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

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

\[
\theta(n, t) = \begin{cases} 
O_o + A_o \sin \left( \frac{n}{\lambda_o} + \omega_o t \right), & n \text{ odd} \\
O_e + A_e \sin \left( \frac{n}{\lambda_e} + \omega_e t + \delta \right), & n \text{ even}
\end{cases}
\] (1)

Scripted Gaits.
Figure: Simulation and Control Framework Architecture.
Figure: Model-View-Controller Architecture.
Figure: Simulation and Control Framework Architecture.
Framework Architecture

Information Flow - Open Loop Robot Test

Figure: Open Loop Test.
Figure: Open Loop Simulation Run.
Figure: Closed Loop Experiment.
Forward Kinematics Plotting Tool

Figure: Forward Kinematics Plotting Tool
Small Pipes

Lateral Rolling Gait $d\theta/dt=180^\circ/s$

Figure: Forward Kinematics Plotting Tool examples.
Figure: Forward Kinematics Plotting Tool examples.
Large Pipes

Side-winding Gait $d\theta/dt=180^\circ/s$

Figure: Forward Kinematics Plotting Tool examples.
Figure: Message Passing Protocol Converter
Figure: Message Passing Protocol Converter
Log File and Real-Time Plotting

Figure: Message Passing Protocol Converter
Log File and Real-Time Plotting

Kde-KST

Figure: Message Passing Protocol Converter
Control Interfaces

- Scripted Gaits Front End
- Parameterized Gaits Front End
- High Level Controller
Figure: Scripted Gaits Front-end.
Figure: Scripted Gaits Front-end.
Log file

Ready to be used ...
Physics simulator structure of classes

- Simulator Control (process pipeline)
- Physics Processor (solves the interaction)
- Snake Container (joints + actuators)
- Graphics Processor (visual rep)
- Data Processor (input/output)
Framework Integration

Error Handling...

Three sources of error

- Invalid Data Input
- Communication Failure
- Unbounded control signal
○ Add/Remove components

○ Embedded on-board, Tested on TI ARM® Cortex-A8™ processors on Gumstix Overo® boards (https://www.gumstix.com/) and Atmel ATMega2561 processor on Dynamixel CM-700 controller (http://support.robotis.com/).
Questions?

Thank you!