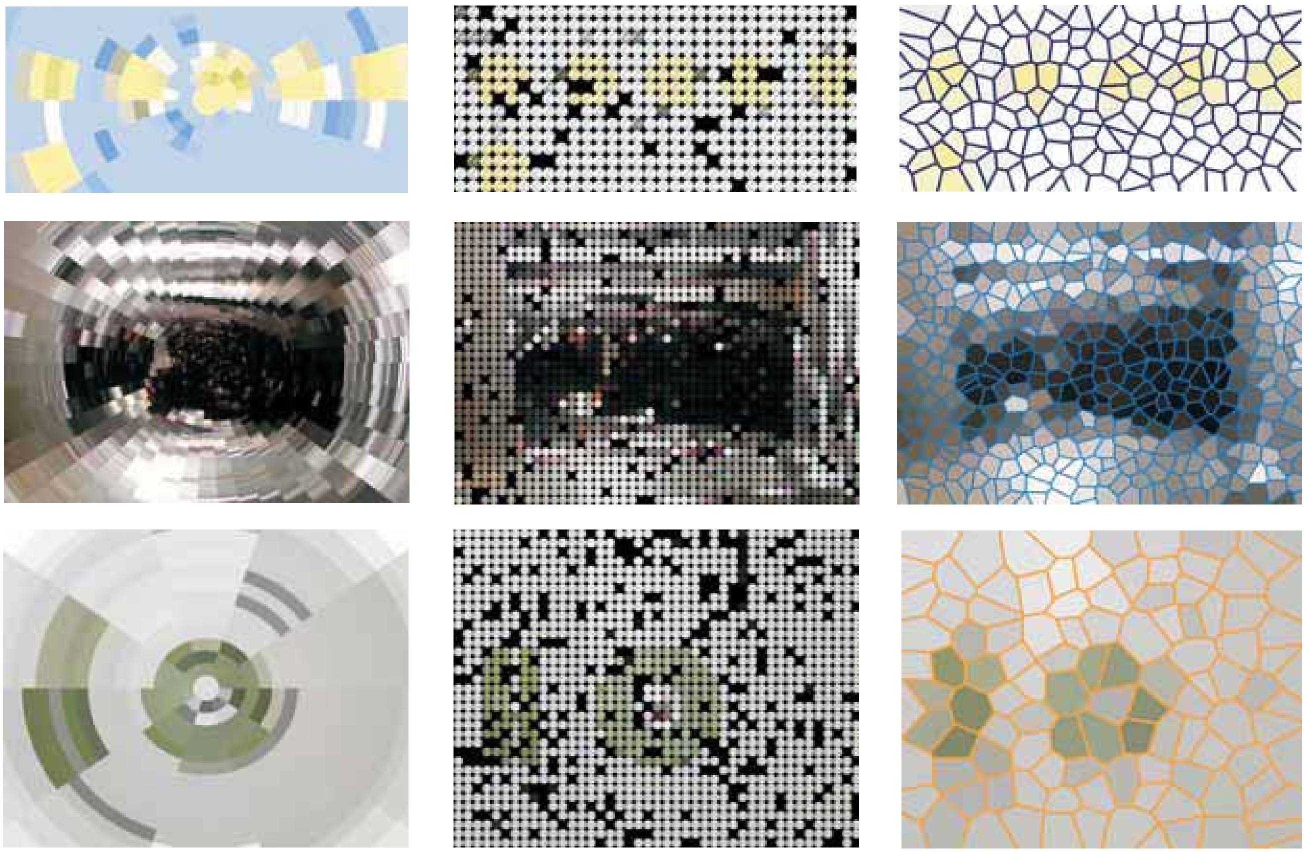
SNE SIMULATION NEWS EUROPE



Volume 16 Number 1 (SNE 46)

