Modelica3D

Platform Independent Simulation Visualization

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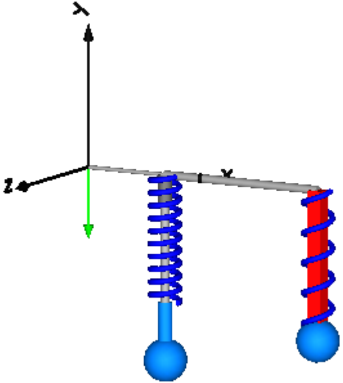
Dymola MultiBody Visualization



Motivation - Goal

Goal: Get those fancy 3D graphics standardized

Modelica3D Design

Modelica3D is . . .

- Platform-independent:
  Modelica3D can be used with OpenModelica, Dymola, ...
  Modelica3D uses only standardized techniques.
- Extensible:
  Modelica3D can be extended with new functionality (new shapes, different visualization tools etc.)
- Leightweight:
  Modelica3D does not depend on any Modelica or C libraries. It does not contain large layers of abstraction or multitudes of features.

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Modelica3D is not . . .

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  Since Modelica3D is a small library it does not contain 3D-connectors or equation support or static graphics.

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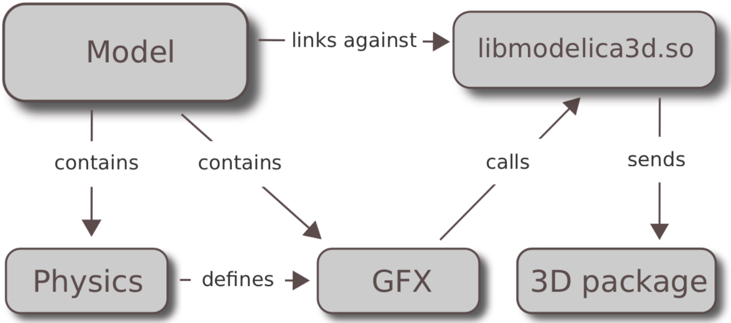
Architecture

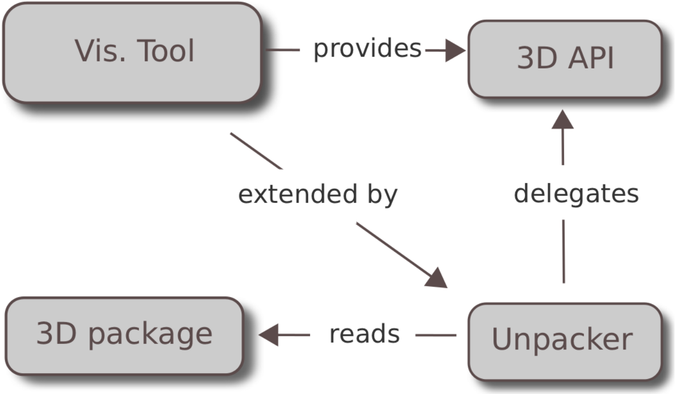
Modelica3D Architecture

- Client/Server approach
- Client: Simulation enhanced with Modelica3D
- Server: Visualization tool (e.g. Blender, 3DSMax, etc.)
- Unidirectional communication (via TCP/IP)
- Physics drive visualization
- Visualization can be ignored, stored, rendered

Modelica3D Client Architecture

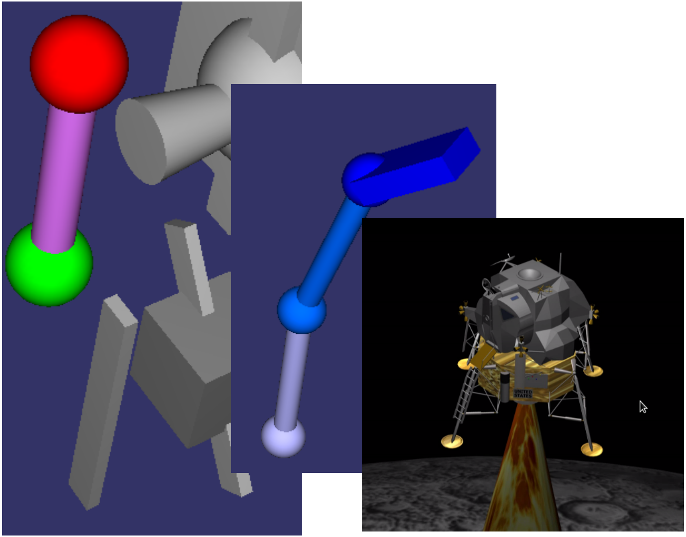


Modelica3D Server Architecture



API - Objects & Operations

Modelica3D Shapes

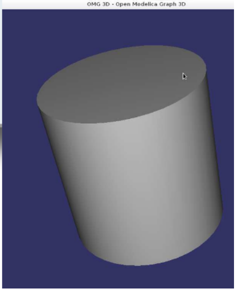


Modelica3D API - Objects

- 3D-shapes can be *instantiated*

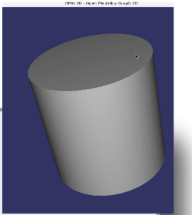
```
model Foo
  import ModelicaServices.Modelica3D;

  Modelica3D.Cylinder cyl;
end Foo;
```



