Modular Snake ROS

Juan Leon, Laura Paez and Kamilo Melo
{juan.leon,laura.paez,kamilo.melo}@km-robota.com
KM-ROBOTA Research Group, KM-ROBOTA S.A.S.
Bogota - Colombia
www.km-robota.com

.

ROSCon2013, Stuttgart, Germany

May 11, 2013

Motivation

Table of contents

Introduction, Lola-OP ^{TM} Robot

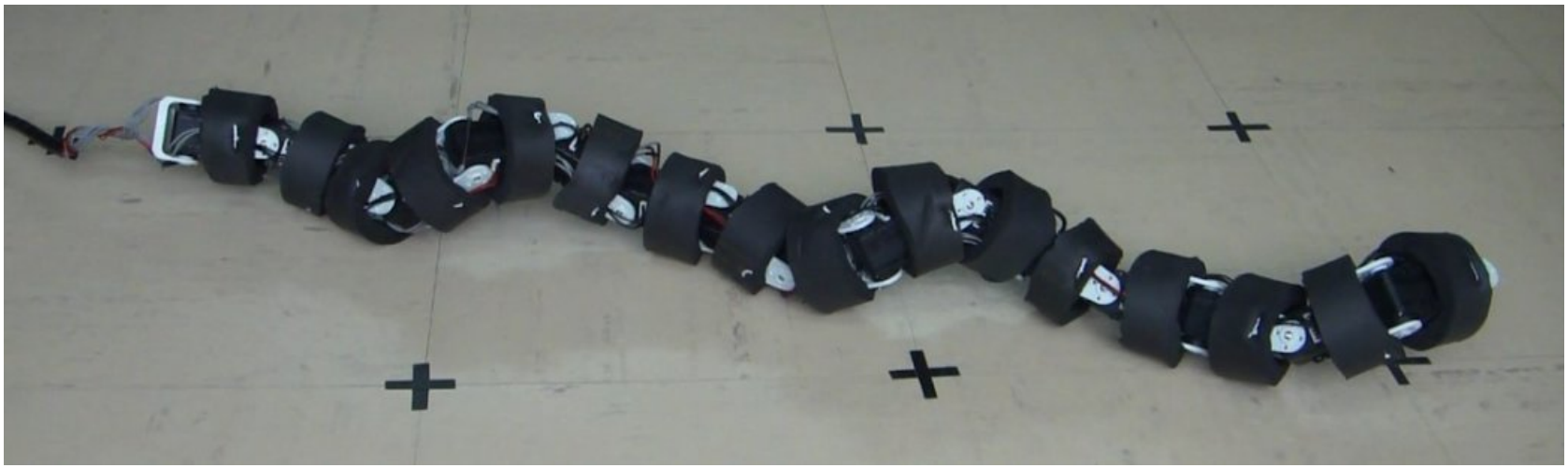


Figure: 16-DOF Lola-OP^{TM}, Modular Snake Robot

http://www.km-robota.com
http://www.robotsource.org

Introduction, Robot Structure

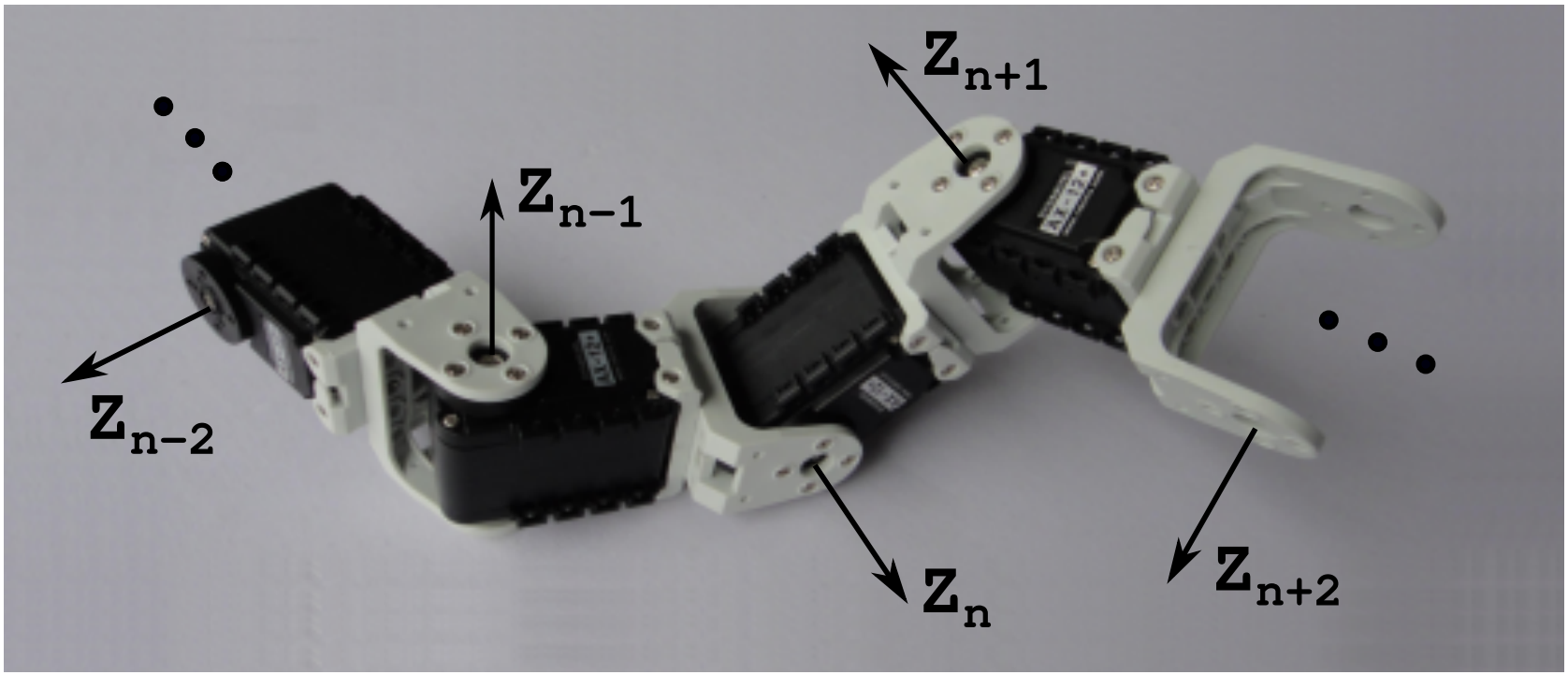


Figure: 16-DOF Lola-OP^{TM}, structure

Introduction, Current Gait Control

- Parameterized gaits

$$\theta(n,t) = \begin{cases} O_o + A_o Sin\left(\frac{n}{\lambda_o} + \omega_o t\right), n\ odd \\ O_e + A_e Sin\left(\frac{n}{\lambda_e} + \omega_e t + \delta\right), n\ even \end{cases} \quad (1)$$

- Scripted Gaits.

