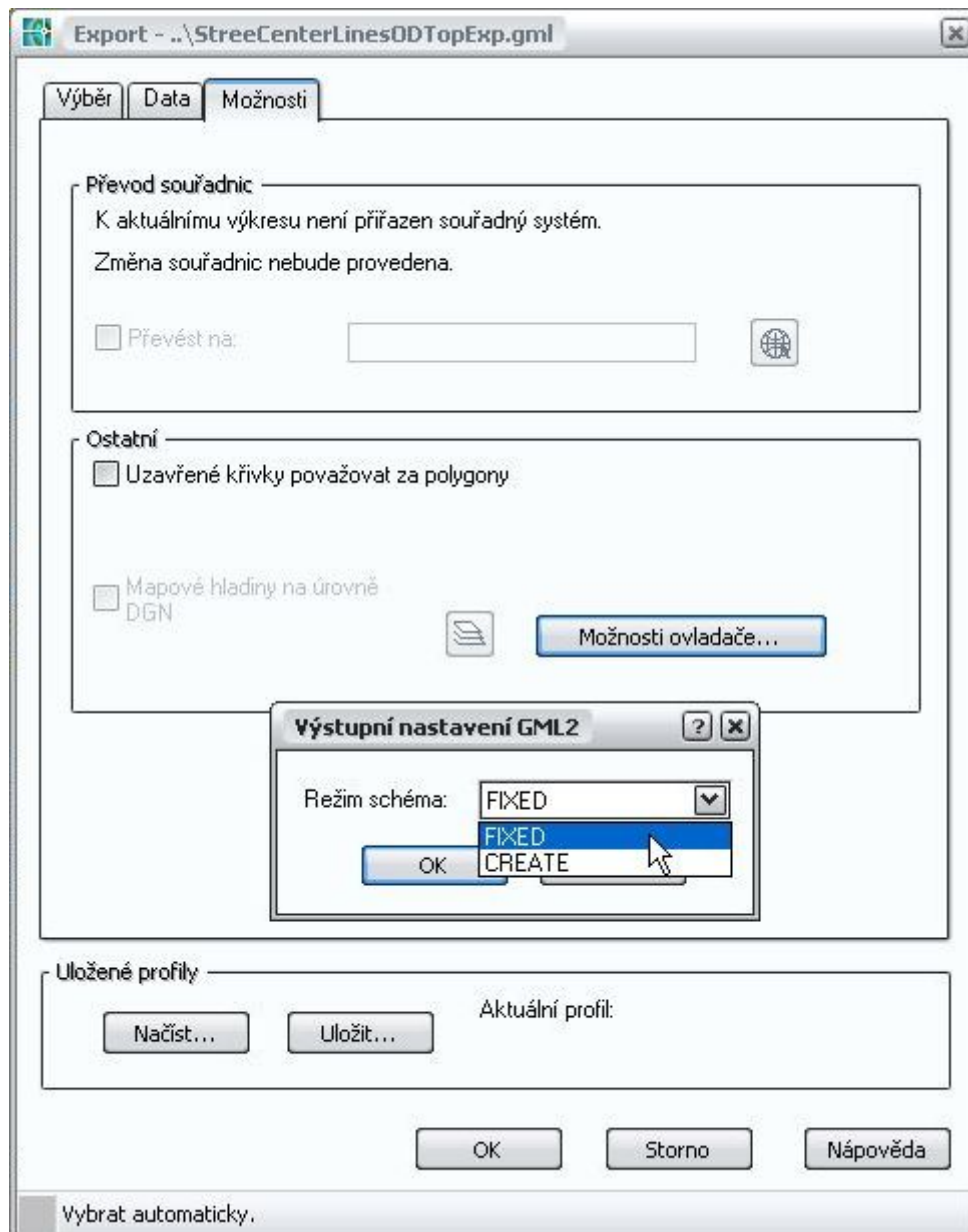
From the interoperability reason there is important a possibility of import and export of many GIS data formats in GIS software. Software Autodesk Map version 2005 and version 2006 have a possibility of import and export to GML file version 2. This functionality is an automatic part of product installation.

