

Template for thesis project proposals

Project Title	Build a series of increasingly sophisticated robot models in Acumen, to (1) explore mathematical formulations and (2) create tutorials and didactic examples.
Author(s)	<i>Student(s) name(s)</i>
Keywords	Rigid-body dynamics, Acumen, Cyber-Physical System
Project description	<p>=== Project Description ===</p> <p>Robots are machines that embody sensors, actuators, and computational resources. They are thus an excellent example of [http://en.wikipedia.org/wiki/Cyber-physical_system] (CPS) and present very interesting twists for modeling and simulation tools. In particular, the equations of motion for robots that can be modeled as rigid-body trees are of a form that has been studied extensively &#091;[[#featherstone-2008 1]]&#093;.</p> <p>[http://www.acumen-language.org/ Acumen] is a domain specific language for modeling CPS. It is being developed by the [http://www.effective-modeling.org/ Effective Modeling group] to address a key challenge for accelerating innovation in this area. Simulation plays a key role in CPS design, and Acumen is a language for capturing and simulating the kind of hybrid continuous/discrete models needed to capture the behavior of cyber-physical systems.</p> <p>The objective of this masters' thesis is to build up a series of increasingly sophisticated robot manipulator examples in Acumen. The aim is twofold: (1) explore which kinds of mathematical formulations need to be efficiently supported by Acumen in order to best support the robot design and prototyping process, and (2) create tutorials and didactic examples for teaching Acumen in particular, and CPS in general.</p> <p>A preliminary idea for the sequence of robot examples is as follows.</p> <ul style="list-style-type: none"> #Point masses in a plane "(serves double duty as intro to Acumen)" #kinematic chains (pendulum, double pendulum, ...) #kinematic trees (stick figures) #Inertias in a plane #kinematic chains #kinematic trees #real-world example: [http://en.wikipedia.org/wiki/SCARA] SCARA] robot #Inertias in three dimensions #study [http://en.wikipedia.org/wiki/Denavit%E2%80%93Hartenberg_parameters] Denavit-Hartenberg] (DH) parameters as a preparation for the following steps #repeat the first four examples in 3D space with DH parameters #model a [http://en.wikipedia.org/wiki/Programmable_Universal_Machine_for_Assembly] PUMA] arm, a very nice example of kinematic chain, with known kinematic and dynamic parameters #model a [http://www.willowgarage.com/pages/pr2/overview] PR2] mobile manipulator, a very nice example of kinematic tree, also with known parameters <p>==== References ====</p> <p><div id="featherstone-2008"></div>[1] R. Featherstone. Rigid Body Dynamics Algorithms. Springer, New York, 2008. ISBN 0387743146.</p>
References	http://www.acumen-language.org/ http://en.wikipedia.org/wiki/SCARA
Prerequisites	Solid mathematical and programming skills
Time frame	<i>Indicate start and duration of project</i>
Supervisor(s)	Roland Philippsen, Walid Taha
Programme	<i>Name and the number of credits</i>
Examiner	<i>Name of project Examiner</i>
Signatures	<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 30%;"><i>Student(s):</i></div> <div style="width: 30%;"><i>Supervisor(s):</i></div> <div style="width: 30%;"><i>Examiner:</i></div> </div>