Introduction

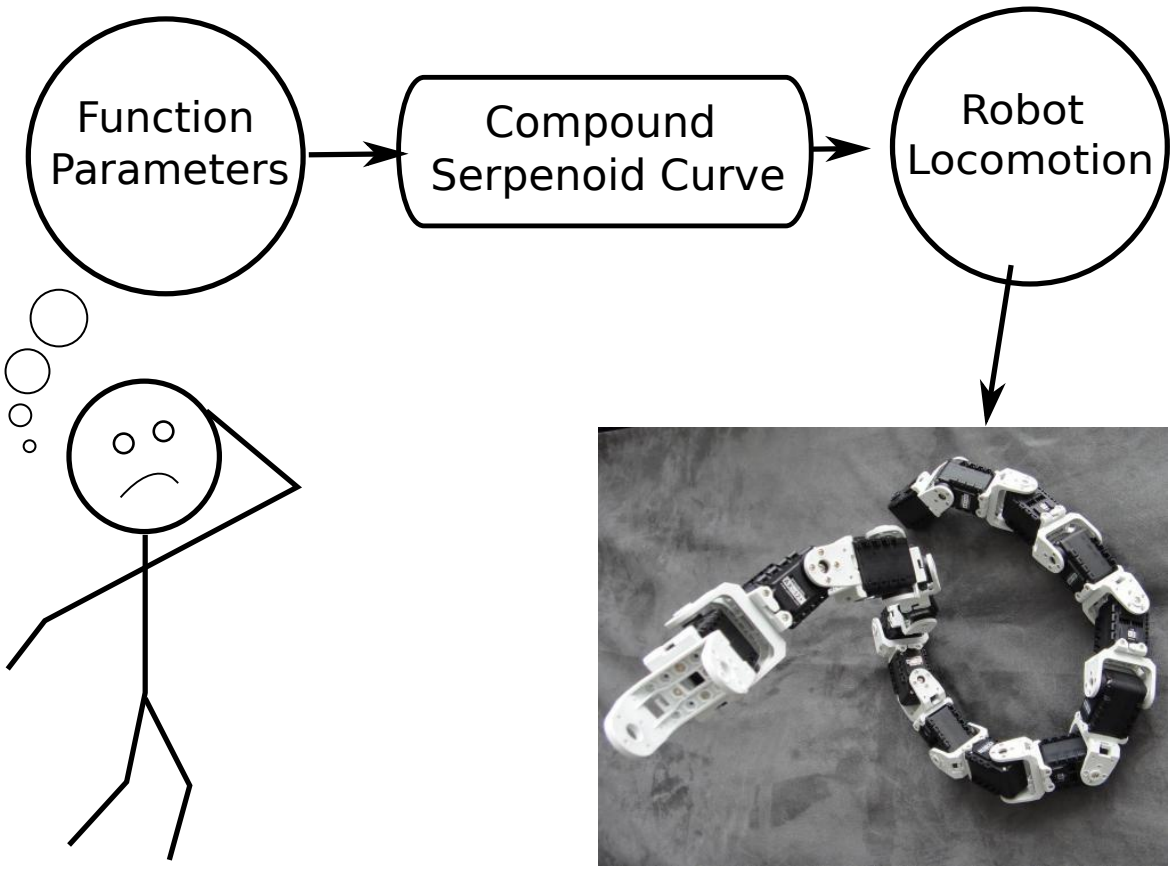


Figure: 16-DOF Lola-OP^{TM}, Controller Mapping

Introduction. Framework Architecture, Information Flow