There is possibility to store miscellaneous geometry and attribute data. It is declared by software documentation in Autodesk Map. In this article we want describe results of import and export tests. Export to GML did not work in version 2005. Export ended with an error message and no GML file was created. We used both Czech and English version of software with same unsuccessful result.

We tested the drawings with only one type of geometry feature (point, line, polygon). There is also declared possibility of export more types of geometry feature, attribute and topology from drawing to one GML files in documentation.

1. Export options

You can set the following options when exporting GML version 2 files. Mode FIXED to create a single GML file (.gml) or mode CREATE to produce 3 files: a GML file (.gml), an xfMap file (.xmp), and an application schema (.xsd). This option is chosen in export dialog window.



Picture 1 Mode of export

The option FIXED is default option. This option is recommended. There is support for ASCII characters storing in more bytes for Asian language as Japanese language etc. We tested both modes. File created by FIXED mode is bigger than total size of 3 files created in CREATED mode. Mode CREATE produces 3 files: a GML file (.gml), an xfMap file (.xmp), and an application schema (.xsd)

Mode FIXED support only one geometry entity in output file in old version of Autodesk Map. We do not verify it because export from version Autodesk Map 2005 to GML do not work in our software installation.

2. Description of GML files

Every GML file generated in Autodesk Map contains the following elements in start section.

```
<?xml version="1.0" encoding="UTF-8"?>
<dataset xmlns=http://www.safe.com/xml/schemas/FMEFeatures
xmlns:fme="http://www.safe.com/xml/schemas/FMEFeatures"
xmlns:gml="http://www.opengis.net/gml"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.safe.com/xml/schemas/FMEFeatures FMEFeatures.xsd">
```

There is defined xml version and encoding in the start section. This GML document explicitly references three namespaces with prefix: fme, gml and xsi. Specifying namespaces prevents potential collisions of homonyms in multi-namespaces XML document. FME is Feature Manipulation Engine from Safe Software company (Canada), which is embedded into Autodesk Map. Next element contains extent and coordinate system.

```

<gml:boundedBy>
  <gml:Box srsName="ca83iiiif">
    <gml:coordinates>
      6140000.945,2080140.69628981 6156748.803,2091480.78613321
    </gml:coordinates>
  </gml:Box>
</gml:boundedBy>

```

Extent is defined by bounding box in tag pair <gml: boundedBy>. srsName attribute in tag <gml:Box> defines the code of Coordinate Reference System (CRS). It is "NAD 83 California State Planes, Zone III, US Foot" in this example. The value of the srsName attribute is a Uniform Resource Identifier. It refers to a definition of the CRS used to interpret the coordinates in the geometry. The CRS definition may be in a document or in an online web service. The OCG has developed a Uniform Resource Name structure and a set of specific names to encode some common coordinate systems.

3. Geometry objects

As a first case we tested export of only geometry objects. The testing drawings contain one type of geometry i.e. point, line or polygon object. The exports were successful. The point object is described by these elements:

```

<gml:Point srsName="">
  <gml:coordinates>-459926.40625, -1090898.75,0
  </gml:coordinates>
</gml:Point>

```

The Z value is 0. We also try export COGO point with Z elevation. The COGO points are used for surface definition in Autodesk Map. Export of COGO points is not supported.

The line object is described by these elements:

```

<gml:LineString srsName="">
  <gml:coordinates>
    -743840.938455485, -1110295.51454798, 0
    -739236.835546242, -1103493.29712886, 0
  </gml:coordinates>
</gml:LineString>

