John Risley and 30 years of computers in physics

Aaron Titus, High Point University
Peg Gjertsen, WebAssign

AAPTS14

Introduction

After a significant career in atomic physics, John Risley devoted his career to physics education. There were 3 significant projects that John led:

1. The Physics Courseware Evaluation Project (PCEP) (early 80s - 2003)
2. Physics Academic Software (PAS) 1989-2011
3. WebAssign 1997-present

The unifying theme of all three of these projects was the use of computers in physics education, from simulation to MBL to evaluation.

PCEP History and Background
(early 80s - 2003)

It began as a computer lab and software library (Physics Courseware Lab) in the early 80s. John wanted to review every software application for physics teaching.

We collected public domain software with permission to distribute it.

Computers in Physics Conference (1989)

- A seminal conference held on NC State’s campus in 1989.
- Wolfgang will describe the impact of the conference.

PCEP Teacher Institute (1993-1995)

- 24 teachers in summers 93-94 and 24 teachers in 94-95
- Leader Teachers (Karen Jo Matsler, “my first baptism by fire”)
- Two week in the first summer, one week in the second summer
- Budget to purchase software
- A lot of time to play and create

PCEP Courseware Reviews (1993-1997)

Computer simulations of electric circuits are useful in both introductory and advanced physics courses for traditional problem-solving and for exploring parameters associated with electric circuits. This section looks at six circuit simulators and offers a comparative description.

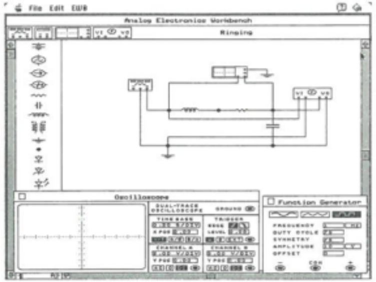
MacBreadboard

MacBreadboard is a unique and realistic TTL digital logic simulator that helps students learn how to wire and interpret digital circuits. The software replicates a breadboard, wires, a variety of digital electronic chips, four input clock types, simple output LEDs, seven-segment displays, and a buzzer. The electronic chip library contains 75 two-state TTL devices, and student can request timing diagrams for active circuits.

MacBreadboard uses excellent graphics and is very user-friendly. Wires and chips are placed on the breadboard with simple mouse movements. The user can make a hard copy of both the circuit design and the timing diagrams.

This package allows for the exploration of the basic principles of digital

Electronics Workbench



Electronics Workbench 3.0
Interactive Image Technologies
$299.00
Requires PC or Mac

Electronics Workbench, an easy-to-use circuit simulator that includes an analog and a digital module, is available for both the PC and Mac platforms. With this program, the user can construct a simple or complex circuit by placing elements into a workspace and then analyze the circuit using available test instruments.

The analog module contains circuit elements such as resistors, capacitors, inductors, transistors, and diodes. It also includes sources such as batteries, sinusoidal voltage supplies, and a function generator. The circuit may be analyzed using voltmeters, ammeters, a multimeter, an oscilloscope, and a Bode