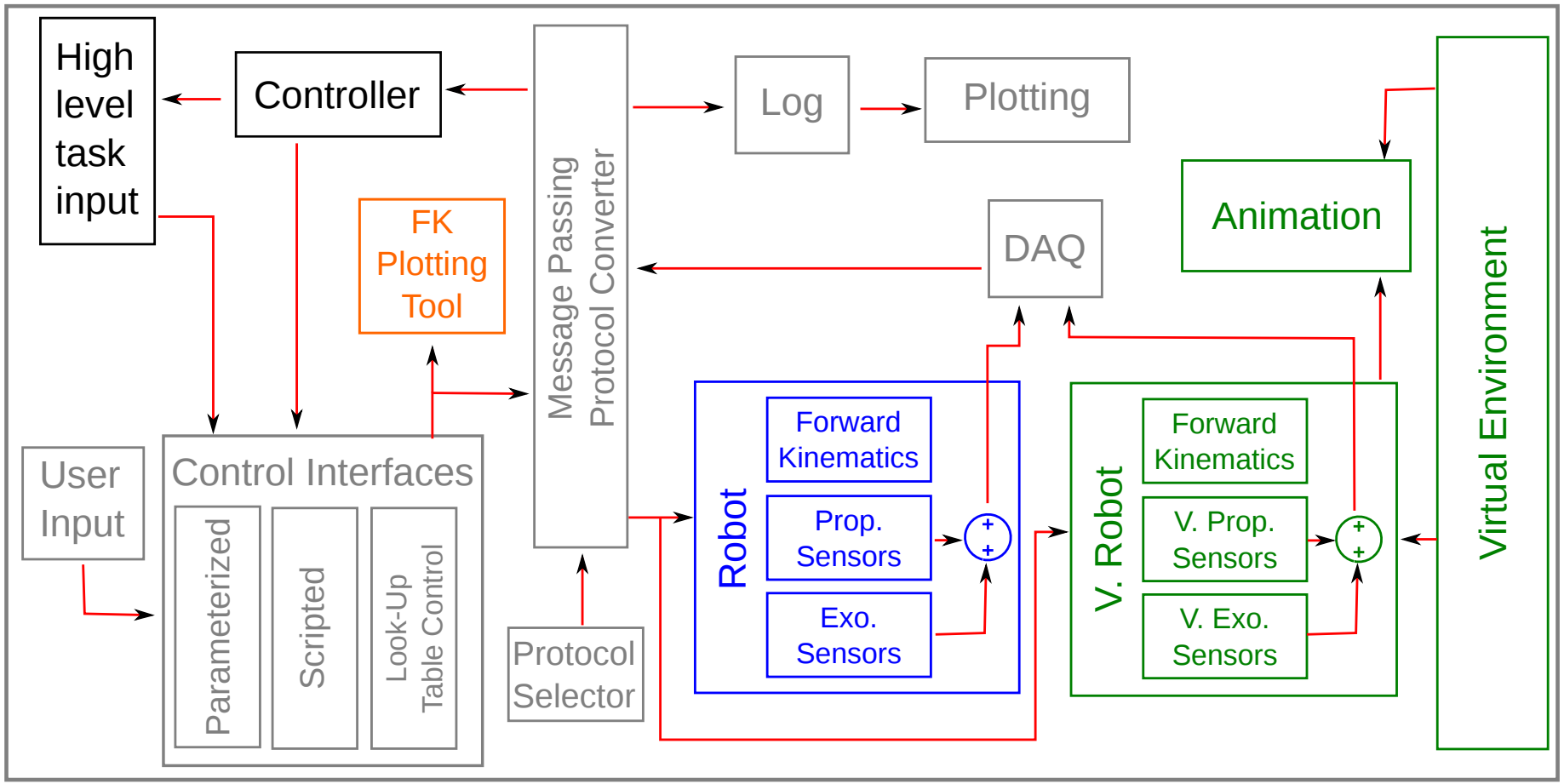
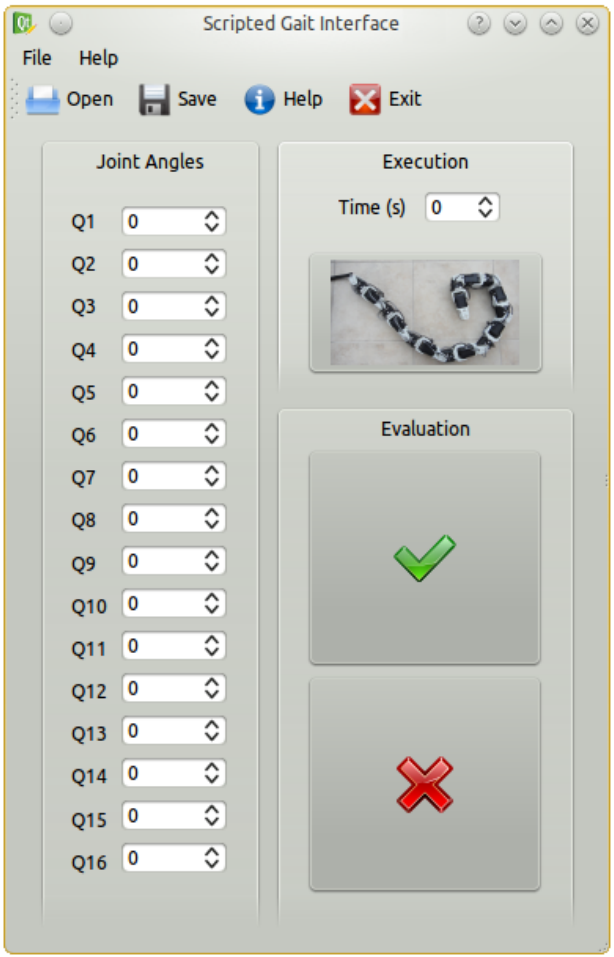


Figure: Simulation and Control Framework Architecture.

