The *.RTO* file format (rational function)

In GeoView®, the location by rational functions model is stored as an XML file (file .RTO) and it contains :

- 2 coordinate systems,
- coordinates standardizing and centering parameters and the extents of these systems,
- the rational functions for the translation from one system to another.

Empty lines and comments lines (starting by « ! ») may be inserted anywhere in the file.

Note : The XML language is not addressed in this document; the official documentation for this language is available on the site of the World Wide Web Consortium: http://www.w3c.org/ and also dealt with on dedicated sites such as http://www.xml.com/ and http://xmlfr.org/. Furthermore, there is a great variety of books on this topic.

Constituents of a rational function file

In the XML language, an element is made up of start tag, a value and an end tag. Here, when referring in general terms to an element, it shall be named by its start tag; for instance the element ***<trans_coord_ratio> ... </trans_coord_ratio>*** will be referred to in general as ***<trans_coord_ratio>***.

<trans_coord_ratio>

This element is the highest ranked, and it is unique in the file. It contains the following :

- **<trans_coord>**
- **<version>**
- **<date>**
- **<sys1_center>**
- **<sys1_coef>**
- **<sys1_min>**
- **<sys1_max>**
- **<sys2_center>**
- **<sys2_coef>**
- **<sys2_min>**
- **<sys2_max>**
- **<fct_ratio>**

It has 1 mandatory attribute, **name**, which allows entering the name of the system (sys1 for instance). The attribute **name** may be empty.
E.g. : **<trans_coord_ratio name="">**

<trans_coord>

It contains the following :

- ***<trans_sys_coord>***
- ***<category>***
- ***<type_modele>***
- ***<direct_available>***
- ***<inverse_available>***

It has 1 mandatory attribute, **name**, which allows entering the name of the system (sys1 for instance). The attribute **name** may be empty.
E.g.: **<trans_coord name="">**

<version>

This item defines the format version for the rational function. It is a positive integer, starting from 1.
E.g.: **<version>1</version>**

<date>

This item indicates the creation date of the file. It is an optional field. The date format is « YYYYMMDDhhmmss », with :

- **YYYY** : year (4 figures required) ;
- **MM** : month (from 01 to 12, 2 figures required) ;
- **DD** : day (from 01 to 31, 2 figures required) ;
- **hh** : hour (from 00 to 23, 2 figures required –24 hour cycle, not 12 hours with am – pm distinction) ;
- **mm** : minutes (from 00 to 59, 2 figures required) ;
- **ss** : seconds (from 00 to 59, 2 figures required).

E.g. : **<date>20060116180727</date>**

<sys1_center > and ***<sys1_coef>***
<sys2_center > and ***<sys2_coef>***

Coordinates standardizing parameters expressed in system 1 and system 2.
These items contain each :

- **<x>**
- **<y>**
- **<z>**

<sys1_min> and ***<sys1_max>***
<sys2_min> and ***<sys2_max>***

These items describe the extents of system 1 and system 2.
They each contain :

- **<x>**
- **<y>**
- **<z>**

<fct_ratio>

This item describes the rational function.
It has 1 mandatory attribute, **name**, enabling to indicate if the rational function is giving either the X or the Y in the system 1 or 2. This attribute may thus have the values **x1**, **x2**, **y1** and **y2**.
It contains :

- **<version>**
- **<date>**
- **<polynom3VReal>**

E.g. :
<fct_ratio name"x1"> here rational function giving the X in the system 1

<trans_sys_coord>

This item contains :

- ***<sys_coord>***

It has 1 mandatory attribute, **name**, which allows entering the name of the system (sys1 par example). This attribute may be empty.
E.g. :
<trans_sys_coord name="">

<category>

This item defines the category of the coordinates converter. Its possible values are :

- **0** : 3D -> 3D conversion. For instance (i, j, h) -> (X, Y, h').
- **1** : 2D+Z -> 2D (+Z) conversion. For instance (i, j ,Z) -> (X, Y, Z).
- **2** : 2D -> 2D conversion. For instance (i, j) -> (X, Y). Single level grid with 2 components.

<type_modele>

This element defines the converter model type. Its possible values are :

- **0** : null model (always returns null coordinates).
- **1** : identity model.
- **2** : specific model.

