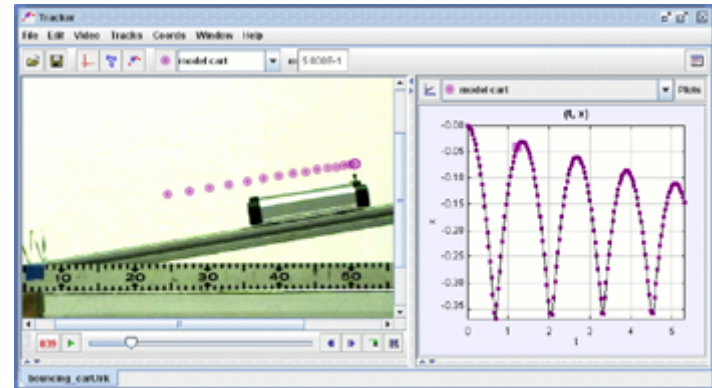


Tracker/EjsS/OSP Workshop for Singapore Teachers

**2 Malan Road Block J, Level 4
eduLab@AST and IT Room 2**

October 26-29, 2015

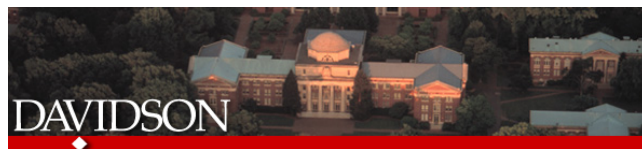


Tracker User Interface

Leaders: Wolfgang Christian and Douglas Brown

Local Facilitators: Wee Loo Kang Lawrence, Leong Tze Kwang, Leong Tze Kwang, Ning Hwee Tiang, Tan Kim Kia, and Chan Him Nok

Sponsors: the National Research Foundation (NRF), Ministry of Education (MOE), and National Institute of Education (NIE).



Schedule Overview

■ Monday

Beginner's workshop on the use of Tracker. Overview of ComPADRE, Open Source Physics, and Tracker resources. Introduction to Tracker video analysis, creating and importing video clips, and data analysis using Tracker (projectile motion). Formulate personal curriculum development objectives.

■ Tuesday

Intermediate workshop on the use of Tracker. Formulate personal curriculum development objectives. Using analytic and dynamic models to predict motion. Multiple objects (collisions and center of mass). Polar coordinates (simple harmonic and pendulum motion). Continued work on personal curriculum development objectives.

■ Wednesday

Advanced workshop with OSP tools and resources. Use of Easy Java/JavaScript resources to complement Tracker activities. Improve personal curriculum development objectives.

NUS Public Lecture:

- Tracker, Video Analysis and Modeling Tool and
- Open Source Physics

■ Thursday

Expert workshop using Tracker and Easy Java/JavaScript Simulation Models.

- Group Project: Barbie Bungee.
- Packaging and sharing personal curriculum in TRZ and zip files with worksheets.
- Personal curriculum development presentations.

Schedule: Day 3

- 09h00 – 10h45 Creating Models with EjsS
 - Introduction to ComPADRE
 - Structure of a JavaScript model in EjsS
 - Variables and their types.
 - Initialization, fixed relations, and custom functions
 - The ODE editor and the Prelim code page
 - Binding model variables to view elements and controls

Tutorial: Harmonic Oscillator [ID13103](#)

- 11h00 - 12h00 Enhancing the View

- Tables and arrays
- Cascading Style Sheets
- Packaging and Distributing Zip Archives

Examples on ComPADRE: Chain of Oscillators [ID12977](#), Free Fall 3D [ID13369](#)

- 12h30 - 14h30 Lunch

- 15:00 – 17:00 NUS Public Lecture:

- Tracker, Video Analysis and Modeling Tool and
- Open Source Physics

OSP-EJS-ComPADRE

“A curriculum in which computation is absent or plays a minor role is inauthentic to the contemporary discipline. This absence is one of the most striking examples of our failure to update the curriculum.”

B. Sherwood

We offer a Computational Physics Education solution:

Open Source Physics (OSP) develops curriculum resources that engage students in physics, computation, and computer modeling. OSP material is based on computational physics as expressed in the Java OSP code library.

Easy Java/JavaScript Simulations (EjsS) is free open source modeling and authoring tool that is designed to create interactive simulations in Java (applications and applets) without the necessity of prior programming knowledge. EJS uses the core OSP library for many of its operations.

Tracker is a free video analysis and modeling tool. Students can both analyze the motion of objects and overlay simple dynamical models on the video and see how well the model matches the real-world.

ComPADRE is an NSF-sponsored NSDL pathway that is supported by the American Association of Physics Teachers, the American Physical Society, and the American Institute of Physics. The ComPADRE OSP Collection distributes OSP curriculum material and EJS models.

Finding and Using Existing Resources

- Log into ComPADRE
- Search the OSP Collection using the search field and browse the collection using the browse button on the main page.
- Find and run two items within the OSP collection that you can use in your teaching. Rank and annotate these two items

Discussion: How should simulations be used in teaching? Describe the items you found and explain how you can use these items.

Filing Cabinet and Community Tools

Logged in as Wolfgang (wochristian@davidson.edu) - [my profile](#) - [logout](#)

[filing cabinet](#) - [suggest a resource](#) - [administrate](#)

Search the OSP Collection...

[Search](#)

[Advanced](#)

- Save the items you found in the previous exercise in a filing cabinet.
- Follow Wolfgang Christian's *Introduction to Computer Simulation Methods* shared g cabinet.

Mario Belloni's Shared Folder My Folders

Mario Belloni's Shared Folders

- Astronomy 105

Astronomy 105 (13 subfolders)
Materials in Support of a College-Level Introductory Astronomy Course at Davidson College.

A survey of the current scientific view of the Universe. Emphasis on the physical and mathematical principles necessary to understand how astronomers observe and interpret phenomena. Topics include the historical development of major astronomical theories, the interaction of light and matter, the life cycle of stars, and the structure and evolution of the Universe. No laboratory.