Introduction. Control Interfaces - Front-ends



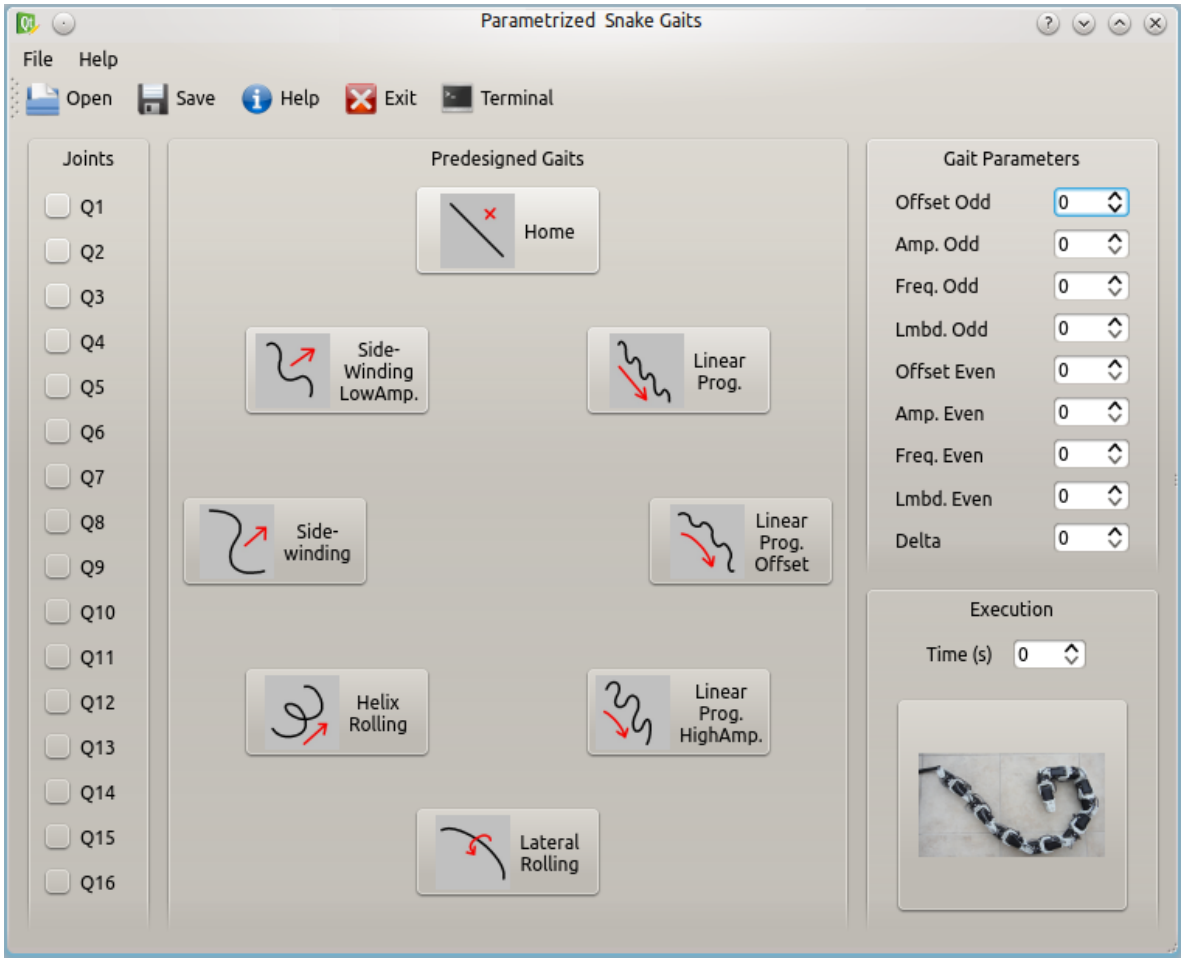


Figure: Scripted and parameterized Gaits Front-ends.