```

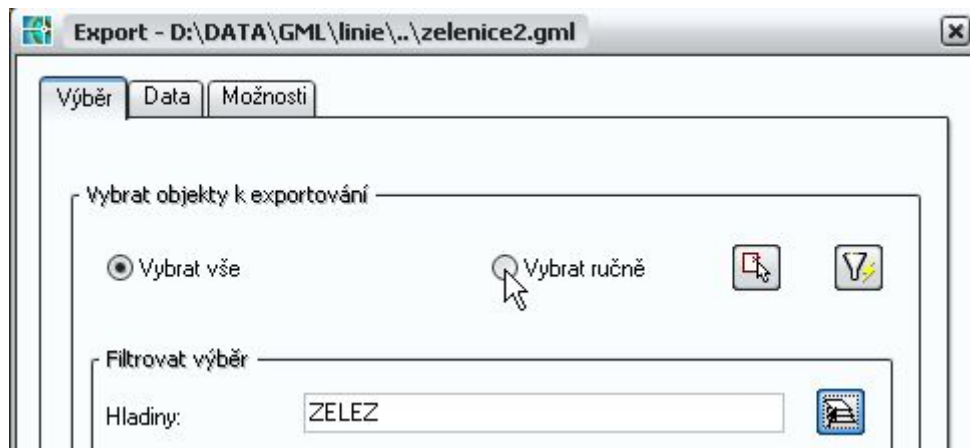
The polygon object is described by the following elements:

```

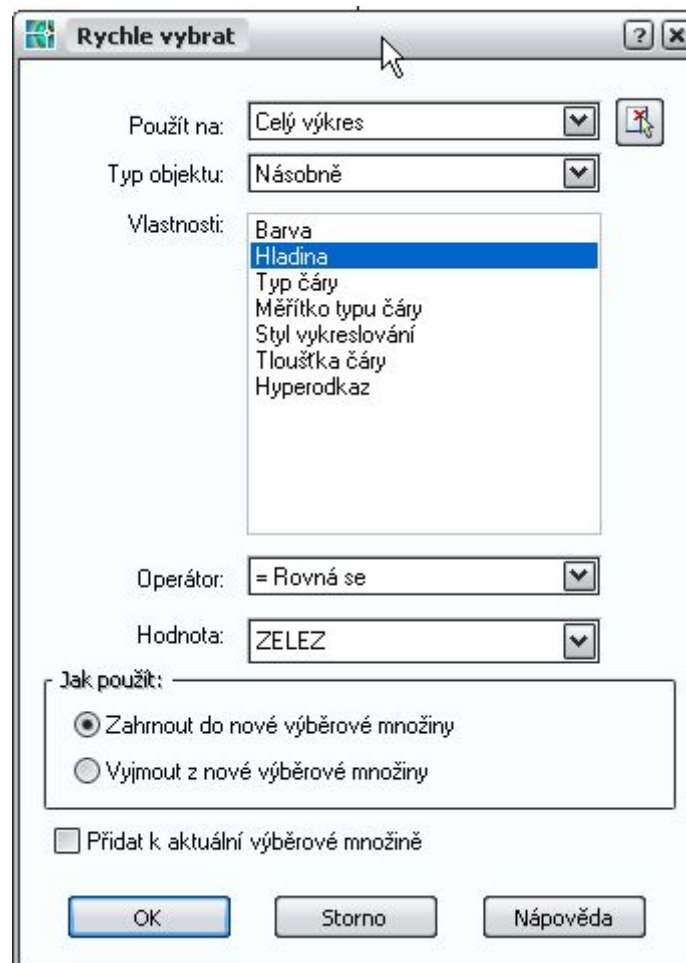
<gml:Polygon srsName="">
<gml:outerBoundaryIs>
  <gml:LinearRing>
    <gml:coordinates>
      350.386701409971,937.810240718256,0
      368.309293856075,771.207847707578,0
      904.194838218266,771.207847707578,0
      350.386701409971,937.810240718256,0
    </gml:coordinates>
  </gml:LinearRing>
</gml:outerBoundaryIs>
</gml:Polygon>

```

You can select a set of geometric objects for export from drawing. There are possibilities for selection: automatic selection or manual selection in Autodesk Map. The selection set can be set up from some layer or by manual selection of objects or by interactive selection of objects. The status bar tells how many objects are currently selected and how many are filtered out. In addition that is a preview of objects that will be exported.



Picture 2 Option manual selection



Picture 3 Definition of selection set by choosing layer

Import and export only one type of geometry to and from GML files was without problem.