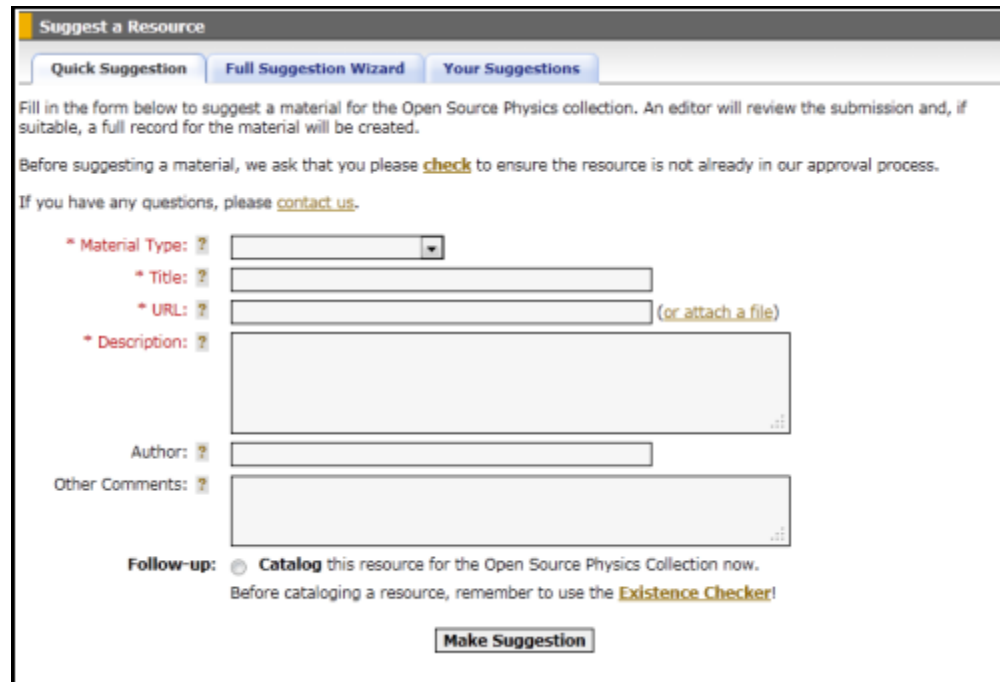
Astronomy 105 Subfolders

- Naked Eye Astronomy (10)
- Optical (Classical) Astronomy (3)
 - Solar System Models (10)
 - Orbits (7)
 - Optics (8)
- Modern Astronomy (0)
 - Stars and Stellar Properties (3)
 - Exoplanets (2)
 - Galaxies (2)
 - General Relativity (5)
 - Classical Simulations (3)
 - Schwarzschild Metric Simulations (9)
 - Kerr Metric Simulations (4)

[Stop following this folder](#)

How to Contribute:

- Join an OSP user group and post to its discussion board.
- Rate material and add comments.
- Suggest material.



Suggest a Resource

Quick Suggestion Full Suggestion Wizard Your Suggestions

Fill in the form below to suggest a material for the Open Source Physics collection. An editor will review the submission and, if suitable, a full record for the material will be created.

Before suggesting a material, we ask that you please [check](#) to ensure the resource is not already in our approval process.

If you have any questions, please [contact us](#).

* Material Type: ?

* Title: ?

* URL: ? (or [attach a file](#))

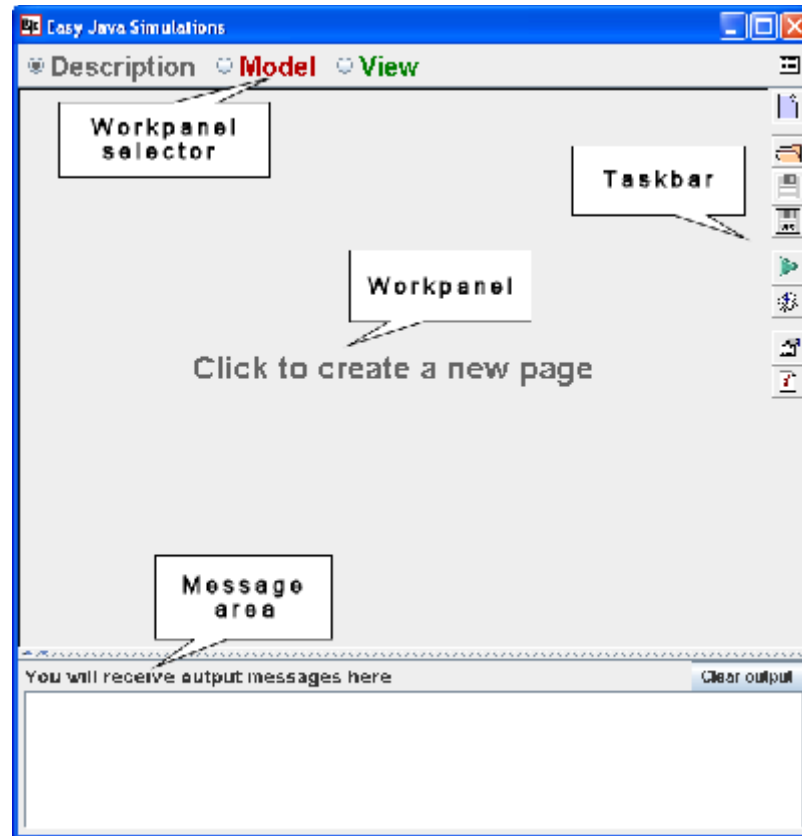
* Description: ?

Author: ?

Other Comments: ?