Introduction. Physics Simulator Examples

Introduction. Log File and Real-Time Plotting

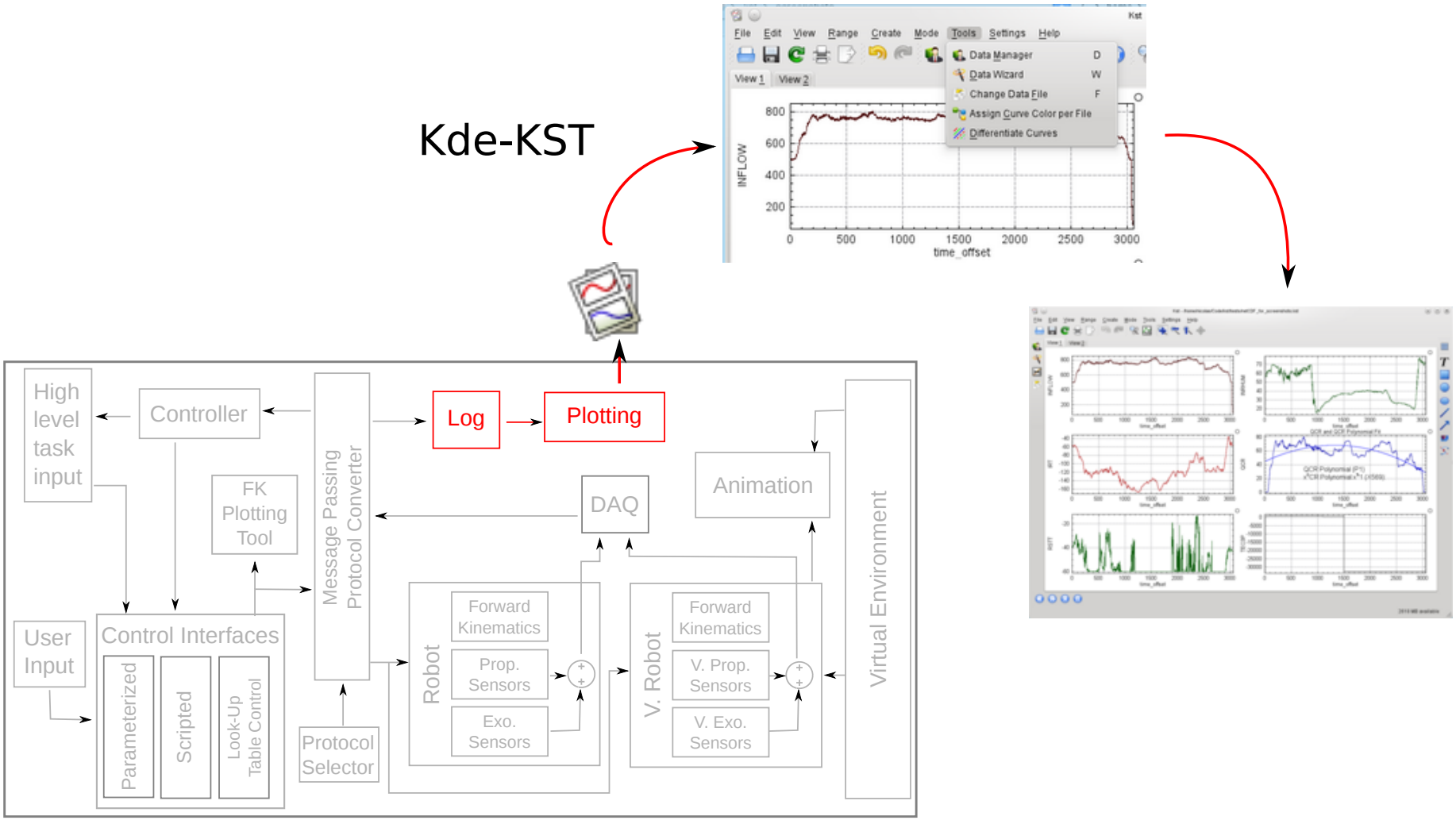


Figure: Plotting Capabilities

Introduction Architecture implemented with ROS

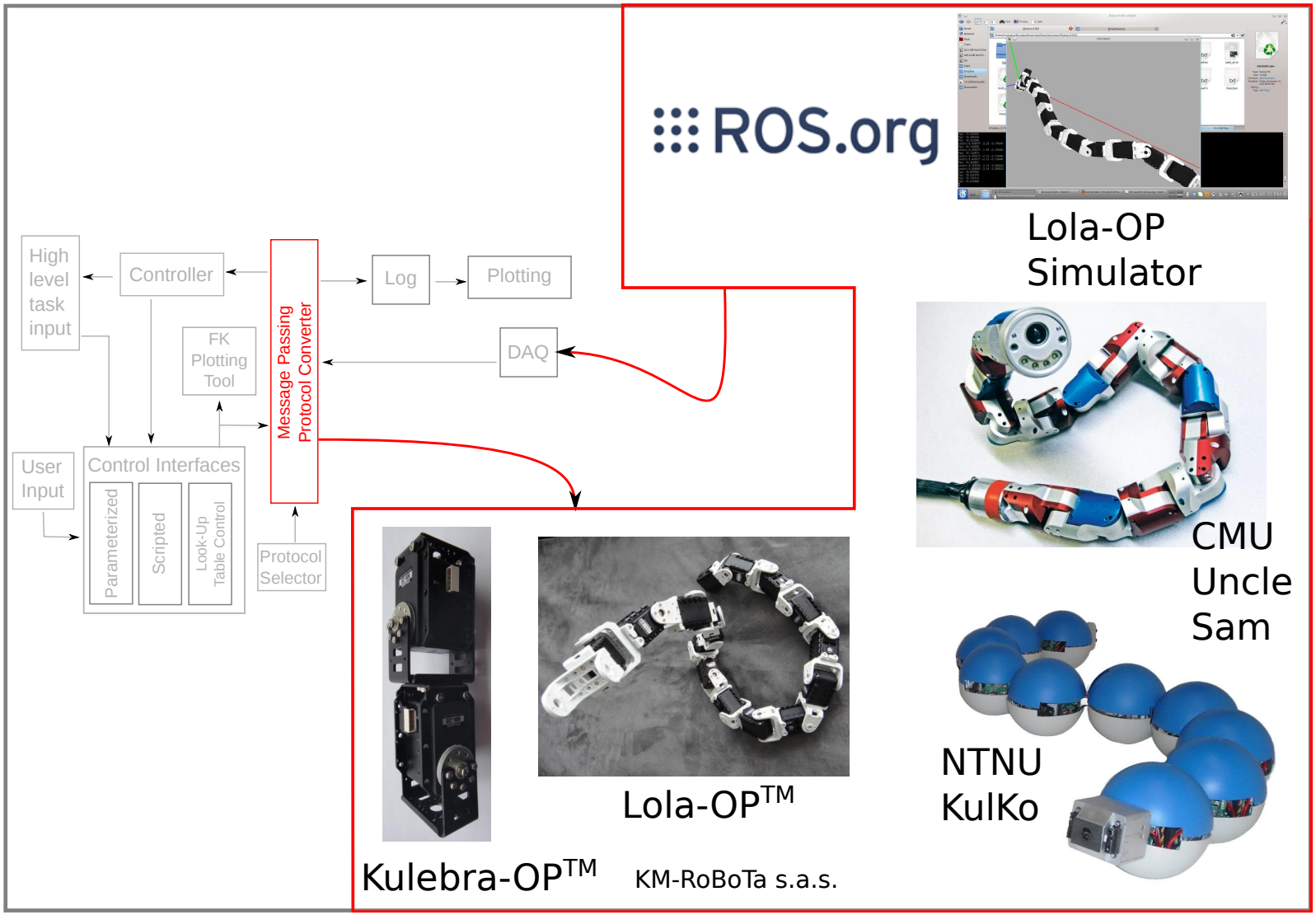


Figure: Message Passing Protocol Converter implemented in ROS

Table of contents

Interfacing the Robot. The lola_op_middleware_package

lola_op_middleware_package features:

- What we need to interface... just Dynamixel AX-12 actuators ?
- ... $< depend\ \ package = "dynamixel\_controllers" / >$ ...
- More Dependences (letting the door open)
- Writing and Reading from the robot (establishing the Topic/s)
- Qt interfaces $\rightarrow$ ROSlauch
- Yes, it can be On-board too

Let's look a simple Demo ...