After that we tested join export more types of geometry in one GML file. Export was successful in both modes (create, fixed) in version 2006. We import also this mixed GML file. Line and point layers import unfortunately into one common layer. Line and point objects do not import to the separate layers. There is no possibility determine target layers and determine which elements import to which layer. Import runs without specifying parameters. There is no dialog windows for import. So other manipulation with these various geometry objects in one layer is more difficult and manual dividing into separate layers is necessary. We recommend export each layer that contains one type of geometry feature to separate GML file. Import of GML files works with the same results in version 2005 and in version 2006.

4. Attribute data

There is also possibility to export and import attribute data of geometry objects. Attribute data is saved commonly with geometry data in one DWG files. This type of attribute data is called "object data" in Autodesk Map. During export you can determine witch attribute you can export.

A GML file contains definition property name and data type of attribute in pair tag <schemaFeatures>:

```
<schemaFeatures>
<gml:featureMember>
<Feature>
  <featureType>ZelezStanice</featureType>
  <property name="gml2_type">gml2_point</property>
  <property name="CISLO_TR">string</property>
  <property name="NAZEV">string</property>
  <property name="ZEL_STAN_I">double</property>
</Feature>
</gml:featureMember>
</schemaFeatures>
```

Example of attribute is:

```
<Feature>
<featureType>ZelezStanice</featureType>
  <property name="CISLO_TR">220</property>
  <property name="NAZEV">Chotoviny</property>
  <property name="ZEL_STAN_I">1724</property>
  <property name="gml2_coordsys"></property>
  <gml:pointProperty>
    <gml:Point srsName="">
      <gml:coordinates>-734109.0625,-1113389.5,0</gml:coordinates>
    </gml:Point>
  </gml:pointProperty>
</Feature>
```

Import of attribute data from GML file is correct. During import you can determine what attributes you can import. Import mixed geometry object with attribute have the same problem as import multi type geometry objects. Even the attribute data is combined to one object from all geometry objects. This is not suitable. And following editing is very hard. We recommend export each layer that contains one type of geometry objects with attribute data to separate GML file.

Attribute data can be stored also in external database in Autodesk Map. We tested export geometry and attribute data stored in external Microsoft Access Database. It was worked correctly.

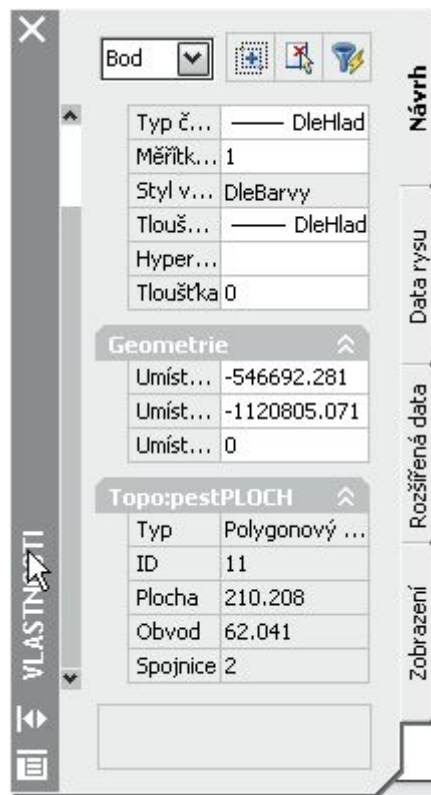
5. Topology data

There is also possibility of export topology to GML in Autodesk Map. Information about topology is saved in DWG format as object data. Export is the same as any other attribute data. It is advantage because GML Simple Feature Profile does not provide support for storage of topology.

