XMILE's Display and Interface: Gaining insights from models

Billy Schoenberg
Software Engineer
isee systems

Gary Baxter
MEMIC
Today’s Agenda

• Introduce Display and Interface objects in two popular modeling tools.
• Highlight significant benefits to modelers of having standard Display and Interface capabilities

• Review and Introduction to the XMILE standard
• Technical discussion of the Display and Interface portions of the XMILE standard
  • XMILE Views
  • Linking model objects and display objects
  • The cascading style system
  • Representation of stock and flow diagrams
  • Review available interface-type objects
Display Objects

• All visual objects representing model equations in a stock and flow diagram.

• Stocks, Flows, Auxiliaries, and Connectors.

• Other visual objects – groups, ghosts, etc.
Display Objects

• Nothing unique about how they are implemented – basically the same look and feel.

• Non-standard set of attributes available for customization.
Interface Objects

• All those visual objects that allow the modeler or customer to interact with the model.

• Buttons, graphs, and input sliders.

• Other visual objects – tables, switches, etc.
Interface Objects

• Nothing unique about how they are implemented – basically the same look and feel.

• Non-standard set of attributes available for customization.
Benefit to Modelers

• Current situation

  • Display and Interface Objects are similar but do not share a standard set of attributes.
  
  • Two separate models in two separate file formats.
  
  • One modeling package for duration of the modeling project.
  
  • Limited to that package’s features and functionality.
Benefit to Modelers

• Future opportunity
  
  • Common file format and a basic “core” set of capabilities.
  
  • Have a truly portable model.
  
  • All the features and functionality of all the packages are now available.
  
  • An opportunity to produce better models.
  
  • Easier consumption of models by other applications.
Do Your Part

• Ask your vendors when they plan to adopt XMILE.

• Here’s the answer I’m looking for:

  “We are committed to implement XMILE in our first major release after formal adoption of the standard.”
Today’s Agenda

• Introduce Display and Interface objects in two popular modeling tools.
• Highlight significant benefits to modelers of having standard Display and Interface capabilities

• Review and Introduction to the XMILE standard
• Technical discussion of the Display and Interface portions of the XMILE standard
  • XMILE Views
  • Linking model objects and display objects
  • The cascading style system
  • Representation of stock and flow diagrams
  • Review available interface-type objects
What is the XMILE standard?

• Open standard and file format for system dynamics models.

• Developed by OASIS Technical Committee (formed in June 2013) composed of software vendors and individual practitioners.

• Builds on more than a decade of discussion in the SD community, and specifically a draft standard published by Karim Chichakly in 2007.

• Draft to be released July 2014, with final release Fall 2014.
Technical Discussion of the Specification
The XMILE View

• Container for all XMILE display objects
• Optional types of views – stock and flow, interface, popup and vendor specific
  • Only stock and flow views can contain the canonical representation of XMILE variables
• Size (width, height) <double>
• Zoom <double>
• Background color or image
XMILE view assumptions and attributes

• All objects in a view must have
  • Position (x,y) <double>
  • Size (width,height) <double> or a child Shape tag

• Stocks cannot be represented using a circle

• Auxiliaries and Flows cannot be represented using a rectangle **UNLESS** they contain a macro/function with an implicit stock

• The shape tag allows for the specification of arbitrary shapes for any display object (pursuant to the above 2 rules)

• Shapes have a required type of rectangle, circle, name_only or vendor specific.

• Rectangle shapes require width, height <double> and optional corner-radius <double> (default: 0)

• Circle shapes require radius <double>

• Name only shape is a marker – no required attributes
Referencing variables in an XMILE view

• Any object appearing in the <variables> tag should have a related <stock|flow|aux|module|group> tag in a <view> tag

• A tag within a <view> is linked to its corresponding tag in the <variables> tag via its name

```xml
<xmile>
  <model>
    <variables>
      <stock name="My_stock"/>
    </variables>
    <views>
      <view>
        <stock name="My_stock" x="100" y="100"
               width="35" height="25"/>
      </view>
    </views>
  </model>
</xmile>
```

**Important:** The first encountered instance of a variable’s view is its canonical representation.
What about objects without a name?

• Graphs, Tables, Sliders, Buttons etc don’t have a name
• Their ‘name’ is their uid (unique identifier) <int>
  • Linearly increasing
  • Not stable across model IO operations
  • Unique per XMILE Model
• uid’s allow us to refer to objects without a name
Ghosts, Shadow Variables, etc. are XMILE Aliases

- An alias is a symbol representing a “portal” to the display of another XMILE model object in the same view.
  - Keeps diagrams neat and prevents connectors from crossing
  - Aliases are allowed to have connectors leaving them, but never pointing to them

```xml
<alias uid="1" x="50" y="100">
  <of>My_stock</of>
</alias>
```

- `uid` - The ‘name’ for the alias
- `x,y` - Its position (all of its size/shape properties are inherited from the variable it represents by default)
- `of` - The name of the model entity which this alias represents. The model entity must be in the same model as the alias.

