

COLLADA: An Open Standard for Robot File Formats

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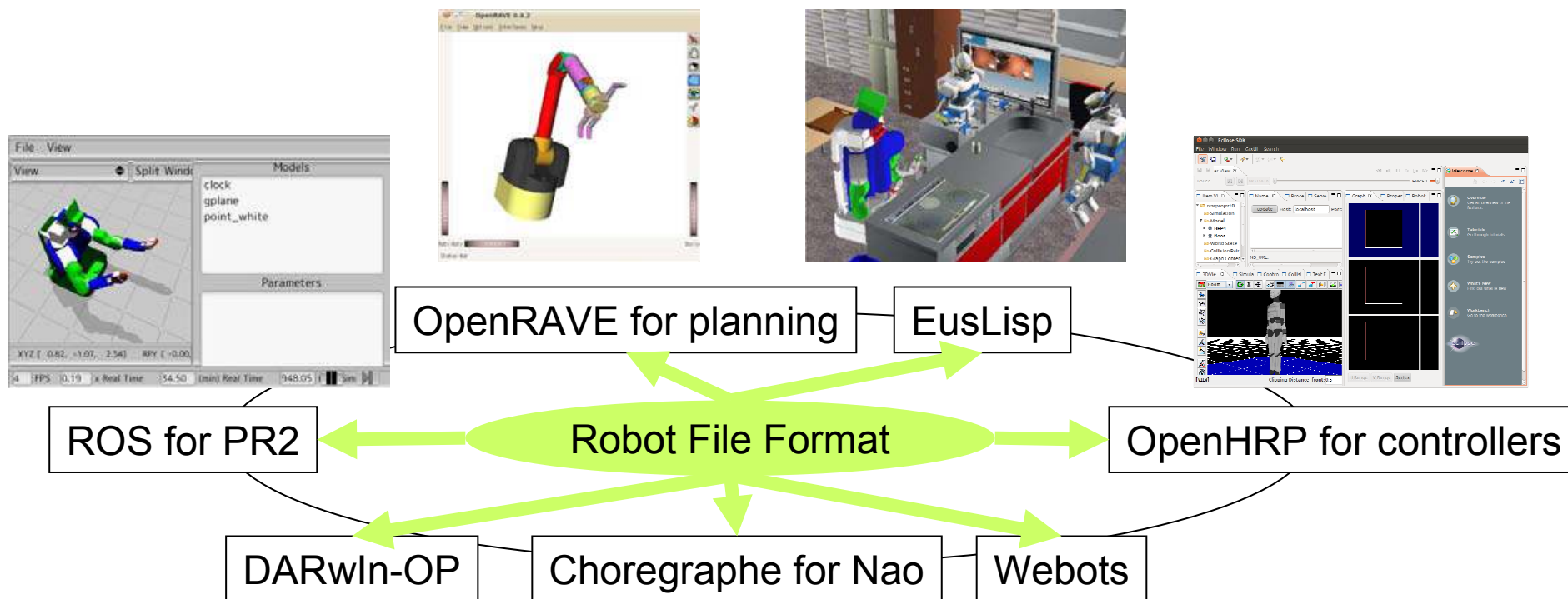
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Introduction

- Robotics Software Platforms
 - To share research tools between robots
- Missing Link: Standard Robot File Format