<direct_available>

It indicates if the direct model sys1 -> sys2 is available or not. It may have 2 values : **0** (for no) and **1** (for yes).

<inverse_available>

It indicates of the inverse model sys2 -> sys1 is available or not. Il It may have 2 values : **0** (for no) and **1** (for yes).

<x> <y> <z>

Value of the X, the Y and the Z.

E.g. :
<x>937932.000000000</x>
<y>2044251.000000000</y>
<z>4000.000000000</z>

<polynom3VReal>

It describes the polynomial of the rational function.
It has 1 compulsory attribute, **name**, which may have 2 values : **numerator** or **denominator**.
It contains the following :

- ***<version>***
- ***<date>***
- ***<degx>***
- ***<degy>***
- ***<degz>***
- ***<cst>***
- ***<x1> <x2> <x3>...*** according to the value of the degree entered in ***<degx>***
- ***<y1> <y2> <y3>...*** according to the value of the degree entered in ***<degy>***
- ***<z1> <z2> <z3>...*** according to the value of the degree entered in ***<degz>***
- ***<x1_y1> <x1_z1> <y1_z1> <x1_y1_z1>...*** according to the value of the degrees entered in ***<degx>***, ***<degy>*** and ***<degz>***

<sys_coord>

This element describes a cartographical, geographical or image reference system. It contains the following :

- ***<sys_coord_plani>***
- ***<sys_coord_alti>***

It has 1 mandatory attribute, **name**, which allows entering the name of the system (sys1 for instance). This attribute may be empty.
E.g. : **<sys_coord name="sys1">**

<degx> <degy> <degz>

These elements contain the degree of the polynomial in X, Y and Z.
E.g. :
<degx>1</degx>
<degy>1</degy>
<degz>0</degz>

<cst>

This element contains the constant term of the polynomial.
E.g. :**<cst>-3.551318373469180E-02</cst>**

<x1> <x2> <x3>...

These elements contain the terms of the polynomial in X, X^2, X^3...

<y1> <y2> <y3>...

These elements contain the terms of the polynomial in Y, Y^2, Y^3...

<z1> <z2> <z3>...

These elements contain the terms of the polynomial in Z, Z^2, Z^3...

<x1_y1> <x1_z1> <y1_z1> <x1_y1_z1>...

These elements contain the terms of the polynomial in X*.Y*, X*.Z*, Y*.Z*, X*.Y*.Z*...

<sys_coord_plani>

This element describes a planimetric reference system. It contains the following :

- **<code>**
- **<unit>**
- **<direct>**
- **<sub_code>**
- **<vertical>**

It has 1 mandatory attribute, **name**, which allows entering the name of the system (sys1 for instance). This attribute may be empty.
E.g. :**<sys_coord_plani name="sys1">**

<sys_coord_alti>

This element describes an altimetric reference system. It contains the following :

- **<code>**

- **<unit>**

It has 1 mandatory attribute, **name**, which allows entering the name of the system (sys1 for instance). This attribute may be empty.
E.g. :**<sys_coord_alti name="sys1">**

<code>

It appears in the elements ***<sys_coord_plani>*** and ***<sys_coord_alti>***. It indicates the planimetric or altimetric code of the epipolar reference system.

<unit>

It appears in the elements ***<sys_coord_plani>*** and ***<sys_coord_alti>***. It indicates the planimetric or altimetric unit used in their respective reference systems and can only have the following values :

- **deg** : decimal degree
- **gr** : grade
- **m** : meter
- **km** : kilometer
- **inch** : inch (= 2,54 cm)
- **ft** : foot (= 12 inches)
- **yard** : yard (= 3 feet = 36 inches)
- **mile** : British mile (= 1760 yards = 5280 feet = 63360 inches)
- **mille** : nautical mile
- **cm** : centimeter
- **dm** : decimeter
- **mm** : millimeter
- **pts** : point (= 1/72 inch)
- **p** : pixel

<direct>

This element gives information on the reference system orientation. The two values admitted are: **0** (indirect) and **1** (direct).

