Multidirectional Typesetting in XSL-FO

Jean-Michel Hufflen

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Jean-Michel HUFFLEN
LIFC (EA CNRS 4157)
University of Franche-Comté
16, route de Gray
25030 BESANÇON CEDEX
FRANCE
jmhufflen@lifc.univ-fcomte.fr
http://lifc.univ-fcomte.fr/home/~jmhufflen

Abstract

XSL-FO texts use an XML-like syntax that aim to describe high-quality print outputs. This article complements the introduction to XSL-FO EuroBachoTEX 2007. We show how XSL-FO allows users to typeset texts belonging to different writing systems: from left to right, from right to left, ... We compare this implementation to TEX-like typeset engines, e.g., XƎTEX.
Keywords multidirectional typesetting, Unicode, XƎTEX.

Streszczenie

XSL-FO są tekstami XMLowymi, których celem jest opisywanie wydruków o wysokiej jakości. Niniejszy artykuł jest uzupełnieniem wprowadzenia do XSL-FO przeprowadzonego na konferencji EuroBachoTEX 2007. Pokażemy, jak XSL-FO pozwalają użytkownikowi składać teksty w różnych systemach pisma: z lewej do prawej, z prawej do lewej, ... Porównamy tę implementację do maszyn TEXowych takich jak np. XƎTEX.
Słowa kluczowe drukowanie wielokierunkowe, Unicode, XƎTEX.

0 Introduction

This article continues the introduction to XSL-FO[1] given in [7]. Let us recall that this language aims to describe high-quality print outputs using XML[2] syntax. Reading this article requires basic knowledge of XSL-FO, as introduced in [7], and of Unicode [12]. More complete introductions to XSL-FO's general features are [1, 9, 10], the official document being [15]. At first glance, texts written using XSL-FO may seem to be very verbose, but let us recall that this language is not devoted to direct use. The 'normal' way to build an XSL-FO text is to get it as an output file of XSLT[3], the language of transformations used for XML texts[4]. We demonstrated this point in [7, § 2], but do not use it in the present article.

Here we focus about multidirectional typesetting in XSL-FO and explain the principles guiding it. Let us recall that some natural languages—e.g., Hebrew and Arabic—are typeset from right to left, some—e.g., traditional Japanese—uses vertical writing. Our demonstrations[5] will be performed by using Apache FOP[6] [2], which yields PDF[7] or PNG[8] figures.

1 Layout and writing mode

Let us consider the XSL-FO text given in Figure 1. The layout, given by the `fo:simple-page-master` element, defines a paper format and its margins, where anything cannot be printed. It also defines *regions*, as shown in Figure 2. The localisation of pages' margins is *physical*, that is, the top margin will be always... at the top of the page, the bottom one will be always at the bottom, and so

* Title in Polish: *Skład wielokierunkowy w* XSL-FO.
[1] e**X**tensible **S**tylesheet **L**anguage—**F**ormatting **O**bjects.
[2] e**X**tensible **M**arkup **L**anguage. Readers interested in a general introductory book to this formalism can refer to [11].
[3] e**X**tensible **S**tylesheet **L**anguage **T**ransformations.
[4] Besides, some XSL-FO processors—e.g., Apache FOP [2]—allow users to join transformations performed by means of XSLT and typesetting XSL-FO texts. But they are still based on XSLT's 'old' version (1.0) [14], introduced in [5, 6].
[5] Passive TEX [3] is a TEX-based engine that may be used as an XSL-FO processor, but it does not provide multidimensional typesetting.
[6] **F**ormatting **O**bjects **P**rocessor.
[7] **P**ortable **D**ocument **F**ormat.
[8] **P**ortable **N**etwork **G**raphics.

```
<?xml version="1.0" encoding="ISO-8859-2"?>

<fo:root xmlns:fo="http://www.w3.org/1999/XSL/Format">

  <fo:layout-master-set>
    <fo:simple-page-master master-name="page-simple" page-height="297mm" page-width="210mm"
                           margin-top="10mm" margin-bottom="20mm" margin-left="25mm"
                           margin-right="25mm" writing-mode="lr-tb">
      <fo:region-body margin-top="20mm" margin-left="20mm" margin-right="20mm"/>
      <fo:region-before extent="20mm"/>
      <fo:region-after extent="20mm"/>
      <fo:region-start extent="15mm" reference-orientation="90"/>
      <fo:region-end extent="15mm"/>
    </fo:simple-page-master>
  </fo:layout-master-set>

  <fo:page-sequence master-reference="page-simple" font-family="serif" font-size="18pt"
                    text-align="left" xml:lang="po">
    <fo:static-content flow-name="xsl-region-before">
      <fo:block text-align="center" font-size="10pt">Pieśń ludowa z opolskiego</fo:block>
    </fo:static-content>
    <fo:static-content flow-name="xsl-region-start">
      <fo:block text-align="center" font-size="10pt">III Symfonia</fo:block>
    </fo:static-content>
    <fo:flow flow-name="xsl-region-body">
      <fo:block>Ej, ćwierkejcie mu tam,</fo:block>
      <fo:block>wty ptosecki boze,</fo:block>
      <fo:block>kiedy mamulicka</fo:block>
      <fo:block>znaleźć go nie moze.</fo:block>
      <fo:block start-indent="10pt">A ty, boze kwiecie,</fo:block>
      <fo:block start-indent="10pt">kwitnijze w około,</fo:block>
      <fo:block start-indent="10pt">niech się synockowi</fo:block>
      <fo:block start-indent="10pt">choć lezy wesolo.</fo:block>
    </fo:flow>

  </fo:page-sequence>

</fo:root>
```