Doesn’t have a name needs a UID
How do we describe the visual relationships between variables?

- The `<connector>` tag is used to describe the visual appearance of the relationships between XMILE model objects.
- A connector is an arrow which only ever appears between two display objects.

```xml
<connector uid="1" x="50" y="100" angle="32"/>
<from>
  <alias uid="1"/>
  <from>
    <to>My_flow</to>
  </from>
</connector>
```

That’s how we use a UID

- The typical connector is an arc, but with XMILE we can represent Bezier connectors with multiple points using the `<pts>` tag.
Commonly seen XMILE display object attributes

- **border-width**="thick | thin | <double>" – default=1px –thick=3px –thin=1px
- **border-color**="<hex code> | predefined color*"
- **border-style**="none | solid" –default=none
- **font-family**="<string>"
- **font-style**="normal | italic" – default=normal
- **font-weight**="normal | bold" – default=normal
- **text-decoration**="normal | underline" – default=normal
- **text-align**="left | right | center"
- **vertical-text-align**="top | bottom | center"
- **font-color**="<hex code> | predefined color*"
- **text-background**="<hex code> | predefined color*"
- **font-size**="<double>pt"
- **padding**="<comma separated list of no more than 4 doubles and no fewer than 1 double>"**
- **color**="<hex code> | predefined color*"
- **background**="<hex code> | predefined color*"
- **z-index**="<int>" –default=-1 (-1 is bottom-most, top-most is INT32_MAX ((1 << 31) – 1))
The cascading style system

• Styles refer to groups of XMILE objects depending on their location
• Styles affect the display of all related XMILE display objects

    <style font-color="blue" font-size="10">
    <stock font-weight="bold" font-color="black"/>
    <flow font-size="12"/>
    </style>

• Any related stock object would have a bold black size 10 font
• Any related flow object would have a normal weight blue size 12 font

• A <style> tag may be placed in any of the following locations which changes the display objects it affects:
  • As a child of the root (<xmile>) tag
  • As a child of a <views> tag
  • As a child of a <view> tag
The representation of a stock and flow diagram

```
<model>
  <variables>
    <stock name="Savings"/>
    <flow name="Interest"/>
    <aux name="Interest_Rate"/>
  </variables>
  <views>
    <style font-family="Arial" font-size="9" color="blue" font-color="blue"/>
    <view type="stock-flow" width="1152" height="1502" zoom="100">
      <stock name="Savings" x="237" y="109" width="35" height="25"/>
      <flow name="Interest" x="180" y="108" width="18" height="18">
        <pts>
          <pt x="146" y="108" />
          <pt x="215" y="108" />
        </pts>
      </flow>
      <aux name="Interest_Rate" x="106" y="134" width="18" height="18">
        <connector x="239" y="126" uid="0">
          <from>Savings</from>
          <to>Interest</to>
        </connector>
        <connector x="115" y="134" uid="1">
          <from>Interest_Rate</from>
          <to>Interest</to>
        </connector>
      </aux>
    </view>
  </views>
</model>
```
Available interface-type objects

- Stacked Containers
- Input Objects
  - Sliders/Knobs
  - Switches/Radio Buttons
  - Numeric Input/List Input Device
  - Graphical Input
- Output Objects
  - Numeric Displays
  - Lamps/Gauges
  - Graphs
  - Tables
- Annotations
  - Text Boxes
  - Graphics Frames (images video)
  - Buttons
Stacked Containers

- Tables and Graphs can be placed in stacked containers to allow users to flip through results.
- Tables and Graphs can also show comparative results from multiple runs.
Input Objects

• Allow users to enter simulation parameters

<slider ...>
  <entity name="Input"/>
  <reset_to>8</reset_to>
</slider>
Output Objects

• These show simulation results, both instantaneous and over time
• Numeric Display, Lamp, Gauge are instantaneous
• Table, Graph* are over time

*Certain graphs are not over time
Annotations

• Used for putting pictures, videos, static text and buttons into simulations
• Buttons can perform a wide variety of simulation related actions
  • Navigation
  • Simulation actions (Run, Pause, Stop, Restore...)
  • Export/Import Data
  • Display information popup
    • Text
    • Image
    • Video
To learn more about XMILE...

XMILE overview webinar schedule:

• April 29: Introduction to XMILE
• May 20: Simulation Capabilities
• June 3: Display and Interface
• June 24: Panel Discussion
• July 21-23: Delft Conference
  • Round table discussion and ballot

Technical Committee information: [www.oasis-open.org/committees/xmile/](http://www.oasis-open.org/committees/xmile/)

Series videos are available at: [www.youtube.com/user/XMILEtc](http://www.youtube.com/user/XMILEtc)