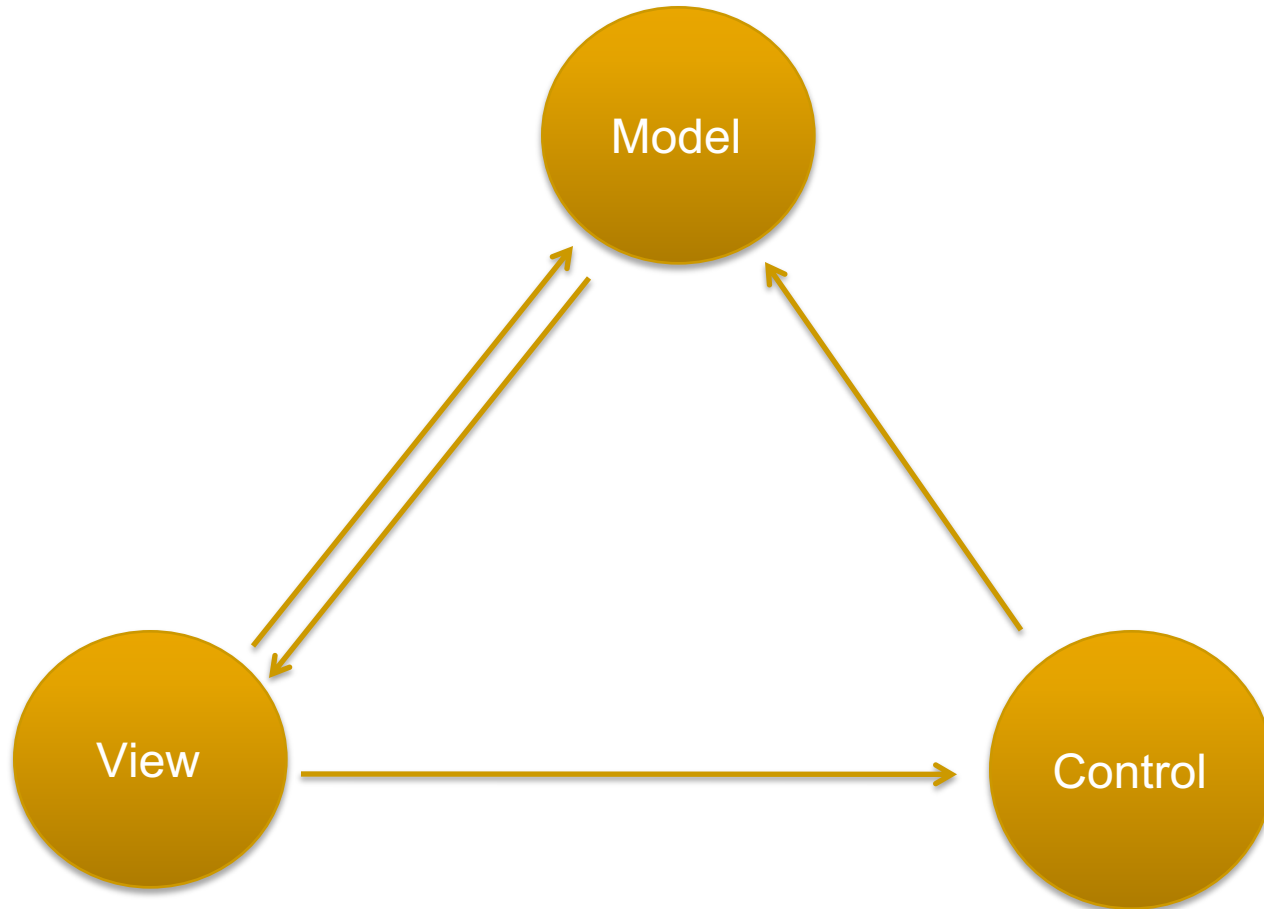
Follow-up: **Catalog** this resource for the Open Source Physics Collection now.
Before cataloging a resource, remember to use the [Existence Checker!](#)

Easy Java/JavaScript Simulations

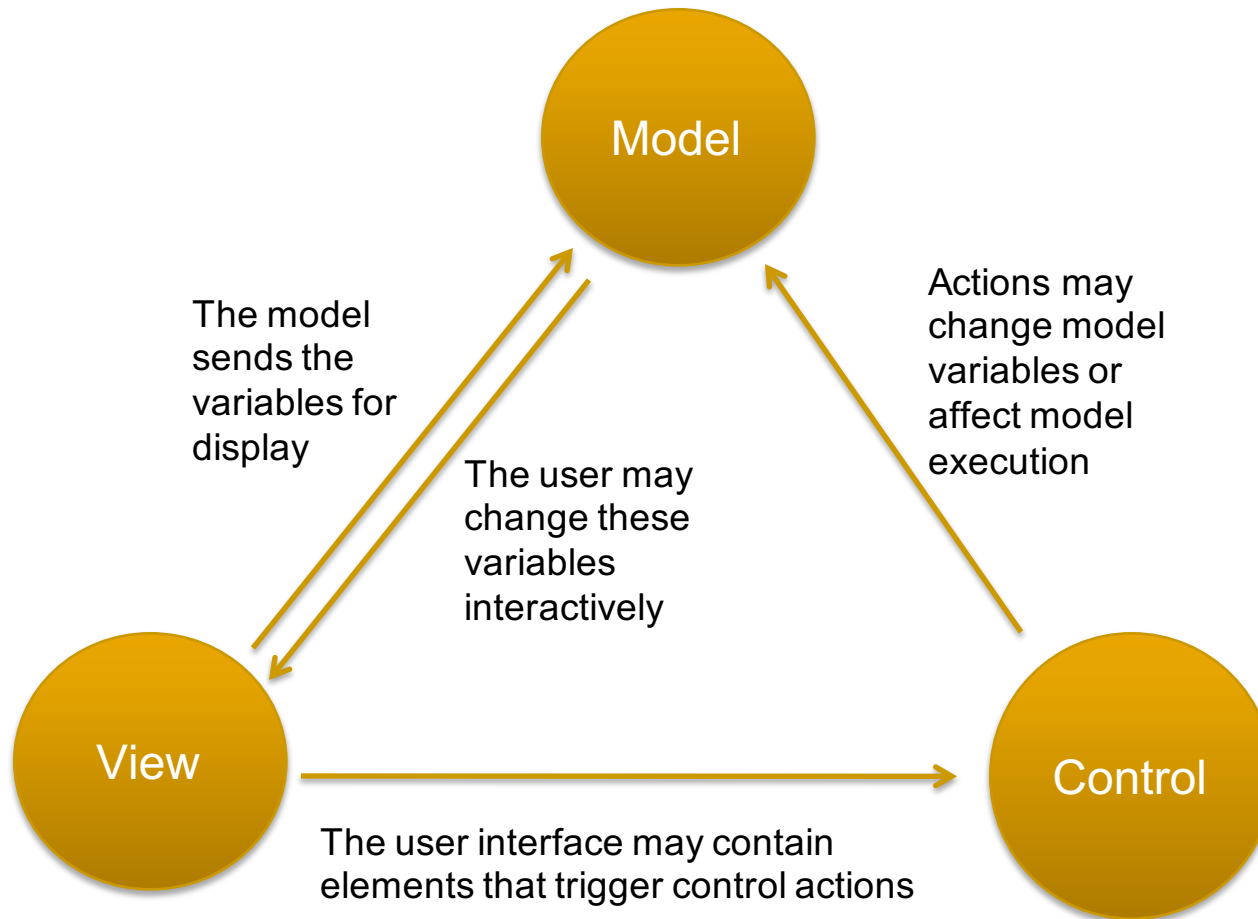


Load, modify, and save a model. [[SHO](#)]