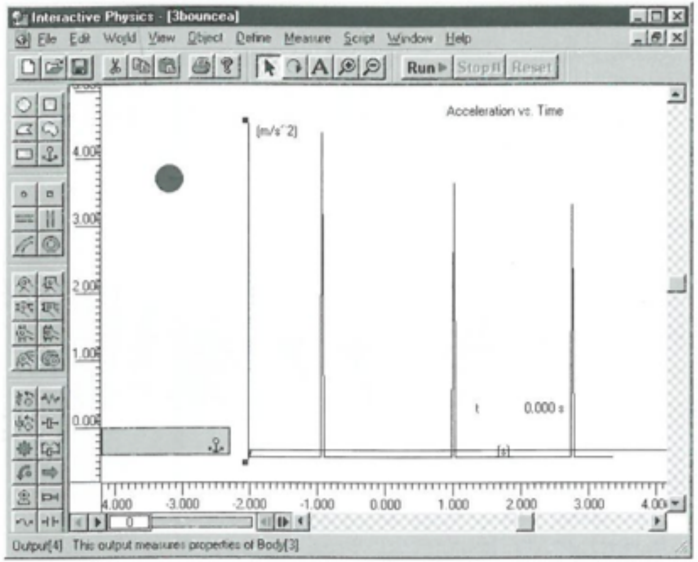
Physics Courseware Communicator

The Physics Courseware Communicator is published quarterly by the Physics Courseware Evaluation Project (PCEP) in the Department of Physics at North Carolina State University. This newsletter describes physics educational software of interest to physics teachers at many levels of instruction. PCEP is supported in part by grant number TPE 92-53343 from the National Science Foundation. Subscription rates are $15 for one year ($35 foreign air mail). Please

PHYSICS COURSEWARE

Summer 1996 *Reviewing Physics Educational Software* Volume 3, Number 4

Interactive Physics 3.0: Third Time Is A Charm



Knowledge Revolution has released a new version of *Interactive Physics* (IP) that promises to be the one used by most physics instructors. Lots of instructors own IP, a two-

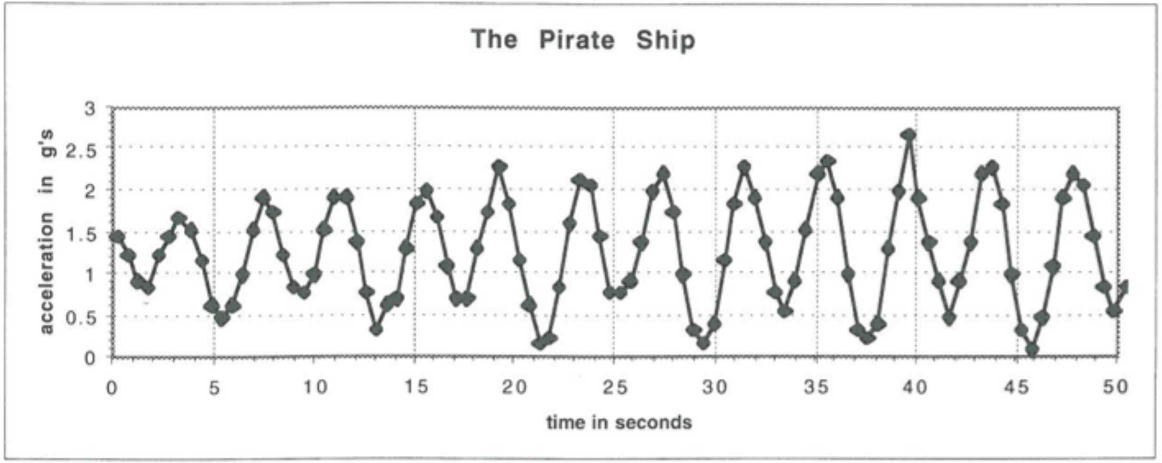
improvements come at a price, however, because this version requires either Windows 95 or NT and runs best on a Pentium with 16 MB RAM. For the Mac, Knowledge Revolution suggests 12 MB RAM. Plan on using 10 to 15 MB of hard disk space, and a CD-ROM is required for installation. With these requirements, some users, especially students, will not be able to upgrade.

Rather than exhaustively list the IP 3's new features, which Knowledge Revolution does well in its advertising, I will concentrate on a few of the features that will most likely make IP more useful to the average instructor.

Editing a simulation is more straightforward. The tool palette includes more tools than did the older, hierarchical palette, and the tools are easier to find. Most significantly, the end points of constraints like ropes or springs now snap to the center of mass or to the edge of a mass object. This makes creating simple simulations easy, and prevents you from unintentionally creating complex models. Mass

We install the TI-Graph Link on a Macintosh and run the program. Now we can pass data and programs between the computer and calculator. Can't we? Um, it's not working. Our first big stumbling block turns out to be loose cables from the computer into the calculator. Just when we think that the plug cannot be pushed any further, we discover that it can. It takes us less than two hours to master the Link program and load several CBL programs into the calculator.