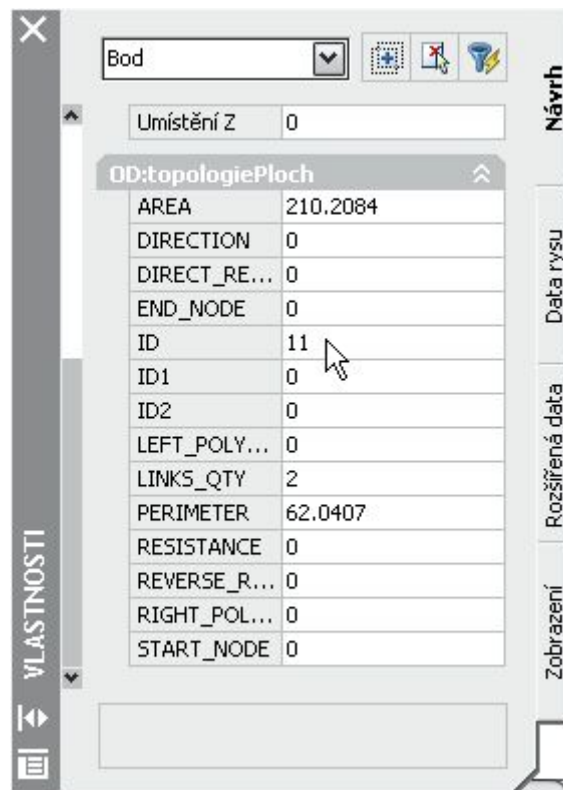
Example of polygon topology data in GML:

```
<property name="LEFT_POLYGON">int</property>
<property name="RIGHT_POLYGON">int</property>
<property name="DIRECTION">int</property>
<property name="DIRECT_RESISTANCE">double</property>
<property name="REVERSE_RESISTANCE">double</property>
<property name="ID2">int</property>
<property name="RESISTANCE">double</property>
```

Import of topology changes topology object data. There are added attributes (null values) from other line topology to polygon topology in tested DWG files. It is demonstrated in following picture. The information are for the same centroid point ID 11.



Picture 4 Origin topology object data



Picture 5 Topology object data after import from GML file

It is better create new topology information after import from GML file. But we lose information about direction, direct resistance and reverse resistance. Those parameters are set up to default values after built new topology.

GML is not a presentation language for data display. Thematic stylization is not possible export from drawing to GML file.

6. Time testing

We used sample drawing data of Autodesk Map and our own created drawing data for testing. Beside functionality we tested time consuming of import and export. You can see also size of DWG and GML files in

the next table.

Type of object	Number of object	Time of export [second]	Time of import [second]	Size DWG file [kB]	Size GML file (mode FIXED)[kB]	Size GML files (mode CREATE)[kB]
Point	779	4	2	202	219	168
Point	6249	9	6	279	1662	1233
Polyline	889	3	2	425	988	930
Point + attribute data (object data)	303	2	1	172	251	71
Polyline+attribute data (object data)	1209	27/11*	16/13*	2352	9918	6348
Polyline+attribute data (external database)	1209	38/12*	16/13*	1996	9845	6419

Table 1 Time and size results of export and import

* Time of export-import is different for mode FIXED (first number) and CREATE mode (second number)

Export and import of only geometry data up to 1000 object is very fast. Time of export is longer in every cases than import time. Time of export is influenced also by the type of mode. The size of the file in FIXED mode is bigger than tree files produced in CREATE mode. Export by CREATE mode is faster for geometry with more than 1000 polyline object. In case attribute data is stored in external database the time of export is longer then export attribute data stored as object data in DWG file for the same geometry.

Time of import and export depends on computer hardware and software. Parameters of the computer where we made tests was: processor Intel Pentium 4, 1.4 GHz, 768 MB RAM, OS Windows XP. The time can be considered as orientational. If we want to compare it we must prepare the larges representative set of drawings for every type of geometry object.

We used sample drawing data of Autodesk Map and our own created drawing data for testing GML export and import.

References

1. Kosek, J.: XML pro každého, Grada Publishing, Praha, 2000, ISBN 80-7169-860-1
2. OGC. Geography Markup Language (GML) Implementation Specification , version 2.1.2 [online]. 2002 [cit. 2005-01-11]. <http://portal.opengeospatial.org/files/?artifact_id=11339>
3. Zaslavsky, I.: Online Cartography with XML, In: Maps and the Internet, ed. Peterson, M. P., Elsevier, 2003, 171-196 p., ISBN 0-08- 044201-3