Structure of a model in EjsS



Structure of a model in EjsS



Structure of a model in EjsS

Model

The model is created completely in the Model panel

The screenshot displays two windows of EjsS 5.2. The left window is in the 'Model' panel, showing the 'Variables' tab with a table of variables:

| Name | Initial value | Type |
|------|---------------|--------|
| x | 1.5 | double |
| vx | 0.0 | double |
| t | 0.0 | double |
| dt | 0.1 | double |

The right window is also in the 'Model' panel, showing the 'Evolution' tab with the 'Equations' sub-tab active. It displays the following differential equations:

| State | Rate |
|--------------------|----------------|
| $\frac{dx}{dt} =$ | vx |
| $\frac{dvx}{dt} =$ | $-k/m * (x-L)$ |

Additional settings in the right window include: 'Frames per second' set to 10, 'SPD' set to 1, 'Autoplay' checked, 'Solver' set to Runge-Kutta 4, and 'Tol' set to 1. The 'Comment' field contains 'Newton's second law'.

Structure of a model in EjsS

The screenshot displays the EjsS 5.2.2 interface for a 'Simple Harmonic Oscillator' model. On the left, the 'Properties for massShape (Shape)' panel is visible, with the 'Position and Size' section highlighted in a yellow circle. The 'HtmlView Page' panel shows a tree of elements, with 'massShape' highlighted. The 'Simple Harmonic Oscillator' view is shown in a red-bordered inset, with a yellow circle labeled 'View' and arrows pointing to the 'massShape' property and the view itself.

Properties for massShape (Shape)

| Main properties | |
|---------------------------|--------|
| Position and Size | |
| X | x |
| Y | y |
| Position | |
| PixelPosition | |
| SizeX | 0.2 |
| SizeY | 0.2 |
| Size | |
| PixelSize | |
| Transformation | |
| Visibility and Int | |
| Visibility | |
| Measured | |
| EnabledPosition | "ENABI |
| MovesGroup | |
| EnabledSize | |
| ResizesGroup | |
| Sensitivity | |
| OnEnter | |
| OnExit | |
| OnPress | |
| OnDrag | |
| OnRelease | vx = 0 |

HtmlView Page

Tree of elements

- Simulation view
 - labelPanel
 - labelTitle
 - mainPanel
 - centerPanel
 - drawingPanel
 - wallShape
 - spring
 - massShape
 - bottomPanel
 - buttonLeftPanel
 - buttonRightPanel