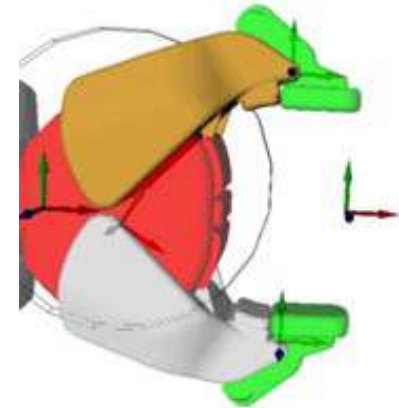


Standard Robot File Format

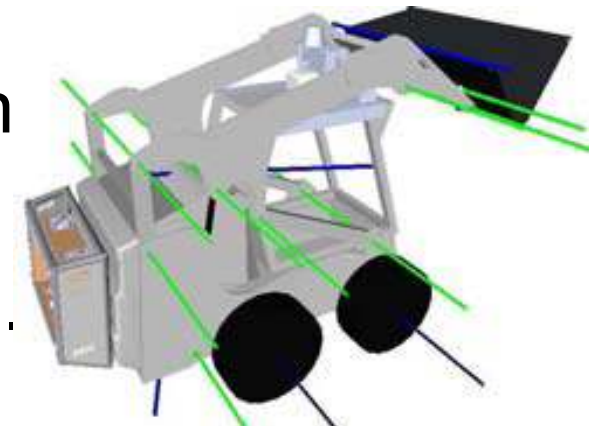
- Define robot file format standards ?
 - Kinematics, Geometry, Physics
 - Sensors, Actuators
 - And more ????
- Content-scalable
 - There will **always** be information that another developer wants to insert
 - NOT adding new information to extend the original content, BUT adding new content.
 - Manage new content and allow extensibility of existing content with the scalability.

COLLADA Features (1)

- COLLADA:COLLABorative Design Activity
 - <http://www.khronos.org/collada/>
- XML-based open standard
- Originally started as 3D model format
- Most recent version(1.5) supports physics, kinematics and b-rep splin
- Supported by Blender, OpenSceneGraph and SolidWorks.



Mimic joint



Closed link

COLLADA Specification

- Core content management tags to dictate the referencing structures
 - Geometries, kinematics bodies, physics bodies and joints as libraries
- Defines different type of scenes for graphics, physics and kinematics
 - Bind joints and links to form these scenes, not one-to-one relations between graphics and kinematics
- COLLADA kinematics supports closed links using the MathML standards

http:

