CS225A : Experimental Robotics
Lecture 4 : Simulation & Graphics

(Aka.. All the details you (n)ever wanted)

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Supported Project: Robotic Control

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, x') + p(x)) \]

Theory
Supported Project: Robotics Projects

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, \dot{x}) + p(x)) \]

Theory

Simulation
Supported Project: Robotics Projects

\[ \Gamma = \dot{J}_T^T (\Lambda(x)x + \mu(x, \dot{x}) + p(x)) \]

Theory

Simulation

Testing (if feasible)
Supported Project: Haptics & Simulation

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, x) + p(x)) \]
Supported Project: Haptics & Simulation

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, \dot{x}) + p(x)) \]

Theory

Keyboard/Mouse Control
\[ \Gamma = J^T_t (\Lambda(x)x + \mu(x, \dot{x}) + p(x)) \]
Supported Project: Human Motion

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, x) + p(x)) \]

Theory
Supported Project: Human Motion

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, x^\prime) + p(x)) \]

Theory

Whole body control
Supported Project: Human Motion

\[ \Gamma = J_t^T (\Lambda(x)x + \mu(x, \dot{x}) + p(x)) \]

Theory

Motion/Trajectory Mapping

Whole body control
Limited spots for each project class

** Rules and conditions apply
Limited spots for each project class

**Rules and conditions apply**

**Rules and conditions apply**
Connecting theory to software....

• Basic kinematics: \( x_{ee}, dx_{ee}, J = f(q) \)
Connecting theory to software....

- Basic kinematics: $x_{ee}$, $dx_{ee}$, $J = f(q)$
- Forces and potential fields: $F_x = \text{pid}(x_{err})$
Connecting theory to software....

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- Forces and potential fields: \( F_x = \text{pid}(x_{err}) \)
- Inertias: \( M_{gc}, M_x \)
Connecting theory to software....

- Basic kinematics: $x_{ee}$, $dx_{ee}$, $J = f(q)$
- Forces and potential fields: $F_x = pid(x_{err})$
- Inertias: $Mgc$, $Mx$
- Subspace projections: $\text{Null}_J$, $J_{\text{dyn}^{-1}}$

Stanford University
SCL : Available resources....
SCL : Available resources....

**Standard Control Library**
web.stanford.edu/~smenon/scl.html - Stanford University

Sep 3, 2014 - Whole-Body Multi-Task Control. Whole-Body Control: SCL controls three very different robots using the same operational space controller.

**Instrument control library** - Dictionary.com
dictionary.reference.com/...standard+instrument+control... - Dictionary.com
Standard instrument control library definition at Dictionary.com, a free online dictionary with pronunciation, synonyms and translation. Look it up now!

**Instrument control** - Wikipedia, the free encyclopedia
The standard was updated in 1987 and again in 1992. This bus is known by three different... These drivers require a VISA library to be installed on the PC.

**Windows Controls** (Windows) - MSDN - Microsoft
msdn.microsoft.com/...library/Ab77317... - Microsoft Developer Network

**SCL CODE REPOSITORY & WIKI**

**SCL CODE TUTORIALS**

**CONTROL MATH TUTORIALS : 3-DOF AND 6-DOF**

**SCL CLASS DESCRIPTIONS**

**OUR METHODS**

Standard Control Library (SCL) is a control and simulation framework that aims to provide a generic implementation of robot agnostic control algorithms for use in simulation or on real robots. It achieves robot agnostic control by specifying closed loop control tasks in operational space, which can then be projected onto to the articulated body dynamics for arbitrary robots. Multiple control tasks are readily accommodated using a prioritized control subspaces, which disallow conflicting control tasks from interfering and destabilizing the controller.
Feel free to edit it! Some links might be stale. Also feel free to notify the TAs...
The S<Name> pages correspond to data structures
Do take a look! (no code; only data)
If you find a bug. Report it!!
Valid and non-trivial bug reports will earn you extra credit!
SCL : Library Architecture

A lot of (almost) independent modules
A lot of (almost) independent modules
(Tied together by shared data structures)
SCL : A glance at the code....
SCL : Building advanced controllers

CcontrollerMultiTask :: Specify your own tasks

https://bitbucket.org/samirmenon/scl-manips-v2/wiki/docu/additional_controllers
Project Discussion / Questions...