Table of contents

Representing the Robot. URDF.xml

```
<!--module 8-->
  <link name="link_8">
    <inertial>
      <origin xyz="0.0135 0 0" rpy="0 0 0"/>
      <mass value="0.055"/>
      <inertia ixx="0.000018792"  ixy="0"  ixz="0" iyy="0.000012027" iyz="0"
      izz=".000016152" />
    </inertial>
    <visual>
      <origin xyz="-0.0115 0 0" rpy="0 0 0"/>
      <geometry>
        <box size="0.05 0.032 0.04" />
      </geometry>
      <material name="black_plastic">
        <color rgba="0 0 0 0.8"/>
      </material>
      <!--origin xyz="0.0175 0 0" rpy="0 0 0"/-->
      <!--geometry>
        <cylinder radius="0.0375" length="0.035"/>
      </geometry-->
      <!--material name="black_foam">
        <color rgba="0 0 0 1"/>
      </material-->
    </visual>
    <collision>
      <origin xyz="-0.0115 0 0" rpy="0 0 0"/>
      <geometry>
        <box size="0.05 0.032 0.04" />
      </geometry>
      <!--origin xyz="0.0175 0 0" rpy="0 0 0"/-->
      <!--geometry>
        <cylinder radius="0.0375" length="0.035"/>
      </geometry-->
    </collision>
  </link>
  <joint name="joint_9" type="revolute">
    <origin xyz="0.0675 0 0" rpy="1.57 0 0"/>
    <parent link="link_8"/>
    <child link="link_9"/>
    <axis xyz="0 0 1" />

    <!--calibration rising="0.0"/-->
    <dynamics damping="0.0" friction="0.0"/>
    <limit effort="1.5" velocity="6.0" lower="-0.785" upper="0.785" />
    <!--safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0"
    soft_upper_limit="0.5" /-->
  </joint>
<!--/module 8-->
```

