Plan and Design for a Mathematical Content Editor based on Fixidea (SVG)

MAINLINE (CNRS / University of Nice)

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Plan

- Mainline research project
- Short overview of Fixidea
- SVG: What and Why?
- Problem with existing techniques
- Our solution: Fixidea (technical details)
- Extension of Fixidea for editing
- Conclusion and perspectives
MAINLINE

- University of Nice / CNRS (i3S)
- Multimedia Applications Involving Non Linear Information for Networked Education
  - Knowledge management of learning material
  - Mathematical content services and tools
  - Mobility and E-Learning (wearable computer)
Fixidea: Overview

- Java Software framework for rendering structured documents
  - XML documents
  - Bridge between content and display
  - Limited edition and selection facilities
- Applied to XML Mathematical Markup
  - MathML Content
  - OpenMath
- Display using SVG
What is SVG?

- Stands for Scalable Vector Graphics
- Defines vector-based 2D graphics
  - “Postscript++ for the Web”
- XML grammar
- W3C Recommendation (SVG-1.0: 2000/11)

Features

- Plain text format (searchable and selectable)
- Scalable
- Zoomable
- Scriptable (animation) / Interactive (dynamic)
Why SVG for Rendering Formulae?

- Vectorial rendering
  - Scalable, Zoomable
- Interactive document
- Format conversion
  - Vectorial (.ps)
  - Bitmap (.png, .jpg, .gif, ...)
  - Others xml dialects
- Mixing drawings and math
- Ready to print in PDF format
- Web integrated
# Techniques for Rendering Formulae on the Web

<table>
<thead>
<tr>
<th></th>
<th>Images</th>
<th>HTML</th>
<th>Plugins</th>
<th>Applets</th>
<th>MathML</th>
<th>SVG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Interactivity</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Std. Format</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Fonts</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Diagrams</strong></td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Printing</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- **Quality**: rendering quality
- **Resolution**: fixed resolution
- **Size**: document size
- **Interactivity**: allow interaction with formula
- **Content**: allow embedding semantics of formula
- **Standard format**: standard format for the web and for mathematics
- **Fonts**: need system fonts for rendering
- **Diagrams**: allow mixing formulae and diagrams
- **Printing**: printable format (or easy inclusion in printable format)
SVG in Practice

- Available on every kind of platform
  - PC (Linux, Windows), Mac, PDA, etc.
- Java SVG toolkit:
  - Suiggle SVG Browser / Batik (Apache)
  - SVG Toolkit (Csiro)
  - X-Smiles XML Browser (X-Smiles org)
- Can be considered as:
  - A low cost but functionally rich canvas
    - easy to generate and support filter Fx
  - An interactive interface to the underlying document
Mathematical Standards to SVG

- MathML Presentation markup to SVG
  - SchemaSoft (http://www.schemasoft.com/MathML)
- MathML Content markup to SVG
  - Content to Presentation with XSLT stylesheet
  - Presentation to SVG with SchemaSoft

- OpenMath to SVG
  - Nothing

- Conclusion: if it exists, it uses XSLT!
Problem with Existing Solutions

- Existing solutions:
  - *Something* to SVG via XSLT

- For editing, need a backward bridge from SVG to XML
Proposed Solution: Fixidea

- Proposed solution:
  - Components: Java classes (plug-in)
  - Instantiation on XPath expressions

Hierarchy of components

XML Document

SVG Document

Mainline, Mathematics on the Semantic Web, 2003 may
Fixidea: Global Presentation

Fixidea

Generating SVG

\[ \int \omega = \int \left( \sum a_i(t) \frac{dx_i}{dt} \right) dt \]

SVG Events

Resource File

Components Code (Plug-ins Java classes)