August 2006, ISSN 0929-2268

Journal on Developments and Trends in Modelling and Simulation

Membership Journal for Simulation Societies in EUROSIM

SNE 16/1 (46), August 2006

Dear readers,
This is the second SNE issue with new layout, and we are glad, that we got positive reactions for changes in SNE layout and for opening the publication strategy of SNE. Together with this issue, we are proud to announce the first SNE Special Issue 'Parallel and Distributed Simulation Methods and Environments'. First born as idea in ASIM - ASIM Working Groups intend to publish alternately a Special Issue each year, the SNE Special Issues are open for all societies and conference organisers. The Special Issues cause a change in numbering the SNE issues: this regular SNE issue, SNE 46, is now identified as SNE 16/1 (Volume 16, Number 1), the first Special Issue as SNE 16/2; the next regular SNE double issue (SNE 47/48) will be numbered SNE 16/3-4. This remembers, that we are running SNE since 16 years, and we thank our faithful readers.
Together with the new layout, both editorial boards are being reorganised and will be enlarged for the future. We are also working on a new infrastructure for running an editorial office, together with tasks for SNE on the web.
We hope, the readers enjoy this issue, and the contributors appreciate the new editorial structure (more strict, but hopefully more efficient). Three Technical Notes and three Short Notes in this issue show the broad variety of modelling and simulation. The Technical Notes are special ones: based on a post-conference review procedure via Internet for contributions to MATHMOD 2006 Vienna, papers were selected for publication in SNE (to appear also in the next SNE issues). Furthermore, as first reaction on the ARGESIM / MATHMOD Yo-yo Challenge, the Techncial Note by Leon Zlajpah introduces into mechanical mysteries of Yo-yo control. The Comparison Section publishes an updated version of Comparison C13 'Crane and Embedded Control', reflecting the developments in this area of modelling and simulation; furthermore, seven comparison solutions concentrate on modelling issues and alternative approaches.
The News Section reports about progress in new structures for EUROSIM, and about activities in EUROSIM member societies and in Societes related to Modelling and Simulation. We thank all contributors, members of the editorial boards, and people of our ARGESIM staff for co-operation in producing this SNE issue.

Felix Breitenecker, editor-in-chief; Felix.Breitenecker@tuwien.ac.at

SNE 16-1 / SNE 46 in Five Minutes

Content

SNE Editorial Boards

SNE - Simulation News Europe – is advised by two Editorial Boards. The *SNE Editorial Board* is taking care on reviewing and handling of Technical Notes, Shortnotes, Software Notes, Book and Journal Review, and of Comparison and Benchmark Notes. The *SNE News Editorial Board* (News Section) is responsible for reports from EUROSIM, EUROSIM societies, International Societies, and for Industry News.

Editorial board

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Editorial Info - Impressum

SNE Simulation News Europe ISSN 1015-8685 (0929-2268).
Scope: Information on development in modelling and simulation, comparisons and bechmarks on modelling and simulation, membership information for EUROSIM and Simulation Societies.
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Layout: A. Breitenecker, ARGESIM TU Vienna / Linz; Anna.Breitenecker@liwest.at
Printed by: Grafisches Zentrum, TU Wien, Wiedner Hauptstrasse 8-10, A-1040, Wien
Publisher: ARGESIM and ASIM
ARGESIM, c/o Inst. for Scientific Computation, TU Vienna, Wiedner Hauptstrasse 8-10, A-1040 Vienna, Austria, and ASIM (German Simulation Society), c/o Wohlfartstr. 21b, D-80939München

Simulation of a Control for a Robot with Two Degrees of Freedom – an E-learning Example

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This contribution shows the modelling, simulation and control of a robot of two degrees of freedom. It is part of a large e-learning project where we want to offer a database of mathematical modelling examples for demonstration and studying online. The main audience are students of electrotechnical engineering and technical mathematics, but also other students might be skilled in modelling in simulation.

Introduction

With our mechatronic models students should be able to 'play' to get to now how control works, but they should also be trained in development of small own models. Here it might be possible to offer to develop own control algorithms of the certain robot.
The system is based on MATLAB and Java, combined with a comfortable experimentation environment

1 Modelling

Modelling the Robot Mechanics. The robot with two degrees of freedom consists of two arms, one moves rotational in the vertical plane around axis o1 (arm 1) and the other one performs a linear movement (arm 2). On arm 2 a grab for taking up loads is fixed, its mass is included in mass of arm 2, m_2 (Figure 1).