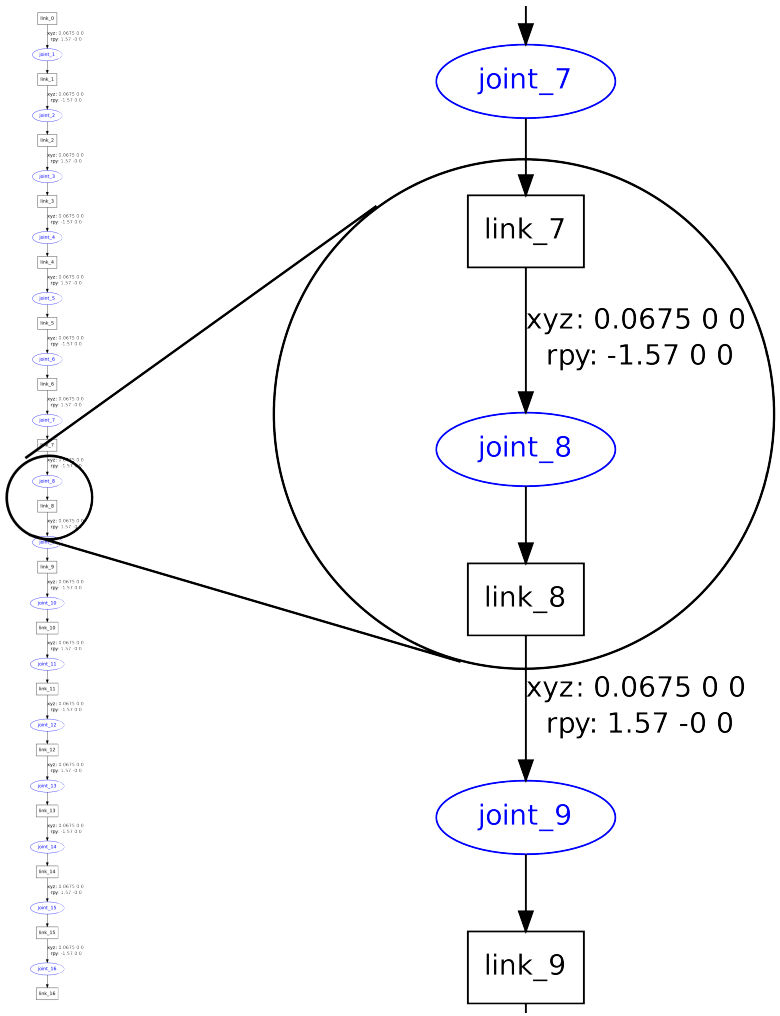


Figure: Fully Featured/Robust Lola-OP^{TM} URDF

Table of contents

High Level Tools. Rviz visualization

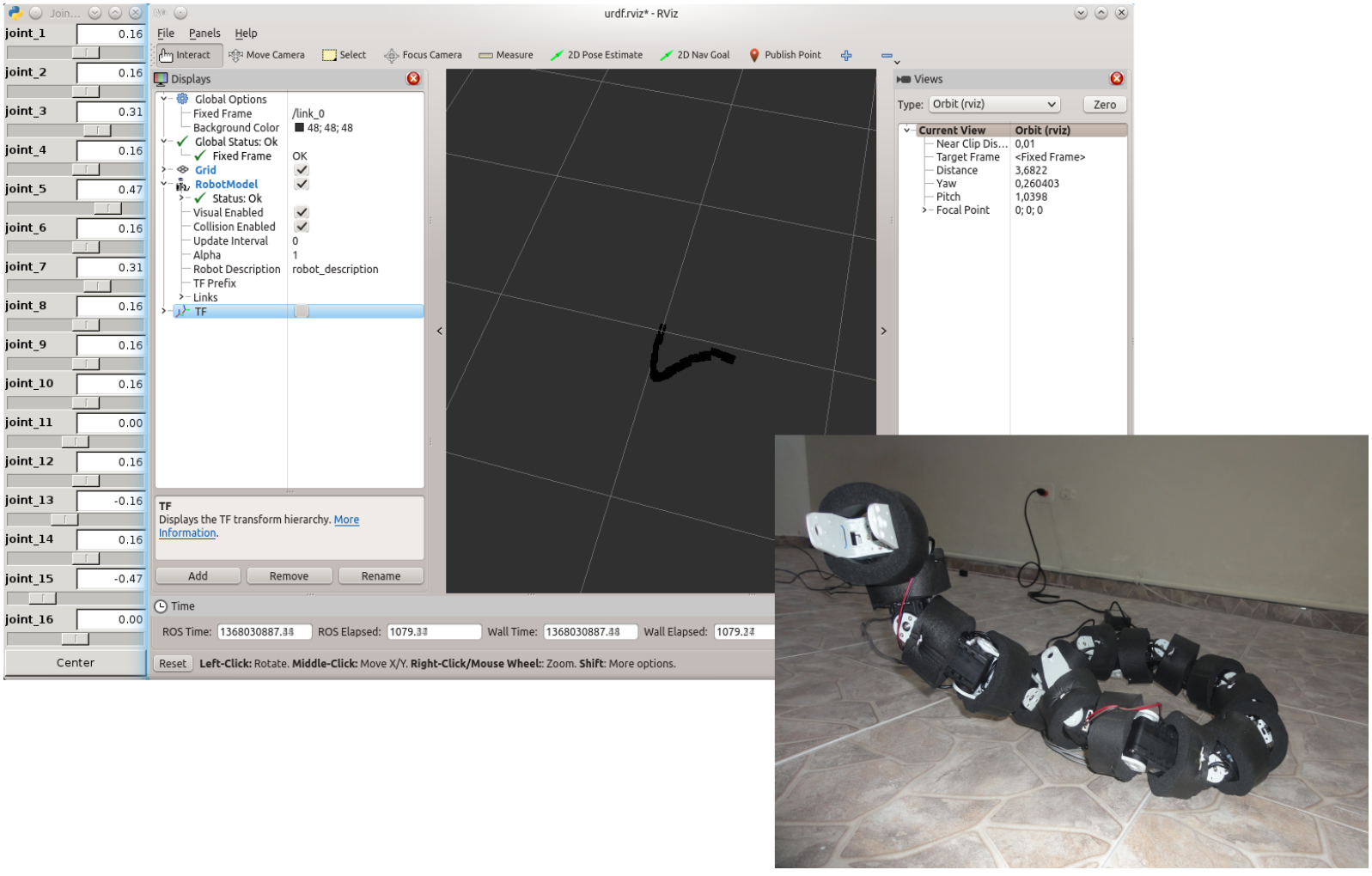


Figure: Lola-OP^{TM}in Rviz, Open loop gait controller

High Level Tools. TF

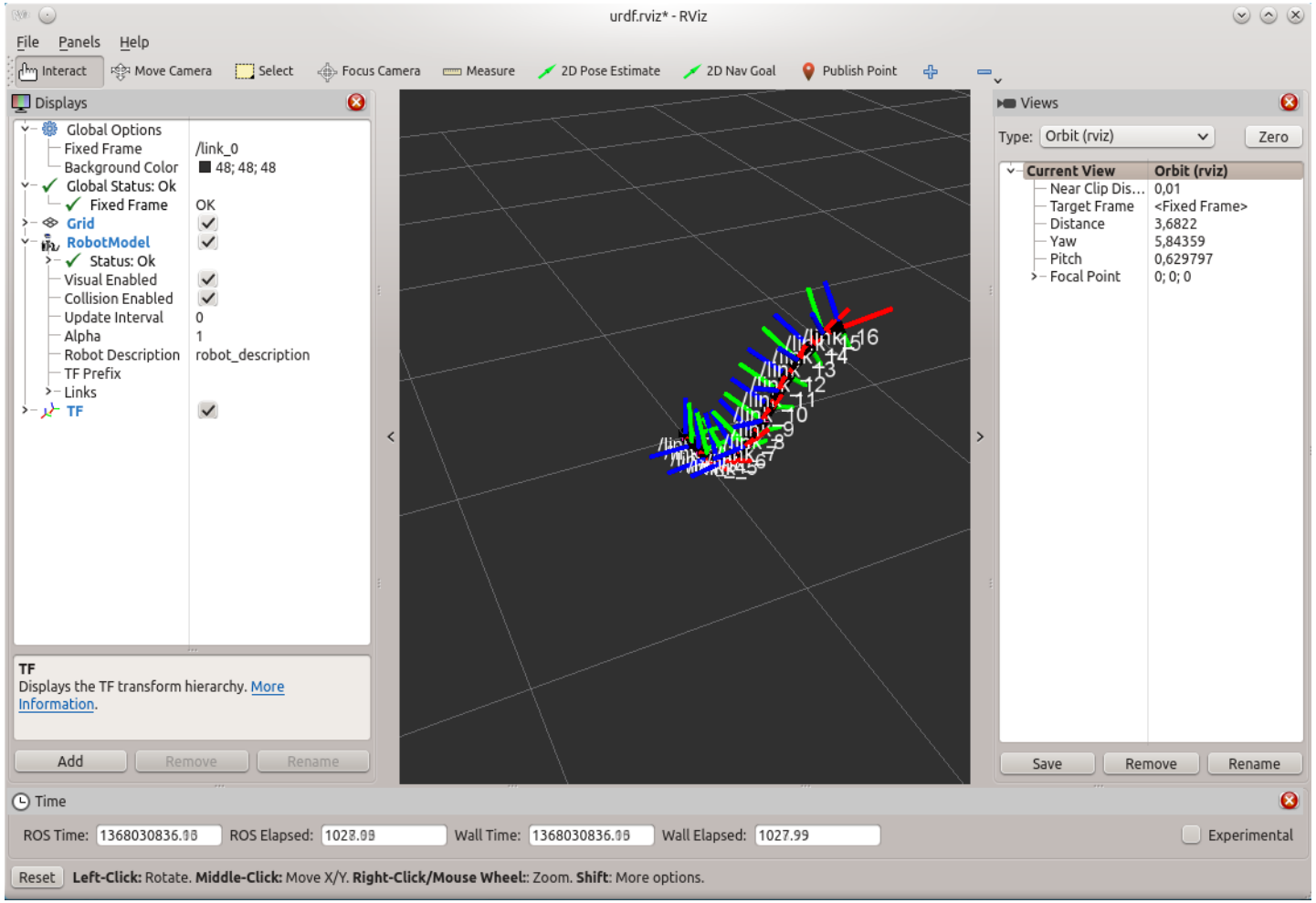


Figure: Using TF to implement the *Floating Body Frame of Reference* in Snake Robots

High Level Tools. Remote Operation