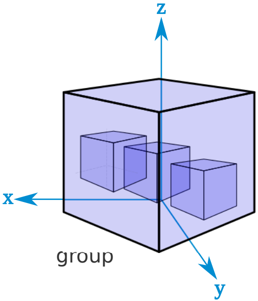
Modelica3D API - Objects II

- 3D-shapes are *external objects* (can be allocated directly)
- Shape definition is an *operation*.

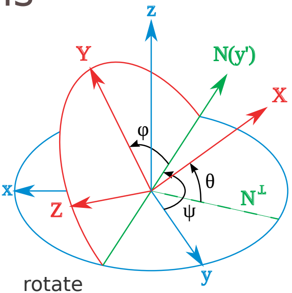


```
class Cylinder "A 3D cylinder object"
  String  name = "";
  ExtID     id = ExtID(name);
  ...
  when initial() then
        dummy := InitCylinder(id, diameter, length);
  end when;
end Cylinder;
```

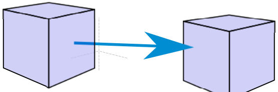
Modelica3D Operations



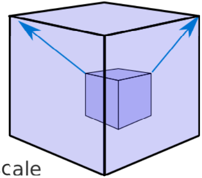
group



rotate

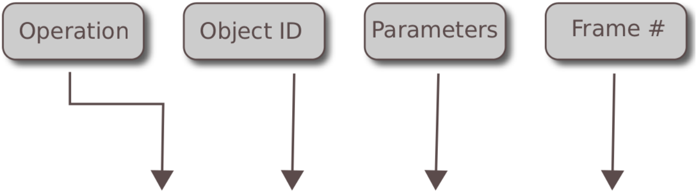


move



scale

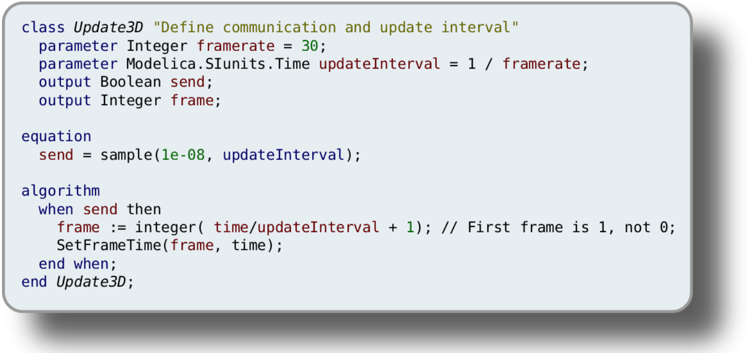
Modelica3D API Convention



```
Modelica3D.Translate(cylinder.id, 5.0, 0.0, 0.0, update3d.frame);
```

- Most operations follow this common pattern.

Modelica3D API - Sampling



```
class Update3D "Define communication and update interval"
  parameter Integer framerate = 30;
  parameter Modelica.SIunits.Time updateInterval = 1 / framerate;
  output Boolean send;
  output Integer frame;

equation
  send = sample(1e-08, updateInterval);

algorithm
  when send then
    frame := integer( time/updateInterval + 1); // First frame is 1, not 0;
    SetFrameTime(frame, time);
  end when;
end Update3D;
```

- Operations require a *frame* to take effect.
- Frames and simulation-time need to be synchronized
- Solution `Update3D` object and `when`-clause.

Application Example: MultiBody

MultiBody

- State-of-the-art in Modelica visualization
- Supports shapes, materials, tranformations
- Has a global state model bundled in `Modelica.Utilities.Internal.PartialShape`
- `Modelica.Mechanics.MultiBody.Pendulum` has 1500 variables
- Idea: Extend `PartialShape` to be extended by Modelica3D calls
- Problem: Conversion between state and Modelica3D nontrivial
- Hit some omc bugs

Demo Video

Interested?

- Mail me for an evaluation license (`christoph.hoeger ÄT tu-berlin.de`).
- Create an account at https://mlcontrol.uebb.tu-berlin.de/redmine/
- Compile Modelica3D
- Get Blender / OSG
- Visualize the Demos

Future Development

- Publish under free license
- Complete MultiBody Support
- Implement Utility Blocks
- More renderers

Thank you for your attention!

Any Questions?

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