L.K. Wilkinson



Next we must master the CBL itself. We spend another few hours getting comfortable with using the CBL and a few probes. All of us have used computer-interfaced probes before, so the process of taking data with the CBL seems natural. It is time to call it a day.

The next day is a Friday—sunny, 70°—and the State Fair is a mile away. Our group is thinking of the Pirate Ship acceleration waiting to be measured. But how does the accelerometer work anyway?

We run the calibration program, setting the acceleration to +1g for a stationary vertical accelerometer pointing down and −1g for up. snapping shots. We run the ACCELER program but are confused by the graph. We are not sure it is actually taking data! Panic. Everyone at the fair is watching. Rapid troubleshooting. Finally it works.

The ride slows to a halt. Knees knocking and hearts pounding, we stumble off the ride. The camera clicks. The operator smiles broadly. He wants to know the greatest speed. We want to talk about g's. We try to convince him of the importance of acceleration, but agree with his estimate of 45 miles per hour and leave for the ice cream pay-off. By this time it is well past 5 o'clock on a Friday afternoon. We upload the data to a Macintosh, but it must wait for analysis.

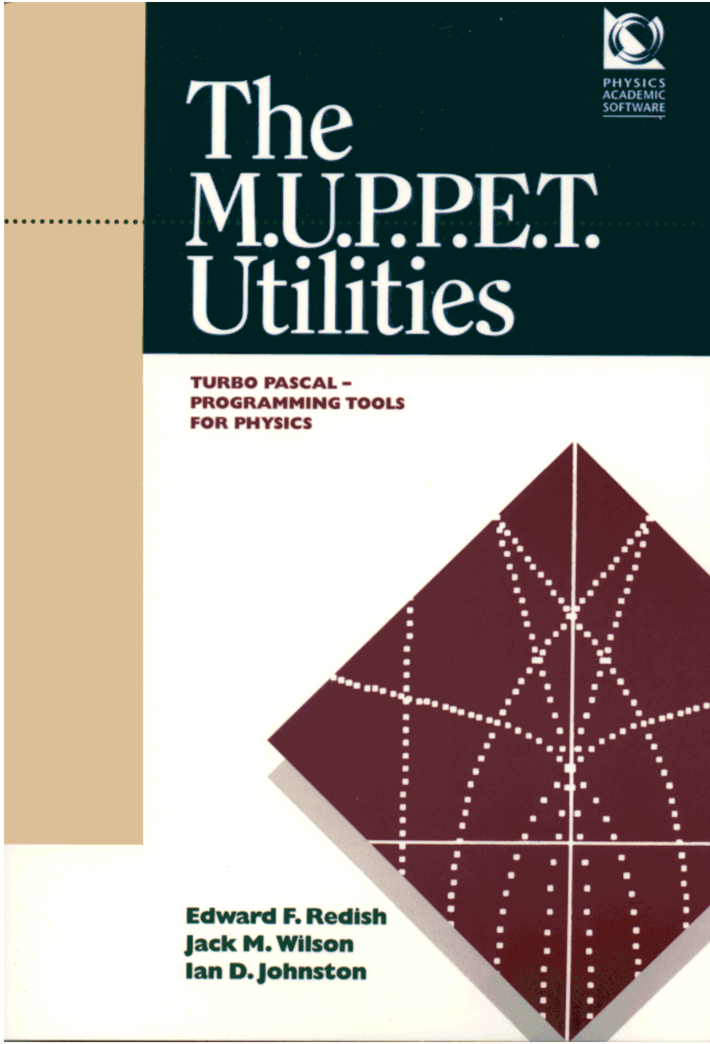
PAS History and Background (1989-2011)

- IBM wanted to sell computers to students and teachers, but there wasn’t a strong collection of software.
- IBM started The Academic Software Library (TASL) by funding professional organizations like AIP to help develop software (PAS). John Risley was the director of TASL and the editor of Physics Academic Software.
- Spacetime by Edwin Taylor was the first PAS program.