Figure 1: Henryk Mikołaj Górecki's 3rd Symphony, 3rd movement, last stanza.

on. On the contrary, regions' placement depend on a *writing mode*. This information specifies two directions: the first is the *inline-progression-direction*, which determines the direction in which words will be placed, and the second is the *block-progression-direction*, which determines the direction in which blocks and lines are placed one after another. This information is expressed within the *page model* by means of a `writing-mode` attribute, that can be set to:

`lr-tb` for 'left-to-right, top-to-bottom' (the default value), suitable for languages such as English, Polish, etc.;

`rl-tb` for 'right-to-left, top-to-bottom', suitable for languages such as Hebrew and Arabic;

`tb-rl` for 'top-to-bottom, right-to-left', suitable for traditional Japanese;

`lr-alternating-rl-tb` inline components within the first line are stacked left-to-right, within the second line they are stacked right-to-left, continuing in alternation; lines and blocks are stacked top-to-bottom[9];

`lr-alternating-rl-bt` like the previous value, but lines and blocks are stacked bottom-to-top[10];

`lr-inverting-rl-bt` like the previous value, but in addition, inline components within even lines are inverted[11];

[9] This writing system is called *boustrophedon*: from Greek etymology, that means 'turning like oxen in ploughing'. Some archaic Greek inscriptions used this system.

[10] Some pre-Columbian scripts in Classical Quechuan — the Inca Empire's language — used this system.

[11] This *reverse boustrophedon* was discovered in some undeciphered scripts in Rapa-Nui.

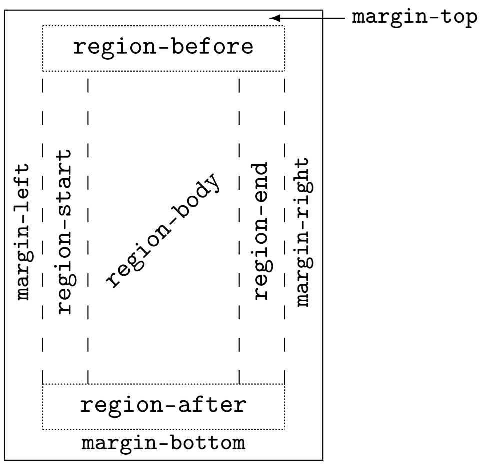


Figure 2: A page's regions for `lr-tb` writing mode.

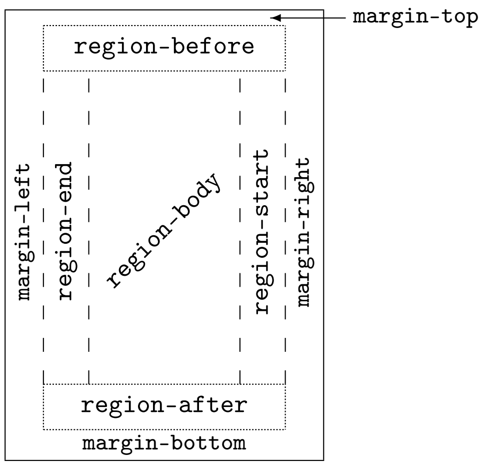


Figure 3: A page's regions for `rl-tb` writing mode.

`tb-lr-in-lr-pairs` text is written in two-character, left-to-right, pairs; these pairs are then stacked top-to-bottom to form a line; lines and blocks are stacked left-to-right[12].

Other analogous values are[13]:

`tb-lr`[14] `bt-lr bt-rl lr-bt rl-bt`
`lr-inverting-rl-tb`

`rl`, `tb` are shorthands for `lr-tb`, `rl-tb`, `tb-rl`.