<sub_code>

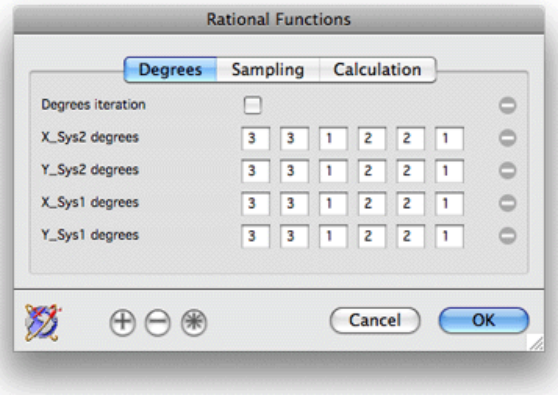
This element gives information on the planimetric sub-code: this field enables characterizing the different grids that may be calculated from a model. This field may be empty.

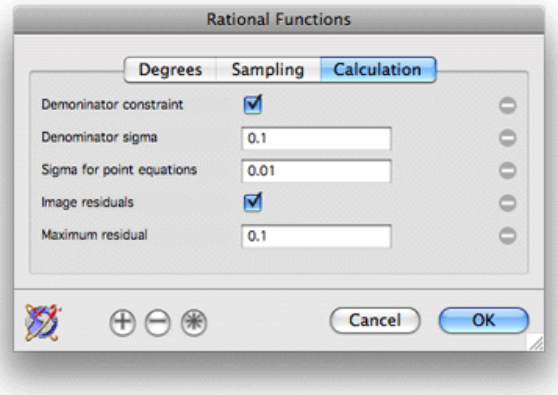
<vertical>

This element gives information on the vertical system: this field determines the type of motion in space when preserving a constant X, Y in the planimetric system and varying the 3rd component. This is particularly useful for the epipolar grids sharing the same planimetric reference system but not the vertical system. Generally, the vertical system is that of the planimetric reference system.