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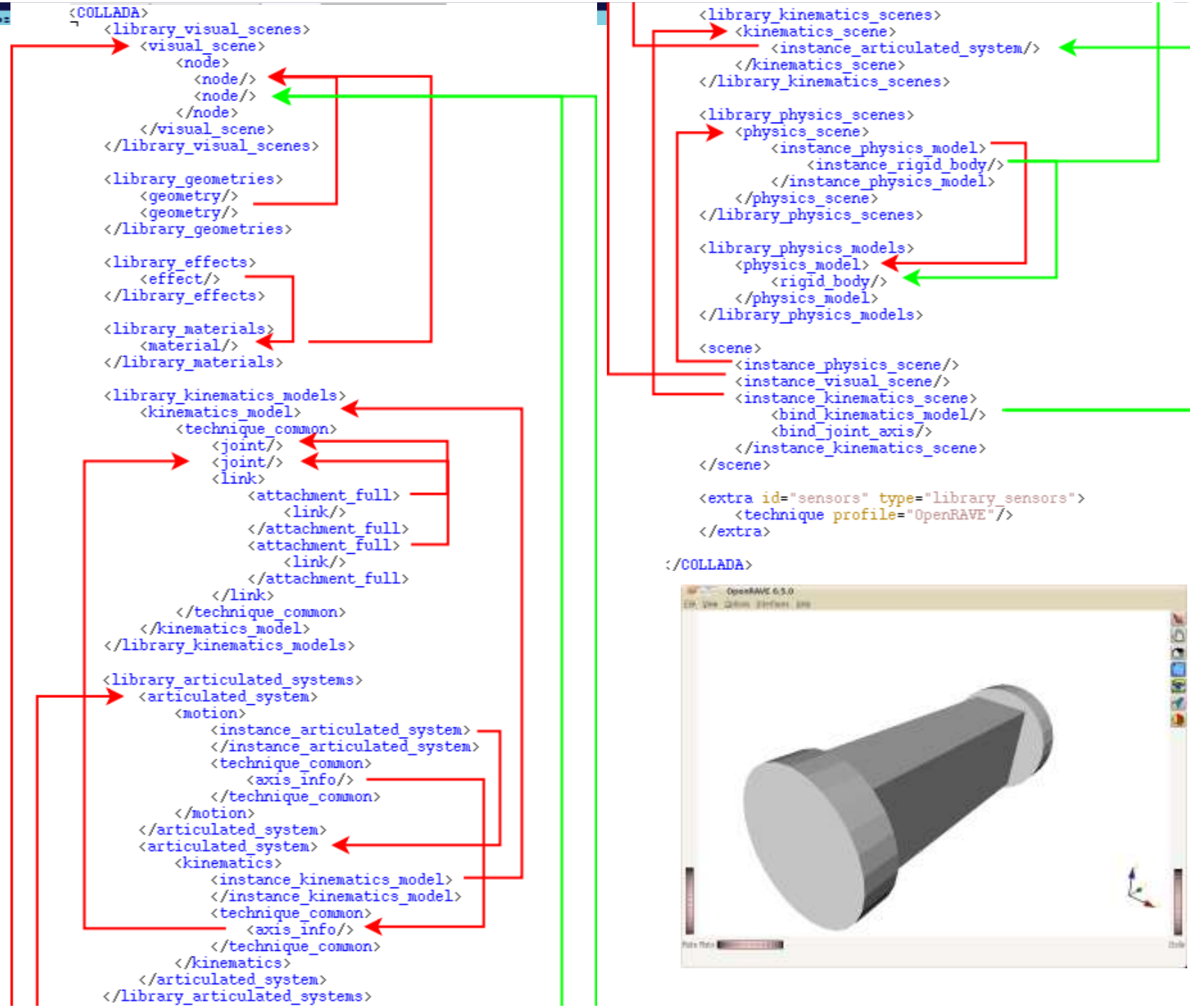
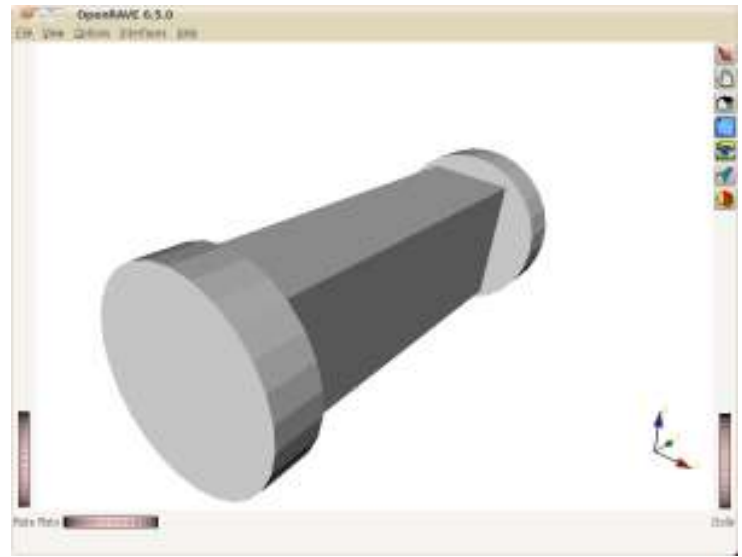
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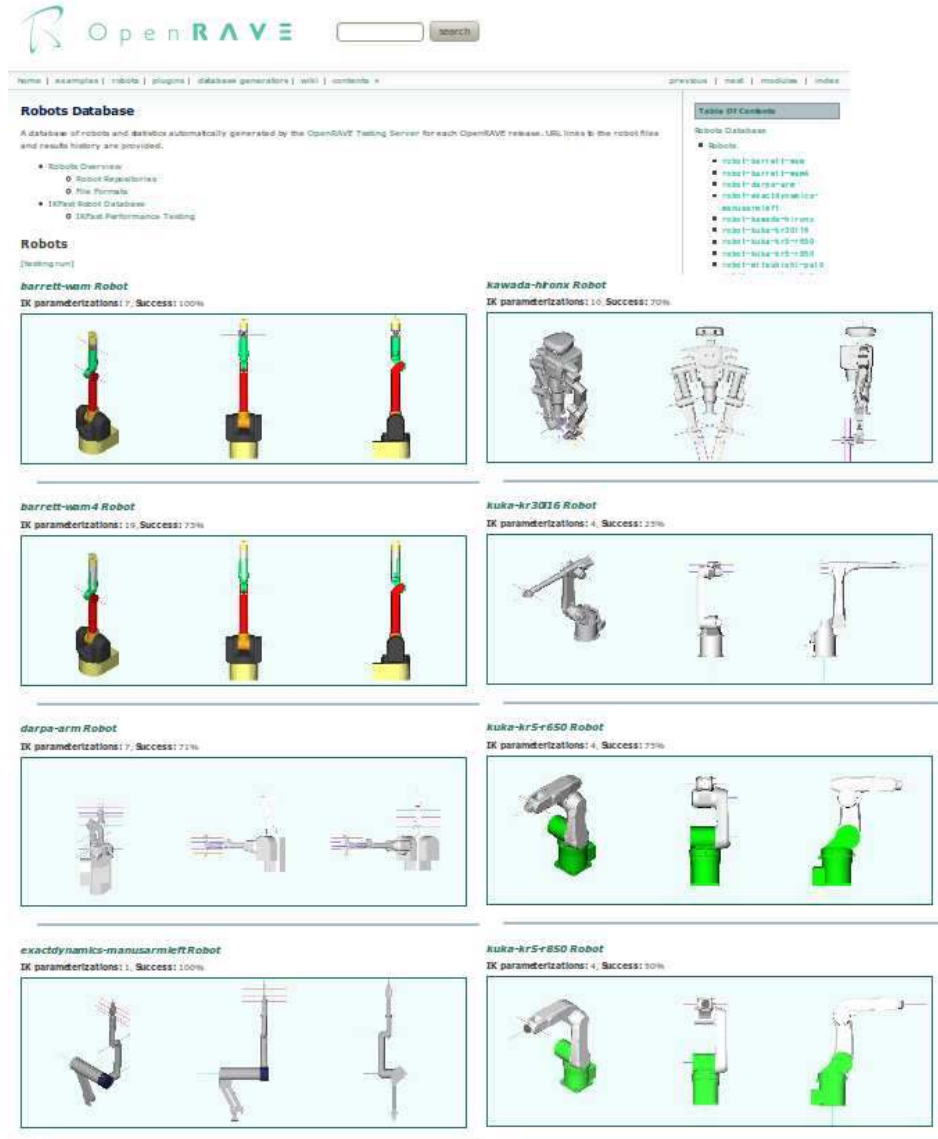