<OMOBJ>
  <math>
    <apply>
      <plus/>
      <ci>x</ci>
      <cn>1</cn>
    </apply>
  </math>
</OMOBJ>
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE fixidea SYSTEM "resources/fixidea.dtd">
<fixidea>
  <component id="math"             match="self::math" type="fr.essi.mainline.fixidea.mathmleditor.MathMLComponent" drawer="fr.essi.mainline.fixidea.drawcomponents.LineObjectDrawer" priority="&NoPrio;">
    <parameter name="tag" value="math"/>
  </component>
  <component id="plus"             match="self::apply/*[position()=1 and local-name()='plus'] | self::apply/*[position()=2 and local-name()='plus']" type="fr.essi.mainline.fixidea.mathmleditor.MathMLComponent" drawer="fr.essi.mainline.fixidea.mathmleditor.InfixObjectDrawer" priority="200">
    <parameter name="tag" value="plus"/>
    <parameter name="lspace" value="mediummathspace"/>
    <parameter name="rspace" value="mediummathspace"/>
    <parameter name="symbolID" value="plusSymbol"/>
    <parameter name="key" value="+"/>
  </component>
  <component id="ci"             match="self::ci" type="fr.essi.mainline.fixidea.mathmleditor.MathMLComponent" drawer="fr.essi.mainline.fixidea.drawcomponents.LineObjectDrawer" priority="&MaxPrio;">
    <parameter name="tag" value="ci"/>
  </component>
</fixidea>

<?xml version="1.0"?>
<math xmlns="http://www.w3.org/1998/Math/MathML">
  <apply>
    <plus/>
    <ci>x</ci>
    <cn>1</cn>
  </apply>
</math>
Fixidea: Important Points (1)

- “Son of JOME” (*Java OpenMath Editor*)
  - Open source
  - Free for all the community
- Designed to be:
  - Generic, Flexible (for math but also for drawings)
  - Extensible (plug-in system)
  - Usable into
    - Browsers
    - Applications
Fixidea: Important Points (2)

- Several input formats
  - MathML Content (*complete*)
  - OpenMath (*some tests*)
  - GraphML (*not yet implemented*)
- Several output formats (*thanks to svg*)
  - Bitmap images (.*png, .jpg, .tif, .gif, ...*)
  - Vectorial formats (.*ps, .svg*)
  - Printable formats (.*ps, .pdf*)
Fixidea: a Core Component for Editing

**Objectives:**
- Embedded as a software component

![Diagram showing Fixidea as a central component with inputs and outputs]

- **XML Inputs**
- **Dedicated Parsers**
- **Keyboard Input**
- **Other Inputs**

- **Plug-ins**
  - **SVG Rendering**
  - **Conversion Package**
  - **MathML OpenMath Output**

Mainline, Mathematics on the Semantic Web, 2003 May
Fixidea: Editing Math on the Web

- Different solutions (currently exploring)

- Graphical Applet
- Dedicated Plug-in
- SVG Plug-in + Applet
- SVG Plug-in + Web Service
- ...

\[
\int \omega = \int \left( \sum a_i(t) \frac{dx_i}{dt} \right)
\]

\[
c(t) \quad t = b
\]
Fixidea: Possible Extensions

Currently
- Produces SVG documents for the Web
- Limited edition and selection
- Serialization as MathML, SVG
- Implementation of specific classes for OM

Future
- Mix graphs, diagrams and formulae
- Software component (Java Bean) to include in:
  - Applets
  - Applications
Examples of SVG documents

- Currently:

\[ \int_{c(t)}^{a} \omega = \int_{t=b}^{a} \left( \sum a_i(t) \frac{dx_i}{dt} \right) dt = \int_{t=b}^{a} \left( \sum a_i(\varphi(\tau)) \frac{dx_i}{d\tau} \frac{d\tau}{dt} \right) dt \]

- Future work:
Conclusion

- MathML 2.0
  - Support for Content Markup (not presentation)
  - Doesn't handle some tags (annotations, declare)
- OpenMath
  - First tests (should be enhanced)
- Rendering
  - Has been enhanced (uses LaTeX fonts)
  - Can use system fonts
- http://mainline.essi.fr/wiki/bin/view/Fixidea
Perspectives

- Adding functionalities for editing formulae
  - Linear edition module
  - 2 dimensional edition module
- Exploring all solutions for editing inside a browser
- Mixing graphs, diagrams and formulae

- Looking for partners to enhance Fixidea:
  - Contributors
  - Within EU instruments