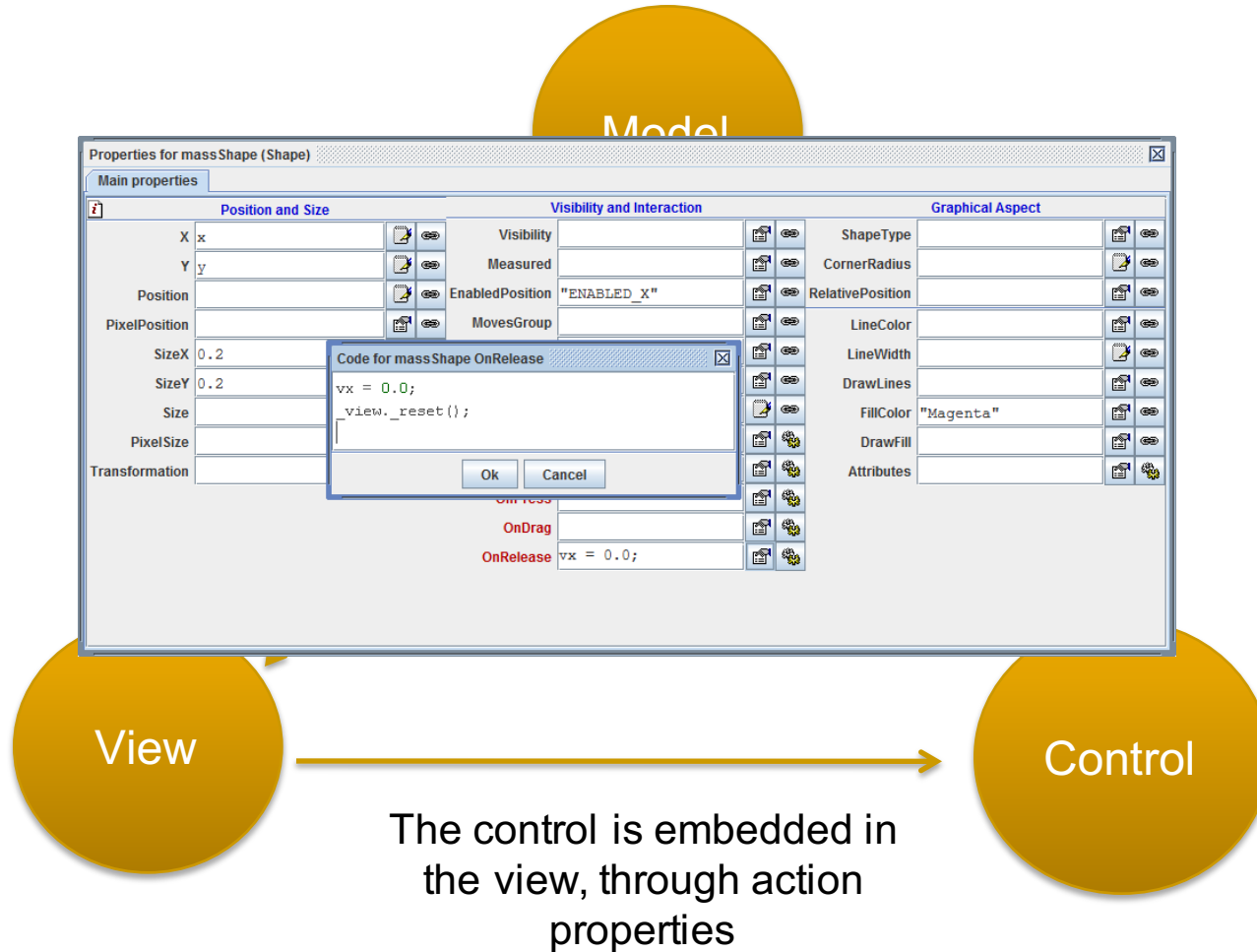
Simple Harmonic Oscillator

time=0.00

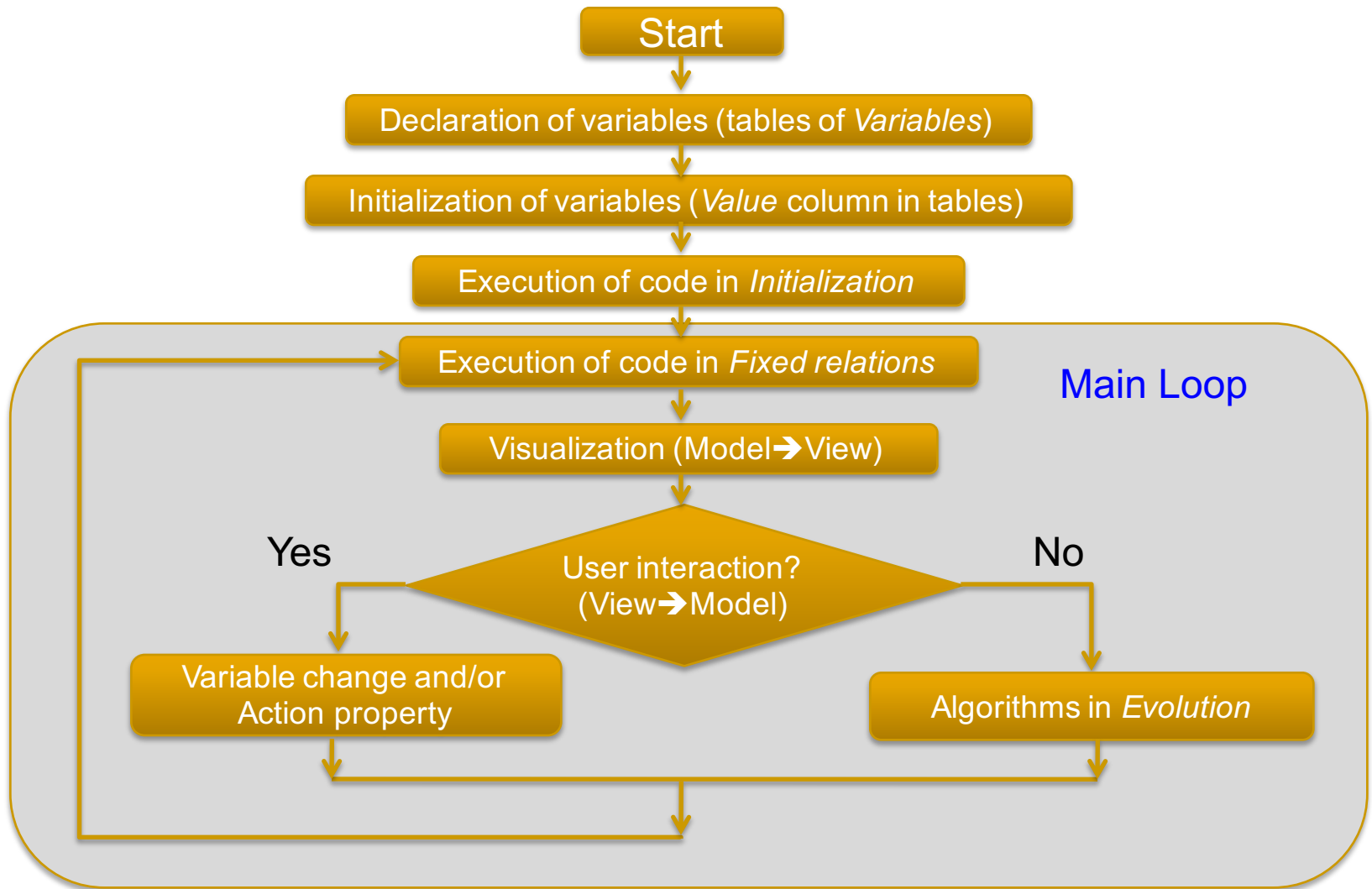
k = 39.480 x = 1.50

The view is created in the View panel and the dialogs set properties

Structure of a model in EjsS

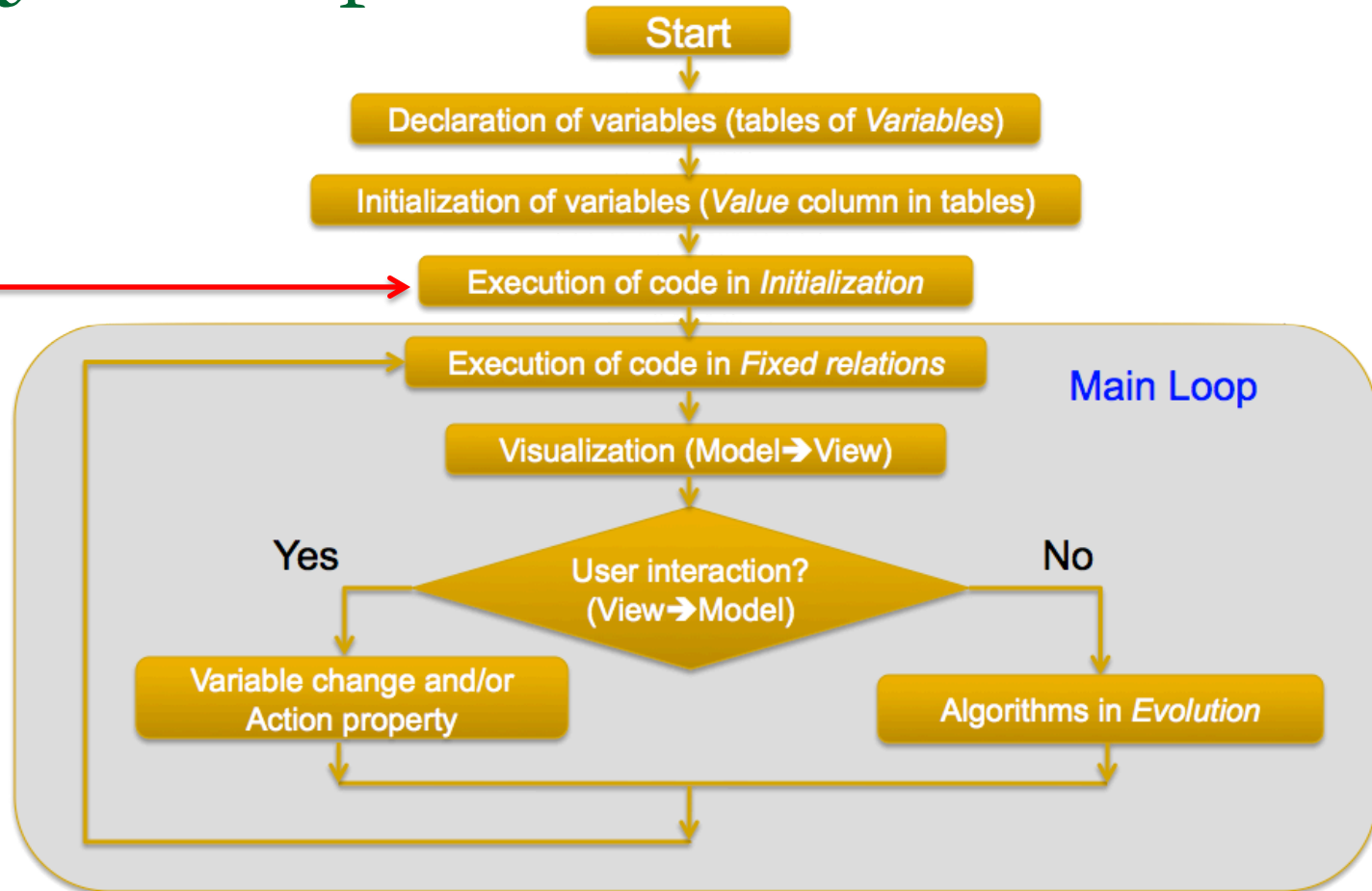


Structure of a model in EjsS

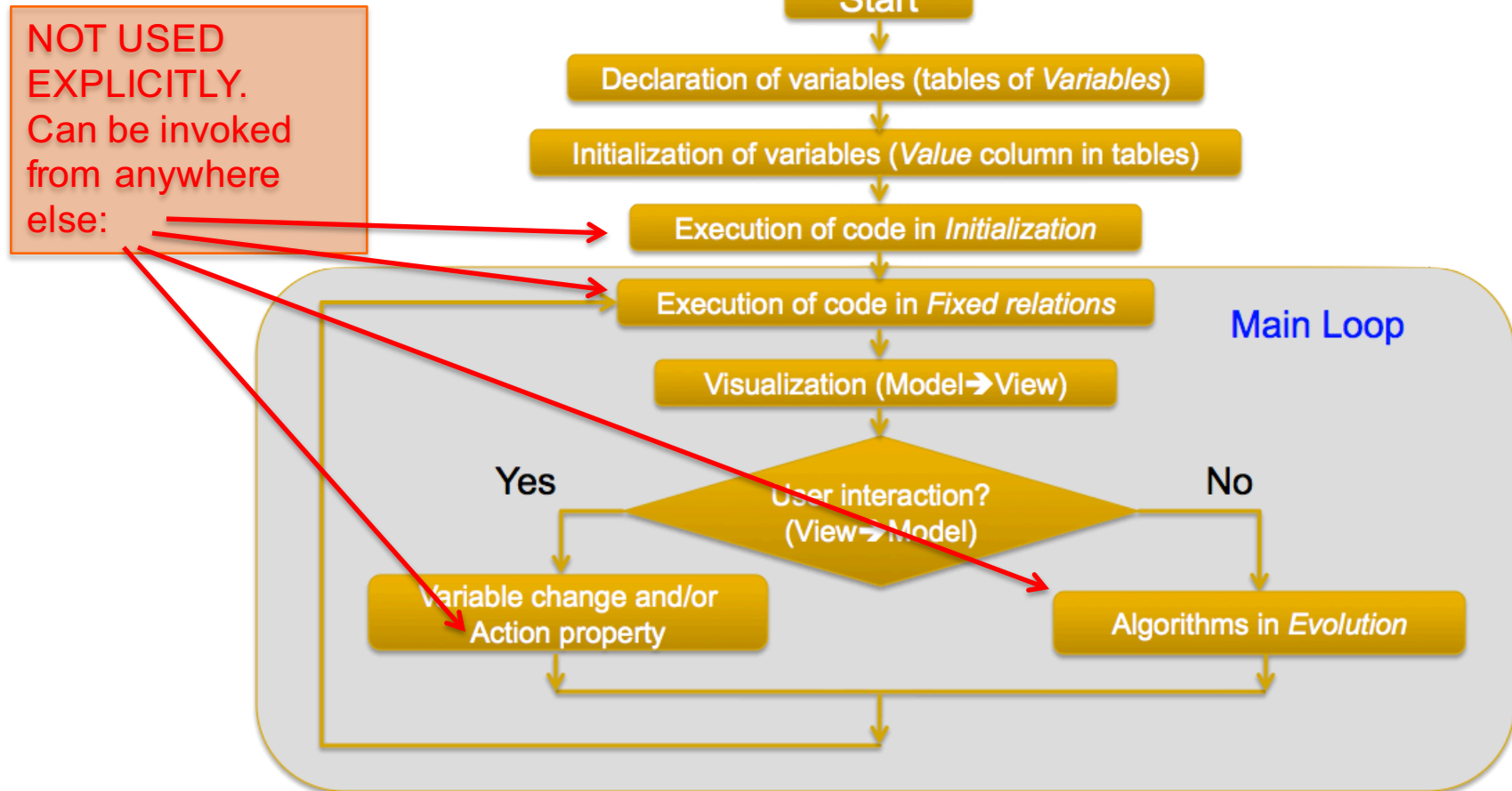


Initialization, fixed relations, and custom JavaScript code

Used here

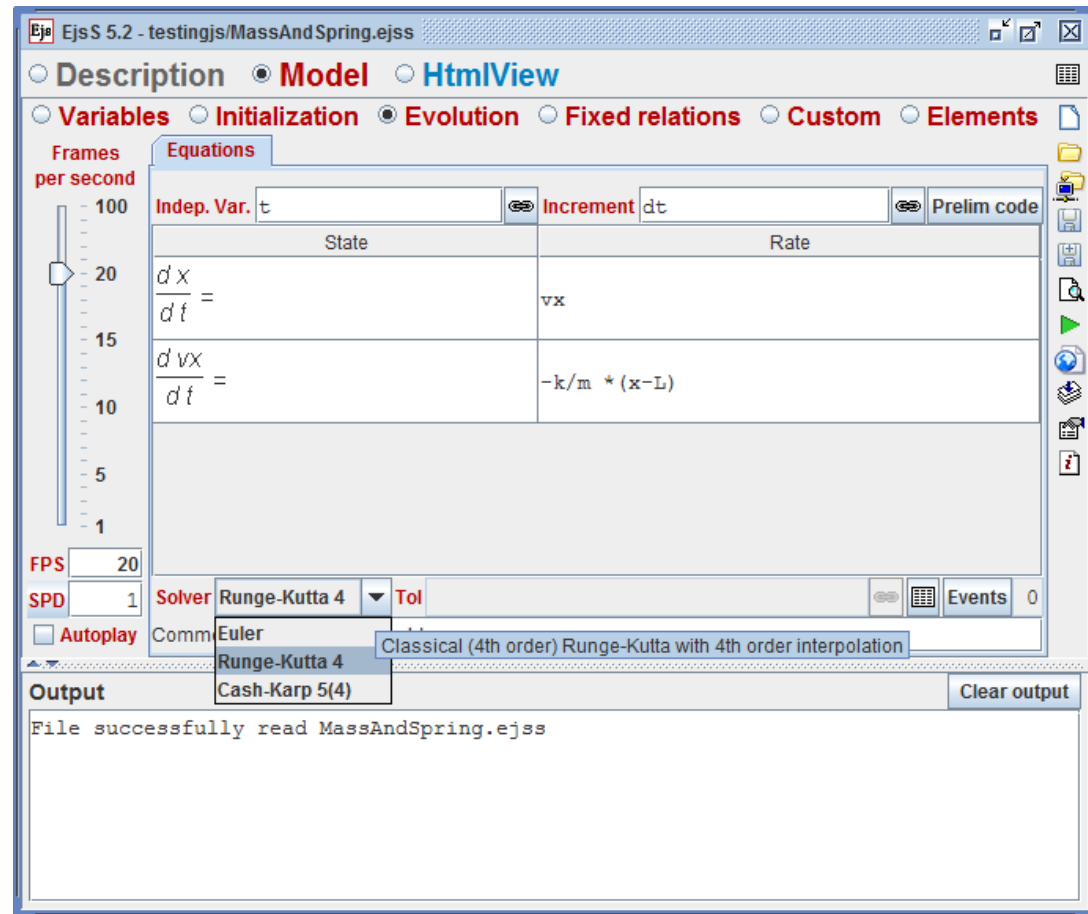


Initialization, fixed relations, and custom JavaScript code