Robot-specific Extensions

- Manipulator
 - Holds a subset of the joints in a robot and defining a hand and an arm
- Sensor
 - Holds camera, laser, encoder definitions and where to place the sensor on the robot
- Actuator
 - Hold the actuation model of each joint
- Collision group
 - Allow a robot to have multiple collision models separate from visual information
- Mimic equations
 - Hold MathML equation for the partial velocity and accelerations of a mimic joints along with the position

COLLADA Robot Database

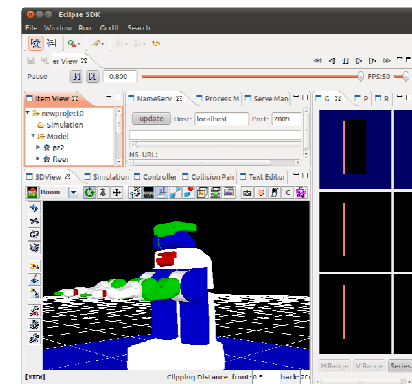
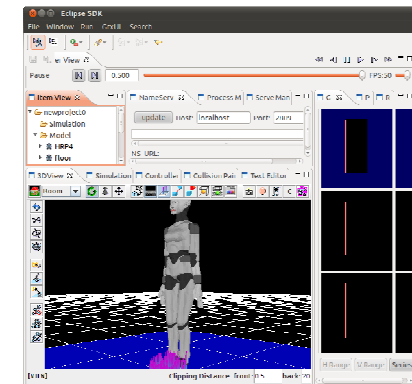
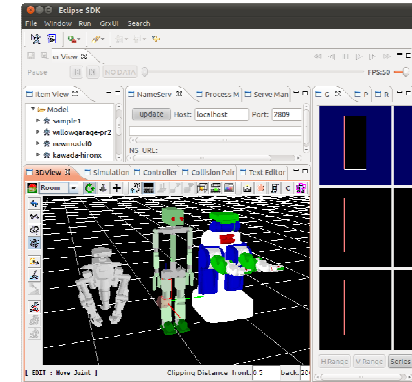
- Provide 14 sample robot models
 - Barrett, Puma, Kuka, PA10, Katana, Schunk, PR2, Hiro,
- This database also provide inverse kinematics solvers



COLLADA supported software (1)