In *regions*, something can be printed as a *static content* — e.g., a page number — or a *flow* — for a text possibly printed on regions belonging to several successive pages. Regions' names do not express 'geographical' directions, such as 'top' or 'bottom', but come from a relative frame reference depending on a writing mode[15]. The 'before' and 'after' (resp. 'start' and 'end') regions are always related to the block-progression-direction (resp. inline-progression-direction). A `writing-mode` attribute set to `"lr-tb"` yields to what is pictured in Figure 2. Other region placements are given in Figures 3 & 4 for `rl-tb` and `tb-rl` writing modes. If the writing mode specifies an inline-progression-direction of left-to-right for odd-numbered lines, and right-to-left for even-numbered lines — that is, when the writing mode is '`lr-alternating-rl-...`' or '`lr-inverting-rl-...`' — the `region-start` (resp. `region-end`) is located at the left (resp. right). If the writing mode is `tb-lr-in-lr-pairs`, the placement rules are the same than for `tb-lr`.

[12] This writing system was used by the pre-Columbian Mayan language.

[13] Readers interested in the history of writing systems can refer to [4], written in French but very clear and providing many examples.

[14] This writing system was used by some old Mongolian scripts.

[15] In addition, the declaration order for the elements modelling these regions is `fo:region-body`, `fo:region-before`, `fo:region-after`, `fo:region-start`, `fo:region-end`; all but but the first being optional. [7, Fig. 2] was correctly processed by some XSL-FO processors' previous versions that were lazy about this point, but that is faultly. The correct order is given in Figure 1. In addition, let us mention that the body's margins are specified 'geographically', by means of the attributes `margin-top`, `margin-bottom`, `margin-left`, and `margin-right`. Do not confuse body's margins with pages': there is no overlapping between pages' margins and pages's regions. Last, let us notice that if you do not define body's margins, the `region-before`, `region-after`, `region-start` and `region-end` will overlap the `region-body`.

In fact, the definitive placement of regions results from a combination of a writing mode with a `reference-orientation` attribute, which is an angle whose value is given in degrees and defaults to zero. More detailed examples can be found in [10, Fig. 3.4]. Each region can define its own writing mode and reference orientation, otherwise these attributes are inherited from parent elements, as done usually in XSL-FO. As an example, we define such a reference orientation in Figure 1 for the 'start' region, the result is pictured in Figure 5.

2 Present and future

As mentioned in [15, §§ 1.2.5 & 5.8], an XSL-FO processor must implement the Unicode bidirectional algorithm [13]. Let us recall that this algorithm only applies to paragraphs, that is, *blocks* w.r.t. XSL-FO's terminology. In addition, this algorithm requires some adaptations to fit into the XSL-FO processing model. The inline-progression-direction is determined at the block level by the writing mode — possibly refined by means of a `fo:block-container`

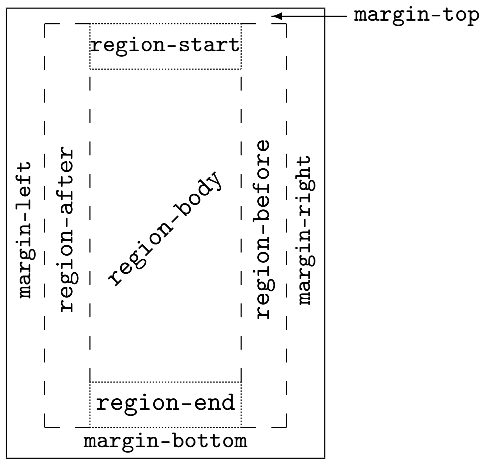
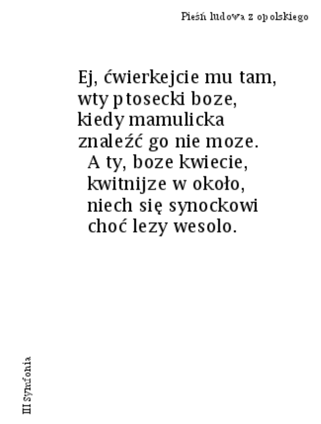


Figure 4: A page's regions for `tb-rl` writing mode.


Pieśń ludowa z opolskiego

Ej, ćwierkejcie mu tam,
wty ptosecki boze,
kiedy mamulicka
znaleźć go nie moze.
  A ty, boze kwiecie,
  kwitnijze w około,
  niech się synockowi
  choć lezy wesolo.