Rational function example

for a setup of the following degree :






```
<?xml version="1.0" encoding="x-mac-roman"?>

<trans_coord_ratio name="">

<trans_coord name="">
```

```
        <trans_sys_coord name="">
            <sys_coord name="sys1">
                <sys_coord_plani name="sys1">
                    <code>LAMBERT2</code>
                    <unit>m</unit>
                    <direct>1</direct>
                    <sub_code></sub_code>
                    <vertical>LAMBERT2</vertical>
                </sys_coord_plani>
                <sys_coord_alti name="sys1">
                    <code>LAMBERT2</code>
                    <unit>m</unit>
                </sys_coord_alti>
            </sys_coord>
            <sys_coord name="sys2">
                <sys_coord_plani name="sys2">
                    <code>1_794</code>
                    <unit>p</unit>
                    <direct>0</direct>
                    <sub_code></sub_code>
                    <vertical>1_794</vertical>
                </sys_coord_plani>
                <sys_coord_alti name="sys2">
                    <code>LAMBERT2</code>
                    <unit>m</unit>
                </sys_coord_alti>
            </sys_coord>
        </trans_sys_coord>
        <category>1</category>
        <type_modele>2</type_modele>
        <direct_available>1</direct_available>
        <inverse_available>1</inverse_available>
    </trans_coord>
    <version>1</version>
    <date>20060111182343</date>
```

```
<sys1_center>
      <x>932940.000000000</x>
      <y>2039291.000000000</y>
      <z>2000.000000000</z>
</sys1_center>
<sys1_coef>
      <x>4.992000000000000e+03</x>
      <y>4.960000000000000e+03</y>
      <z>2.000000000000000e+03</z>
</sys1_coef>
<sys1_min>
      <x>927948.000000000</x>
      <y>2034331.000000000</y>
      <z>0.000000000</z>
</sys1_min>
<sys1_max>
      <x>937932.000000000</x>
      <y>2044251.000000000</y>
      <z>4000.000000000</z>
</sys1_max>
<sys2_center>
      <x>2714.270000000</x>
      <y>2821.259000000</y>
      <z>2000.000000000</z>
</sys2_center>
<sys2_coef>
      <x>7.159923828125000e+03</x>
      <y>6.867404785156250e+03</y>
      <z>2.000000000000000e+03</z>
</sys2_coef>
<sys2_min>
      <x>-4445.653828125</x>
      <y>-4046.145785156</y>
      <z>0.000000000</z>
</sys2_min>
```

```
<sys2_max>
	<x>9874.193828125</x>
	<y>9688.663785156</y>
	<z>4000.000000000</z>
</sys2_max>
<fct_ratio name="x2">
	<version>1</version>
	<date>20060111182343</date>
	<polynom3Vreal name="numerateur">
		<version>1</version>
		<date>20060111182343</date>
		<degx>3</degx>
		<degy>3</degy>
		<degz>1</degz>
		<cst>1.400662091386357E-02</cst>
		<x1>5.449259865127695E-01</x1>
		<x2>-4.158738005567121E-05</x2>
		<x3>5.957824925590611E-08</x3>
		<y1>5.966254866482140E-03</y1>
		<x1_y1>-1.352925648984231E-03</x1_y1>
		<x2_y1>2.051844298087884E-09</x2_y1>
		<y2>-8.167636765550136E-06</y2>
		<x1_y2>2.856457997401033E-08</x1_y2>
		<y3>-2.974103614751897E-09</y3>
		<z1>-6.903905455370563E-03</z1>
		<x1_z1>1.717606791365941E-04</x1_z1>
		<x2_z1>-1.370236088513767E-08</x2_z1>
		<y1_z1>1.901516571522346E-05</y1_z1>
		<x1_y1_z1>-4.255179101641564E-07</x1_y1_z1>
		<y2_z1>-1.782513062374325E-09</y2_z1>
	</polynom3Vreal>
	<polynom3Vreal name="denominateur">
		<version>1</version>
		<date>20060111182343</date>
		<degx>2</degx>
```

```
            <degy>2</degy>
            <degz>1</degz>
            <cst>1.000000000000000E+00</cst>
            <x1>1.024186334742896E-03</x1>
            <x2>4.220180663396913E-04</x2>
            <y1>2.202842023804735E-02</y1>
            <x1_y1>-4.930724891836647E-06</x1_y1>
            <y2>3.558321007132624E-04</y2>
            <z1>-4.312214681195340E-01</z1>
            <x1_z1>3.857649173905370E-05</x1_z1>
            <y1_z1>1.077570924615957E-03</y1_z1>
      </polynom3Vreal>
</fct_ratio>
<fct_ratio name="y2">
      <version>1</version>
      <date>20060111182343</date>
      <polynom3Vreal name="numerateur">
            <version>1</version>
            <date>20060111182343</date>
            <degx>3</degx>
            <degy>3</degy>
            <degz>1</degz>
            <cst>-2.266072937425954E-02</cst>
            <x1>4.674316345341447E-03</x1>
            <x2>-4.087842782369641E-07</x2>
            <x3>-7.761088203069643E-10</x3>
            <y1>-5.647052217326974E-01</y1>
            <x1_y1>6.898912180642882E-05</x1_y1>
            <x2_y1>-6.842209562091580E-08</x2_y1>