M.U.P.P.E.T. Utilities (1987)

Programming tools for solving physics problems

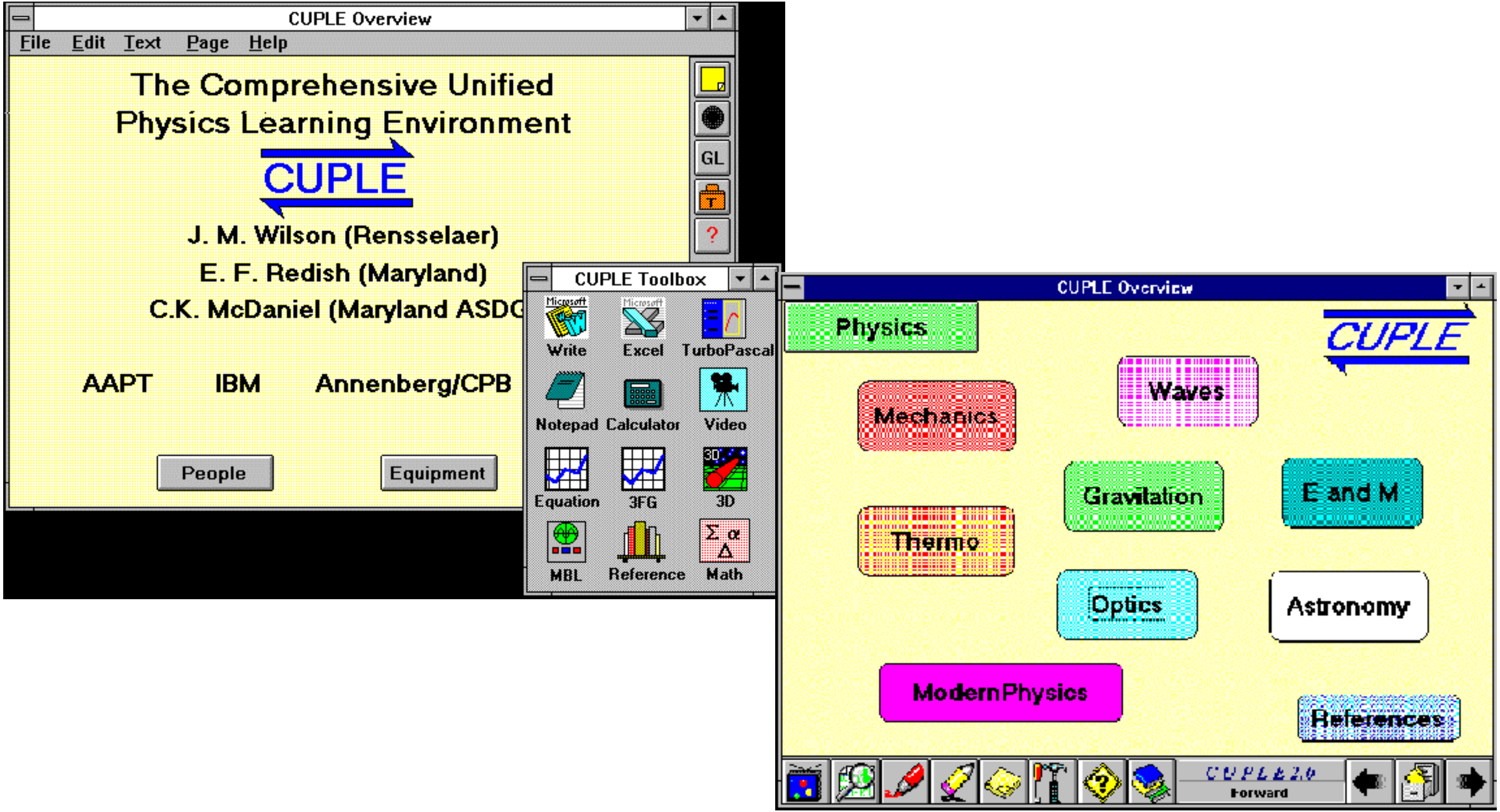
http://physics.umd.edu/ripe/muppet/muppet.html