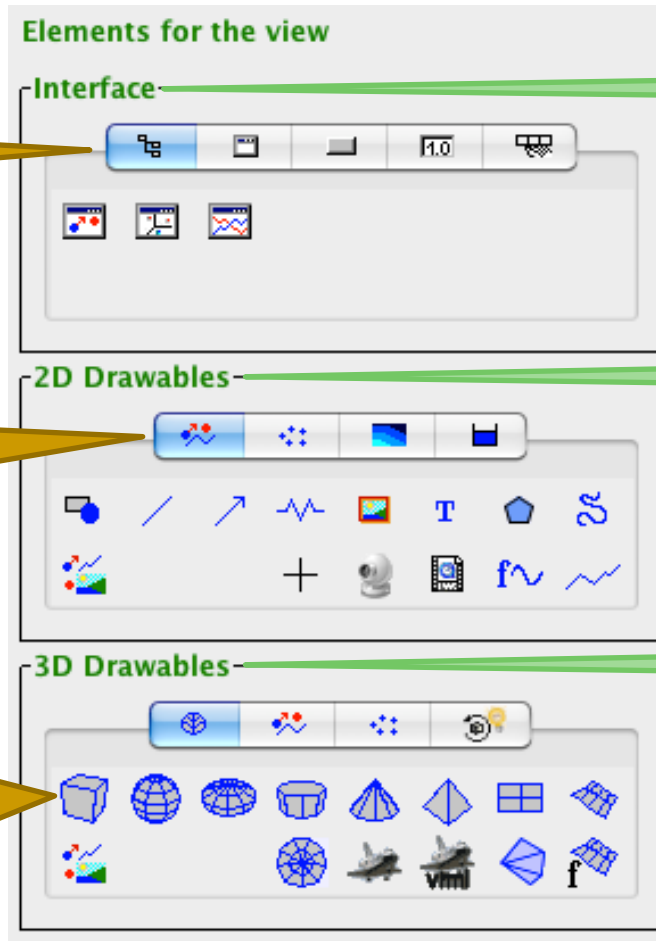


Introduction to the ODE editor and the Prelim code page

1. Indep. Variable
2. Increment
3. (Preliminary code)
4. Equations
5. Solver
6. (Tolerance)
7. (Advanced)
8. (Events)



Elements and Properties



Tabs with subgroups

Swing interface elements

Mouse-over shows subgroup hint

2D OSP elements

Mouse-over shows hint and name. Right-click for help.

3D OSP elements

Click an icon to select it for addition to the view tree

Creating and distributing models.

EJS 4.3.3.2 - ModelingScience/Ch02_Intro/MassAndSpringComplete.xml

Description Model View

Introduction Activities

Title: Introduction Language: default

Mass and Spring system

This is the simulation of the motion of a mass m situated at the end of a spring of length l and negligible mass. The motion is restricted to the horizontal dimension. (We choose a coordinate system in the plane with origin at the fixed end of the spring and with the X axis along the direction of the spring).