            <y2>1.546807711417530E-03</y2>
            <x1_y2>-6.373656720206729E-09</x1_y2>
            <y3>-2.252945144564453E-08</y3>
            <z1>-7.456025992965766E-04</z1>
            <x1_z1>1.573967928021896E-06</x1_z1>
            <x2_z1>-1.130383121770870E-07</x2_z1>
```

```
            <y1_z1>-1.753411138571048E-04</y1_z1>
            <x1_y1_z1>1.922769771494194E-08</x1_y1_z1>
            <y2_z1>4.364416788636137E-07</y2_z1>
        </polynom3Vreal>
        <polynom3Vreal name="denominateur">
            <version>1</version>
            <date>20060111182343</date>
            <degx>2</degx>
            <degy>2</degy>
            <degz>1</degz>
            <cst>1.000000000000000E+00</cst>
            <x1>9.681684360617720E-04</x1>
            <x2>4.219268757836148E-04</x2>
            <y1>2.177212638722287E-02</y1>
            <x1_y1>-6.589512793094714E-06</x1_y1>
            <y2>3.494968536010083E-04</y2>
            <z1>-4.312214436681112E-01</z1>
            <x1_z1>6.272204788677714E-05</x1_z1>
            <y1_z1>1.188113129050049E-03</y1_z1>
        </polynom3Vreal>
    </fct_ratio>
    <fct_ratio name="x1">
        <version>1</version>
        <date>20060111182343</date>
        <polynom3Vreal name="numerateur">
            <version>1</version>
            <date>20060111182343</date>
            <degx>3</degx>
            <degy>3</degy>
            <degz>1</degz>
            <cst>-2.525931200325679E-02</cst>
            <x1>1.833110971000866E+00</x1>
            <x2>1.142415410746918E-03</x2>
            <x3>-1.427945670554963E-03</x3>
            <y1>1.886490823947273E-02</y1>
```

```
            <x1_y1>-3.505398571381758E-02</x1_y1>
            <x2_y1>-2.013825310046797E-05</x2_y1>
            <y2>-3.382070752371091E-04</y2>
            <x1_y2>-1.390832228834006E-03</x1_y2>
            <y3>-1.388170757225901E-05</y3>
            <z1>1.268123360625684E-02</z1>
            <x1_z1>-7.911975456003302E-01</x1_z1>
            <x2_z1>-4.744004217142424E-04</x2_z1>
            <y1_z1>-8.099975213909554E-03</y1_z1>
            <x1_y1_z1>1.518453951147421E-02</x1_y1_z1>
            <y2_z1>1.510622971187413E-04</y2_z1>
      </polynom3Vreal>
      <polynom3Vreal name="denominateur">
            <version>1</version>
            <date>20060111182343</date>
            <degx>2</degx>
            <degy>2</degy>
            <degz>1</degz>
            <cst>1.000000000000000E+00</cst>
            <x1>-1.760382045597513E-03</x1>
            <x2>-2.182982356313444E-03</x2>
            <y1>2.420829951834317E-02</y1>
            <x1_y1>6.281796254359736E-05</x1_y1>
            <y2>-2.899848246814548E-03</y2>
            <z1>4.239695257238469E-04</z1>
            <x1_z1>-5.788012390911553E-06</x1_z1>
            <y1_z1>2.801703104688601E-05</y1_z1>
      </polynom3Vreal>
</fct_ratio>
<fct_ratio name="y1">
      <version>1</version>
      <date>20060111182343</date>
      <polynom3Vreal name="numerateur">
            <version>1</version><date>20060111182343</date>
            <degx>3</degx>
```

```
        <degy>3</degy>
        <degz>1</degz>
        <cst>-4.033455827136950E-02</cst>
        <x1>1.523968572587319E-02</x1>
        <x2>1.099453173541654E-04</x2>
        <x3>-1.240470690308393E-05</x3>
        <y1>-1.769558940824450E+00</y1>
        <x1_y1>-1.049432571351290E-03</x1_y1>
        <x2_y1>1.459462430884195E-03</x2_y1>
        <y2>3.776637343191860E-02</y2>
        <x1_y2>-2.683565291521906E-06</x1_y2>
        <y3>1.271458598799580E-03</y3>
        <z1>-1.217833273309829E-03</z1>
        <x1_z1>-6.540661547905570E-03</x1_z1>
        <x2_z1>-1.443004588936552E-05</x2_z1>
        <y1_z1>7.633533291909220E-01</y1_z1>
        <x1_y1_z1>4.388333265734879E-04</x1_y1_z1>
        <y2_z1>-1.627546854728667E-02</y2_z1>
    </polynom3Vreal>
    <polynom3Vreal name="denominateur">
        <version>1</version>
        <date>20060111182343</date>
        <degx>2</degx>
        <degy>2</degy>
        <degz>1</degz>
        <cst>1.000000000000000E+00</cst>
        <x1>-1.965803353594793E-03</x1>
        <x2>-2.254054108326833E-03</x2>
        <y1>2.205221222767206E-02</y1>
        <x1_y1>5.696032767924435E-05</x1_y1>
        <y2>-2.933458487721118E-03</y2>
        <z1>4.238460592521318E-04</z1>
        <x1_z1>-5.364127940521576E-06</x1_z1>
        <y1_z1>7.142890410417380E-06</y1_z1>
    </polynom3Vreal>
```

```
</fct_ratio>

</trans_coord_ratio>
```

Top