III Symfonia

Figure 5: The formatted output of Fig. 1.

element [15, § 6.5.3] — and within the inline formatting objects within a block — by refining the writing mode of a `fo:inline-container` element [15, § 6.6.8] or by means of the attributes `direction` and `unicode-bidi` associated with a `fo:bidi-override` element [15, § 6.6.2]. Character properties, as they are defined by the standard Unicode [12], are implicit or may be refined by means of the `fo:character` element [15, § 6.6.3]. The inline-progression-direction of each glyph[16] is used to control the stacking of glyphs.

To sum up, XSL-FO bidirectional algorithm is not controlled by functionalities related to precise natural languages, as did in XƎTEX [8] — by means of natural-language-oriented environments such as `arab` and `urdu` — but is superseded by informations about writing modes.

At the time of writing, this algorithm is not fully implemented yet by XSL-FO processors. Besides, most processors difficultly deal with non-Latin characters. However, some interesting effects can be observed by using the attributes `writing-mode` and `direction`, even on texts writing using the Latin alphabet. As two additional examples:

- the source text of Figure 6 is obtained from Figure 1's text by changing the `writing-mode` attribute of the `fo:root` element to `"rl-tb"`;
- the source text of Figure 7 is obtained from Figure 1's text by applying the following changes:
  - the `writing-mode` attribute of the root element, `fo:root`, is set to `"tb-rl"`;
  - the font size used for the `start-region`'s contents has become smaller:

    ```
    <fo:block text-align="center"
              font-size="9pt">
      III Symfonia
    </fo:block>
    ```
  - the second `fo:block` element is replaced by:

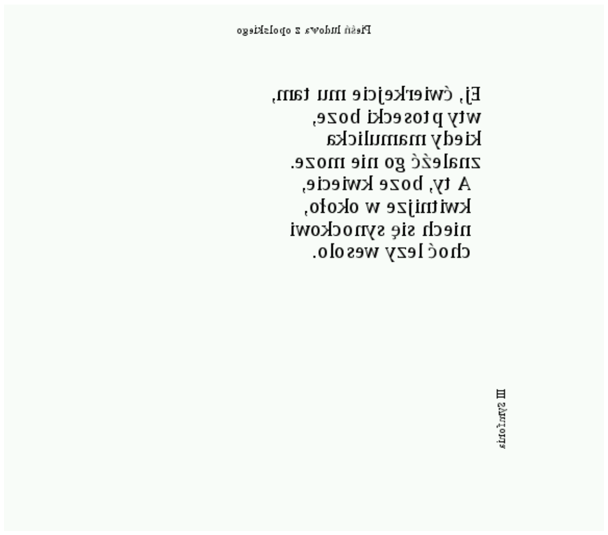
    ```
    <fo:block-container
      writing-mode="rl-tb">
      <fo:block text-align="right">
        wty ptosecki boze,
      </fo:block>
    </fo:block-container>
    ```

More examples will be demonstrated at the BachoTEX 2009 conference.

3 Acknowledgements

Many thanks to Jerzy B. Ludwichowski, who has translated the abstract and keywords in Polish very quickly.

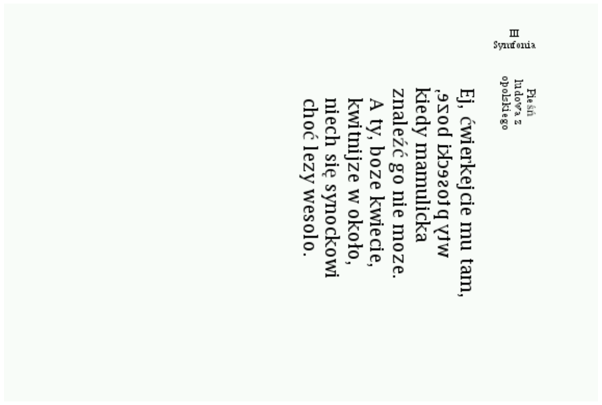
[16] See [12] for more details about Unicode's terminology.


Pieśń ludowa z opolskiego

Ej, ćwierkejcie mu tam,
wty ptosecki boze,
kiedy mamulicka
znaleźć go nie moze.
A ty, boze kwiecie,
kwitnijze w okolo,
niech się synockowi
choć lezy wesolo.

III
Symfonia

Figure 6: Formatting a text in `tb-rl` writing mode (page's upper part).


III
Symfonia

Pieśń ludowa z opolskiego

Ej, ćwierkejcie mu tam,
wty ptosecki boze,
kiedy mamulicka
znaleźć go nie moze.
A ty, boze kwiecie,
kwitnijze w okolo,
niech się synockowi
choć lezy wesolo.

Figure 7: Formatting a text in `tb-rl` writing mode (page's upper part).

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