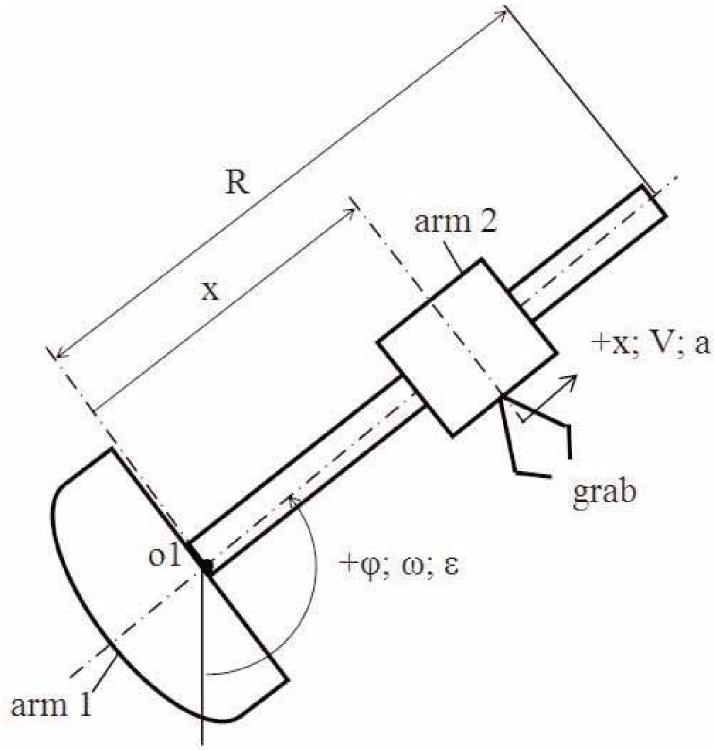

Figure 1: Scheme of robot with 2 degrees of freedom.

The positions are described through the angel φ and the distance x. Velocities and accelerations are given through ω, ε and V, a respectively. The basic geometry is given in Figure 1. For the description of the robot mechanics we need to define its inertial forces, named J_{01} for arm 1. For arm 2 we also have to consider the position of the grab.

The whole robot dynamics with drive is shown in Figure 2, where the basic equations of balance are given in the central box.

In our model friction is neglected for clearer presentation but it should be able to experiment with different electrical engines and so mechanical conversion is regarded. For the actuation of the robot arms we have conversions; the following equations complete the model, giving conversion parameter for arm 1 and for arm 2:

$$i_{\eth} = \frac{\omega_{en1}}{\omega}, \quad R_{\ddot{\imath}\eth} = \frac{V}{\omega_{en2}}$$

Modelling the electrical drive. In our example also the drive of the electrical engine is modelled including the digital-analog converter and amplifiers. All parameters are taken from real parts, so students can make studies with different kind of engines, for example. It should also be possible to experiment with different kind of electrical engines to understand the differences in its control.

2. Digital controller

The implemented digital controller supports linear and circular movements of the robot grab, realised by a P-control mechanism. The path the robot grab should follow, can be defined by the student and the change of position and velocity of each arm can be observed. Also the error in position and velocity can be studied.

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A simulation result is shown in Figure 3, where the positions of the arms can be observed. Also the overall position of the grab, here performing a circle, is shown.

In further development students can also develop there on controls, following an ellipsoid for example.

3 Implementation

The model was implemented in MATLAB, but also in Java, what makes it available easier on the net for E-learning purposes.

The additionally developed graphical user interface is shown in Figure 3. Everything is implemented by an object oriented approach what makes our model adaptable easily for other parts or for more sophisticated features of the robot.