We assume that the reaction of the spring to a displacement dx from the equilibrium point can be modeled using Hooke's Law, $F(dx) = -k dx$, where k is a constant which depends on the physical characteristics of the spring. Thus, applying Newton's Second Law, we obtain the following second-order ordinary differential equation:

$$d^2x / dt^2 = -k/m(x-l),$$

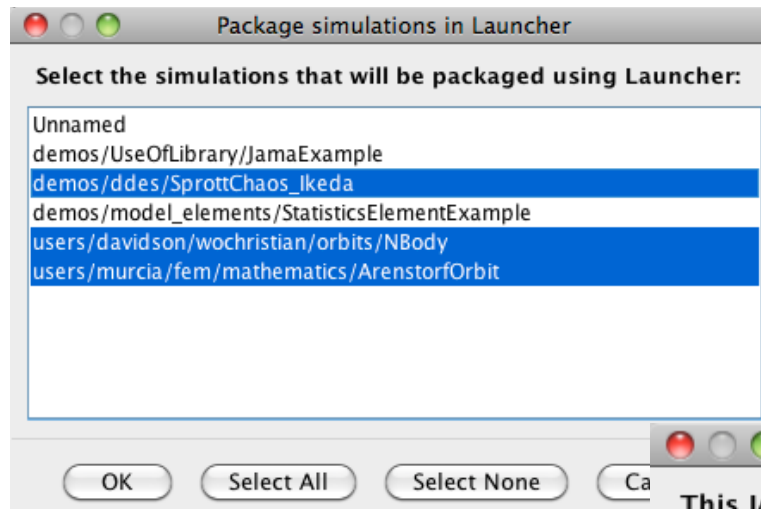
where x is the horizontal position of the free end of the spring.

In the simulation we solve numerically this equation and visualize the results.

- Package current simulation only
- Package several simulations**
- Package simulations in Launcher
- Export website with applets
- ZIP the simulation source files
- ZIP several simulations source files
- Remove current simulation
- Remove compiled code

Creating and distributing models

1. Choose the simulations to package

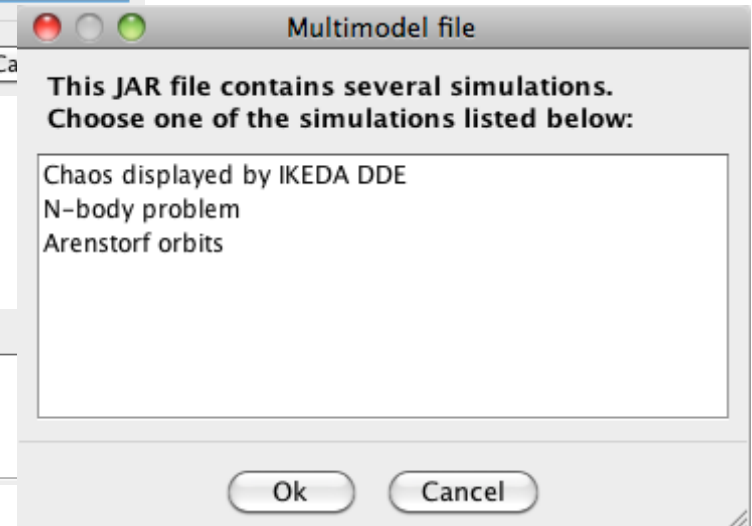


3. Double-click the generated file

2. Choose the destination file

Output

```
File successfully read MassAndSpringComplete.xml
Packaging error. Compressed file not created.
Compressing file... ejs_package.jar
Compressed file created successfully ejs_package.jar
```



Break



Building a JavaScript model

Complete EjsS Tutorial

Build a model of your choice such as:

- A simple driven harmonic oscillator model with damping.

$$\ddot{x} = -kx - b\dot{x} - \sin \omega t$$

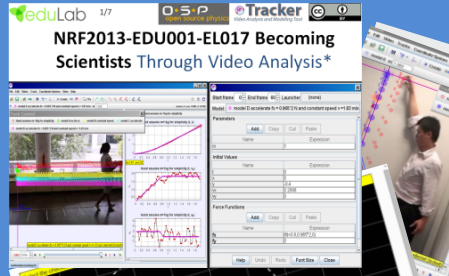
- A rocket model.
- A bungee jump model.

Lunch



You are cordially invited to attend

Free Admission

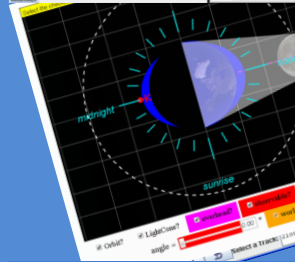


The Public Lecture on Tracker Video Analysis and Modeling Tool and Open Source Physics

Date: October 28, 2015

Time: 3 – 5 pm

Venue: Lecture Theater LT31, (S16-03), Faculty of Science, Lower Kent Ridge Rd, NUS



Douglas Brown is an Emeritus Professor (Cabrillo College, USA) and a Java Programmer. He obtained his PhD in Physics from the University of Colorado, Boulder under Howard Berg in 1974. He was a former Program Chair of the Physics Department at Cariblo College where he extensively created and developed courses based on the Tracker Video Analysis and Modeling Tool. He manages the Tracker-based curriculum resources and he is also the Resource Editor for ComPADRE Open Source Physics Collection. He has also published extensively in Physics Education Research.



Douglas Brown, creator of Tracker video analysis and modeling tool



Wolfgang Christian, creator of Open Source Physics

Wolfgang Christian obtained his PhD in 1976 from North Carolina State University at Raleigh and he is currently the Brown Professor of Physics at Davidson College, North Carolina, USA. His research interests are in the area of computational physics and instructional software design and he has led dozens of national and international faculty development workshops in this area. He has published several books on open source physics and Physlets® as well as numerous papers on open source software and other topics related to physics education. He is the elected secretary for the national American Association of Physics Teachers (AAPT) and he is past President of the NC Section of the AAPT. He is a Fellow of the American Physical Society and AAPT and he received the AAAS Science Prize for Online Resources in Education (SPORE) Award.

This public lectures are jointly organized by the Department of Physics, National University of Singapore; the Ministry of Education, Singapore; the National Institute of Education; Institute of Physics Singapore and funded by National Research Foundation