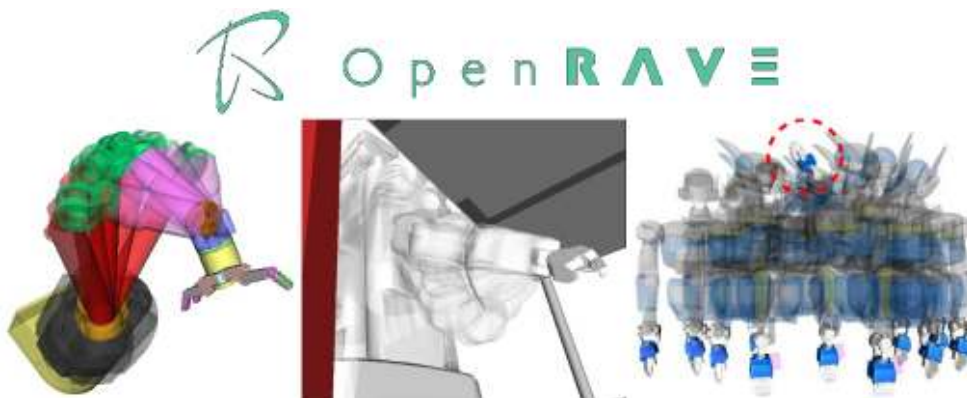
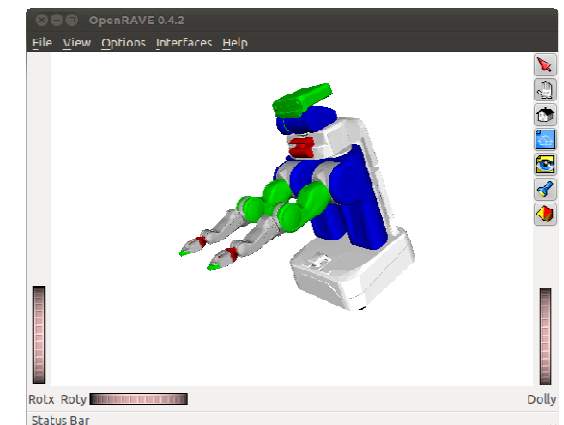
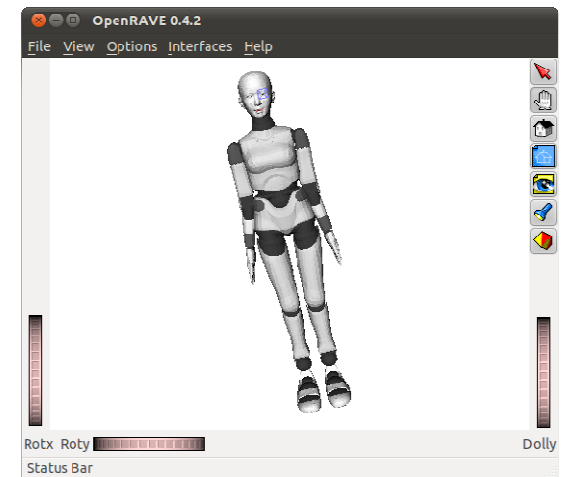
OpenHRP3

- Open Architecture Human-centered Robotics Platform version 3
 - Provide dynamics simulator, view simulator, collision detector, model loader, controller on CORBA network
 - Used for dynamics controller for both simulated and real humanoid robot
- Model file format
 - Using VRML PROTO structures defined in h-anim 1.1(specification of representing humanoids in VRML)
 - Humanoid, Joint, Segment, AccelaretionSensor, GyroSensor, VisionSensor, ForceSensor, RangeSensor
- COLLADA supported ModelLoader on CORBA network
 - Model file is parsed in ModelLoader program and converted internally to an intermediate data format to sent through CORBA network
 - COLLADA exporter is also supported



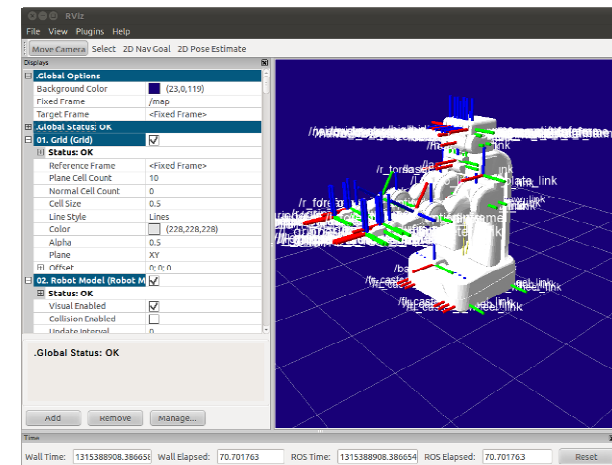
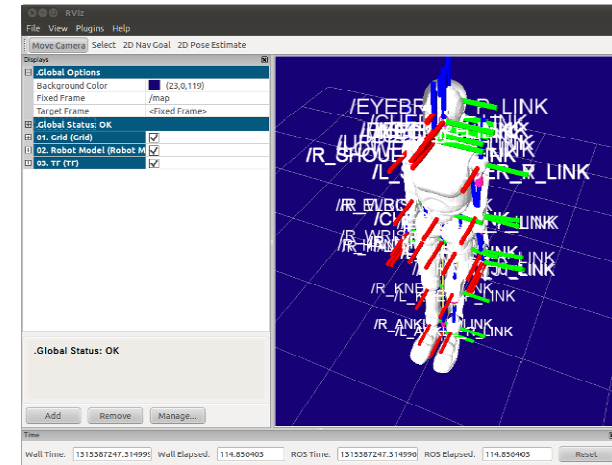
COLLADA supported software (2) OpenRAVE