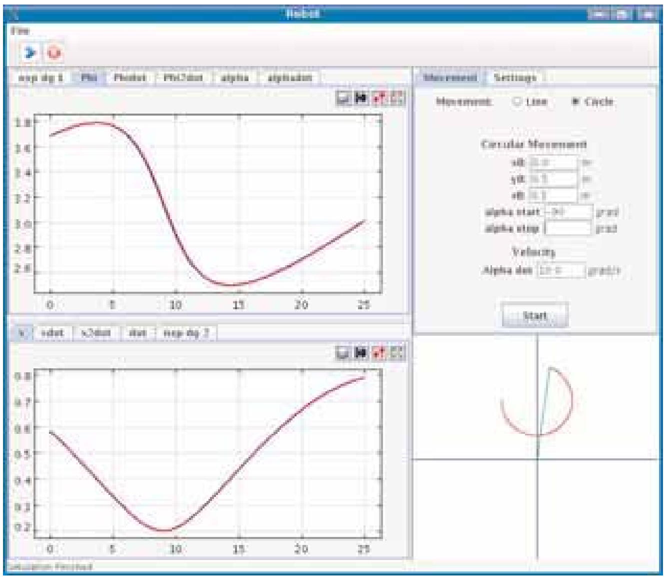

Figure 3: Screenshot of the Java robot control GUI.

Summary

Summarizing we have developed a user friendly tool to experiment with a robot of two degrees of freedom online.
The example is not too complex consciously. It should transport the main ideas and principles of modelling and simulation.
At end of the project, software will be available at the web.

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Received: March 2006
Revised: June 3, 2006
Accepted: July 15, 2006

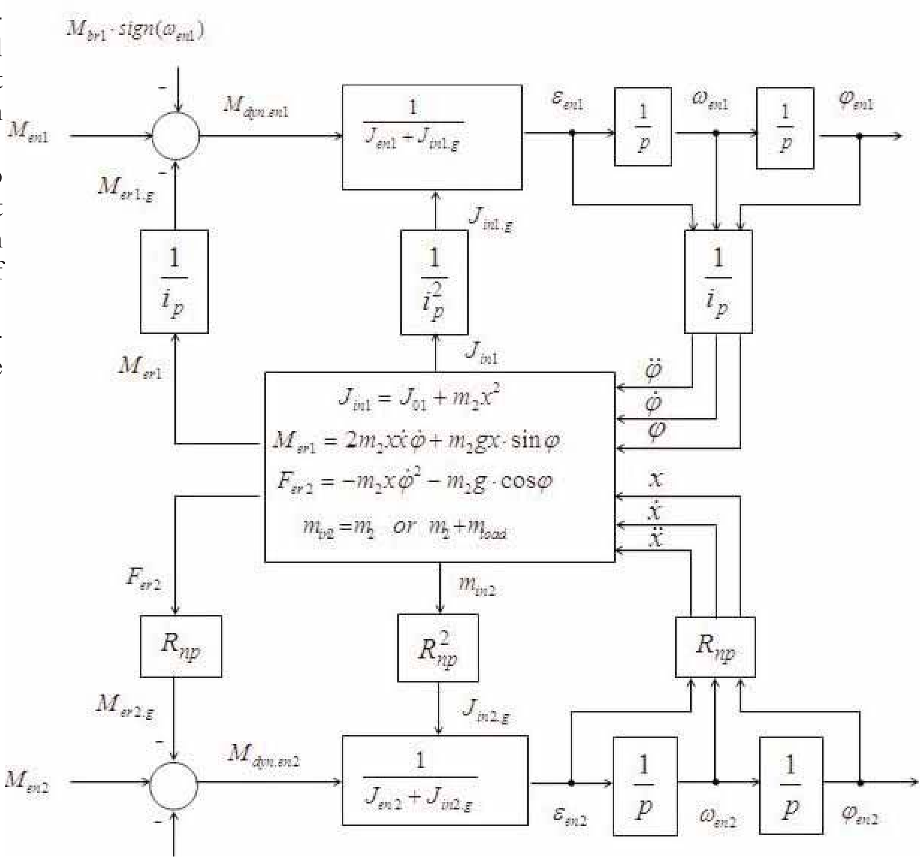

Figure 2: Structure of the model for robot and control.