CUPLE (1991)

The Comprehensive
Unified Physics
Learning Environment

http://www.physics.umd.edu/perg/cuple/


CUPLE Overview
File Edit Text Page Help
The Comprehensive Unified
Physics Learning Environment
CUPLE
J. M. Wilson (Rensselaer)
E. F. Redish (Maryland)
C.K. McDaniel (Maryland ASDC
AAPT
IBM
Annenberg/CPB
People
Equipment
GL
?
CUPLE Toolbox
Write
Excel
TurboPascal
Notepad
Calculator
Video
Equation
3FG
3D
MBL
Reference
Math
CUPLE Overview
Physics
CUPLE
Mechanics
Waves
Gravitation
E and M
Thermo
Optics
Astronomy
Modern Physics
References
Forward

cT

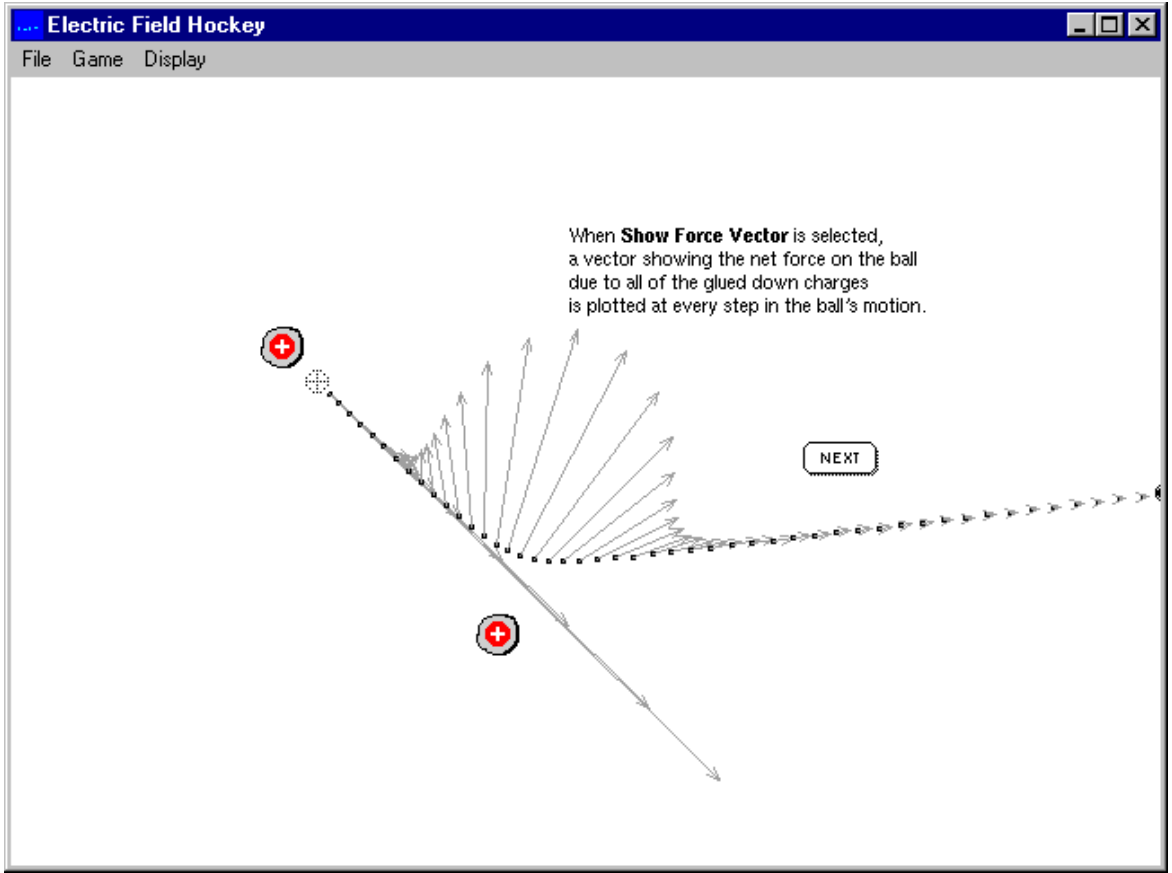
```
* A subroutine to draw 1-d chaos, from a
* sample program by Bruce Sherwood.

unit    chaos
        f: pop, rate  $$ population and growth rate
        i: n, TRIES=40, base=8
        i: usecolor
        f: h, s, v
calc    usecolor := (zncolors >= 8 base)
palette zred,100,0,0,zwhite
if      usecolor
        loop    n := 0,7  $$ make hues from blue to red
                getrgb  240[1-(n 1)/8],100,100; h, s, v
                palette base n,h,s,v
        endloop
endif
color   zwhite
```