- Environment for testing, developing and deploying motion planning algorithms
- COLLADA robot extensions is loosely based on OpenRAVE API



COLLADA supported software (3) ROS

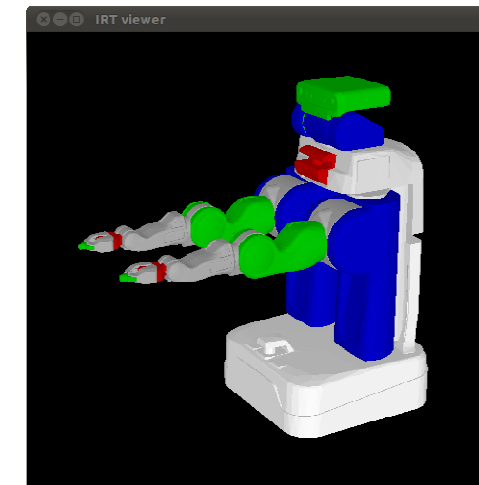
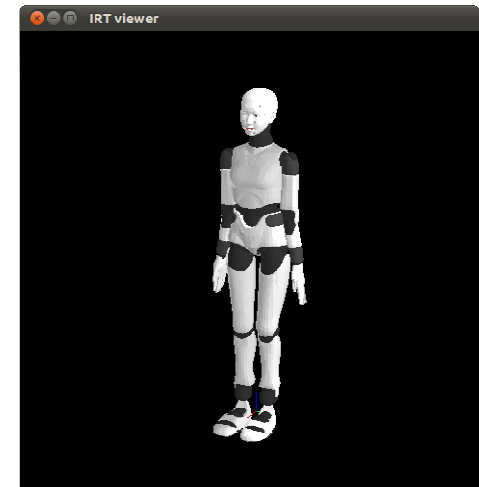
- ROS URDF
 - Universal Robot Description Format
 - XML-based format
- COLLADA supported ROS packages
 - robot_model : adding COLLADA support to robot model management stack commonly used in ROS packages
 - collada_urdf : COLLADA exporter



COLLADA supported software (4)

EusLisp

- EusLisp
 - 1986 Toshihiro Matsui @ AIST
 - Light Weight Language
 - 3D Solid Modeling
 - Foreign Language Function
 - Multithread, OpenGL, Object Oriented
- Used for top-level interpreter for rapid prototyping
- Robot and environment are described in lisp(.l) file formats as program
- Importers and exports are supported using the euscollada package



Conclusion

- Common robot file format is the key to share research results
- Choosing content-scalable file format to design standard robot file format
 - No matter how hard a developer attempt to unify the robotics information, there will **always** be information that another developer wants to insert
- COLLADA :
 - Ability of defining different types of scenes with referencing system allows libraries makes adding new content easily
- Proposal of robot-specific extensions
 - Manipulator, sensor, actuator, collision group, mimic equations.
- Robot database, COLLADA support for OpenHRP3, OpenRAVE, ROS and EusLisp

- Setup environment <http://code.google.com/p/rtm-ros-robotics/>
 - Download HRP4C model from <http://unit.aist.go.jp/is/humanoid/hrp-4c/hrp-4c.html>
 - Convert .wrl file to .dae file
- ```
$ rosrun openhrp3 export-collada -i HRP-4C/HRP4Cmain.wrl -o HRP4C.dae
```
- OpenRAVE
- ```
$ rosrun openrave openrave HRP4C.dae
```
- ROS
- ```
$ roslaunch orrosplanning collada_rviz_display.launch model:=HRP4C.dae
```
- ```
$ rostopic echo /tf
```
- OpenHRP3
- ```
$ roslaunch hrpsys hrpsys.launch MODEL_FILE:=`pwd`/HRP4C.dae
```
- EusLisp
- ```
$ rosrun euscollada collada2eus HRP4C.dae hrp4c.l
```
- ```
$ rosrun euslisp irteusgl hrp4c.l "(objects (hrp4))"
```