Take the control, write the message, send it, move the real robot, gather info, send it back, decode it, Rviz and visualize what is going on.

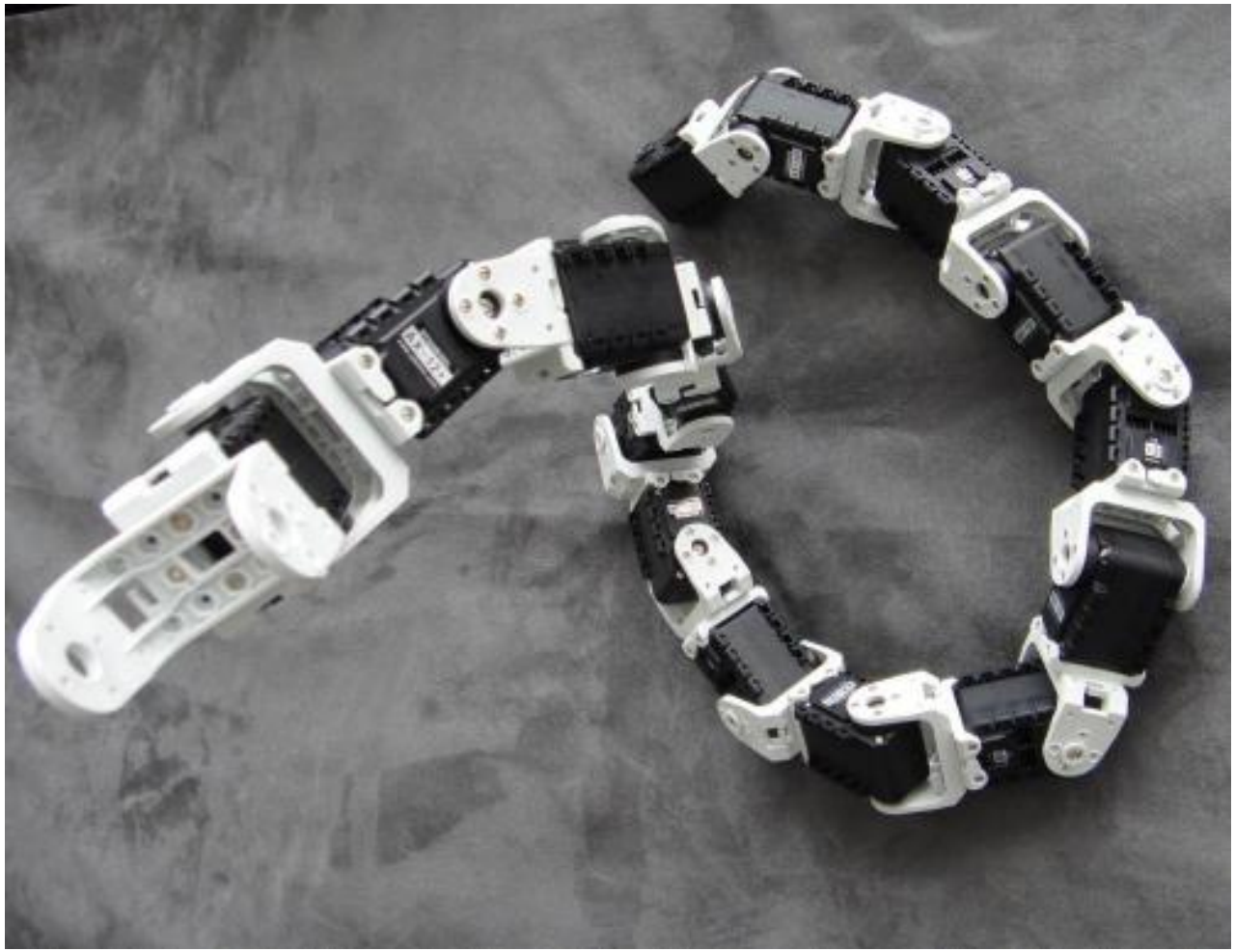
- As simple as Bagfiles...
- TCP/IP, from LAN $\rightarrow$ to Internet
- What about Real Time ??

Let's look another simple Demo ...

Conclusions

- Integration with Lola-OP^{TM}Robot Architecture (each block as a ROSnode)
- High Level Tools aid, Open issues to explore
- What about MoveIt ?? (ROSCon2014...Maybe?)

Conclusions



Questions?

Thank you!