cT is an algorithmic scripting language intended for building animations, user interfaces, and multimedia presentations.

cT is supported by a large library of built-in commands for handling images, videos, sounds, fonts, and other kinds of graphics data, file I/O, network communication, and system interfacing.

Dictionary of Programming Languages http://cgibin.erols.com/ziring/cgi-bin/cep/cep.pl?_alpha=c

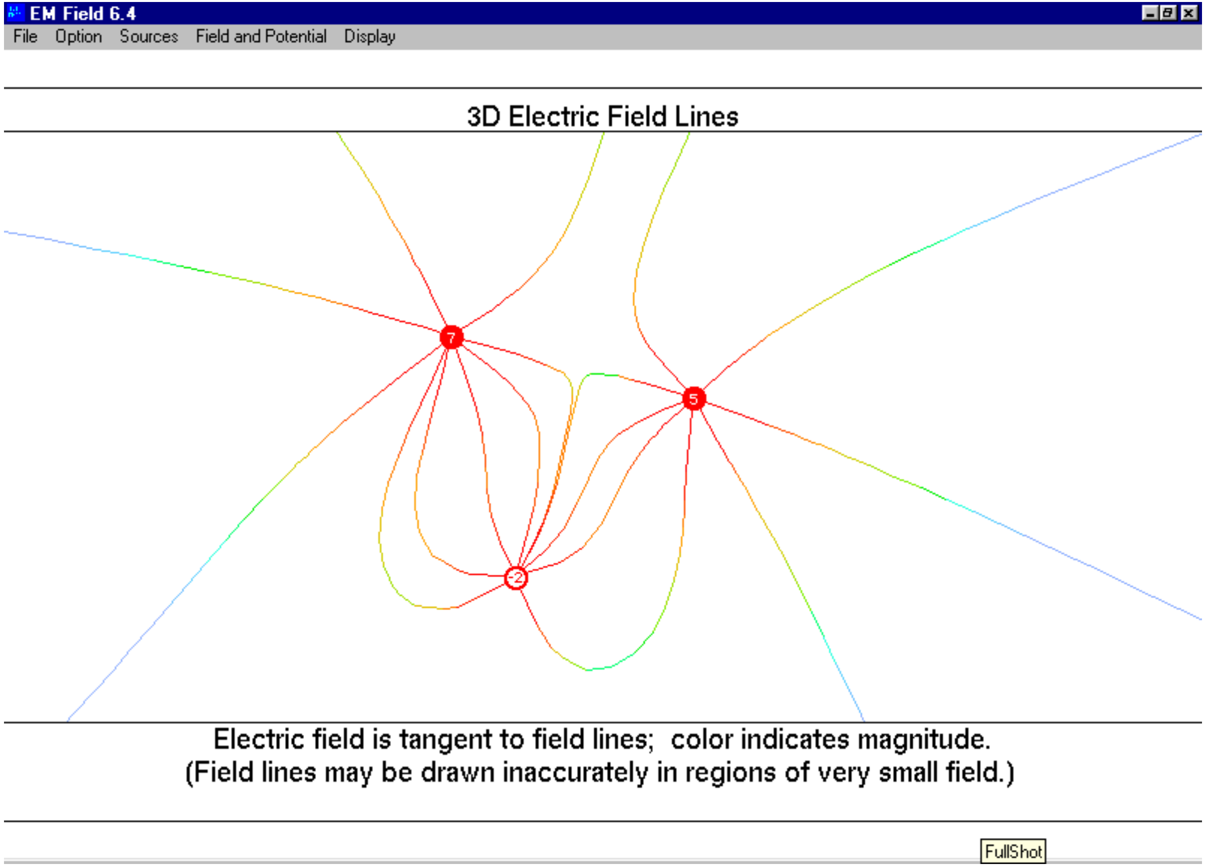
Electric Field Hockey



PHET Electric Field Hockey

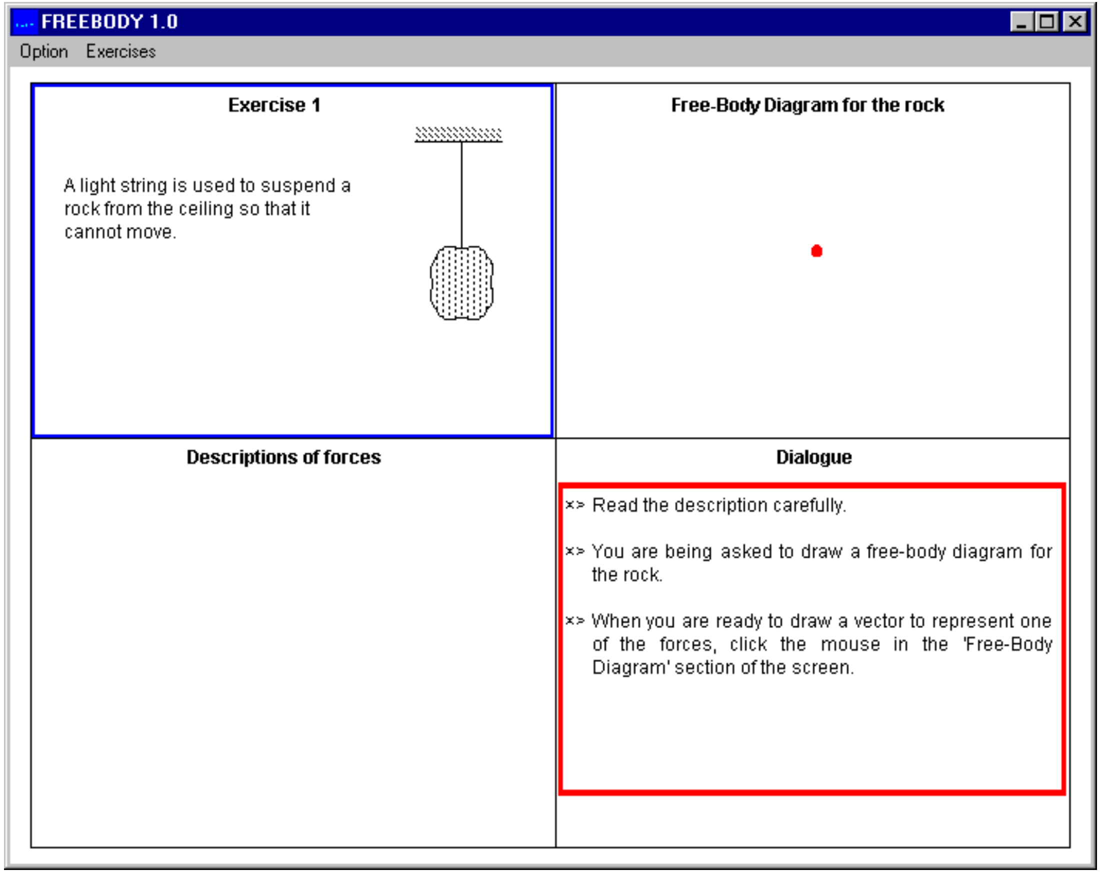
(http://phet.colorado.edu/en/simulation/electric-hockey)

EMField

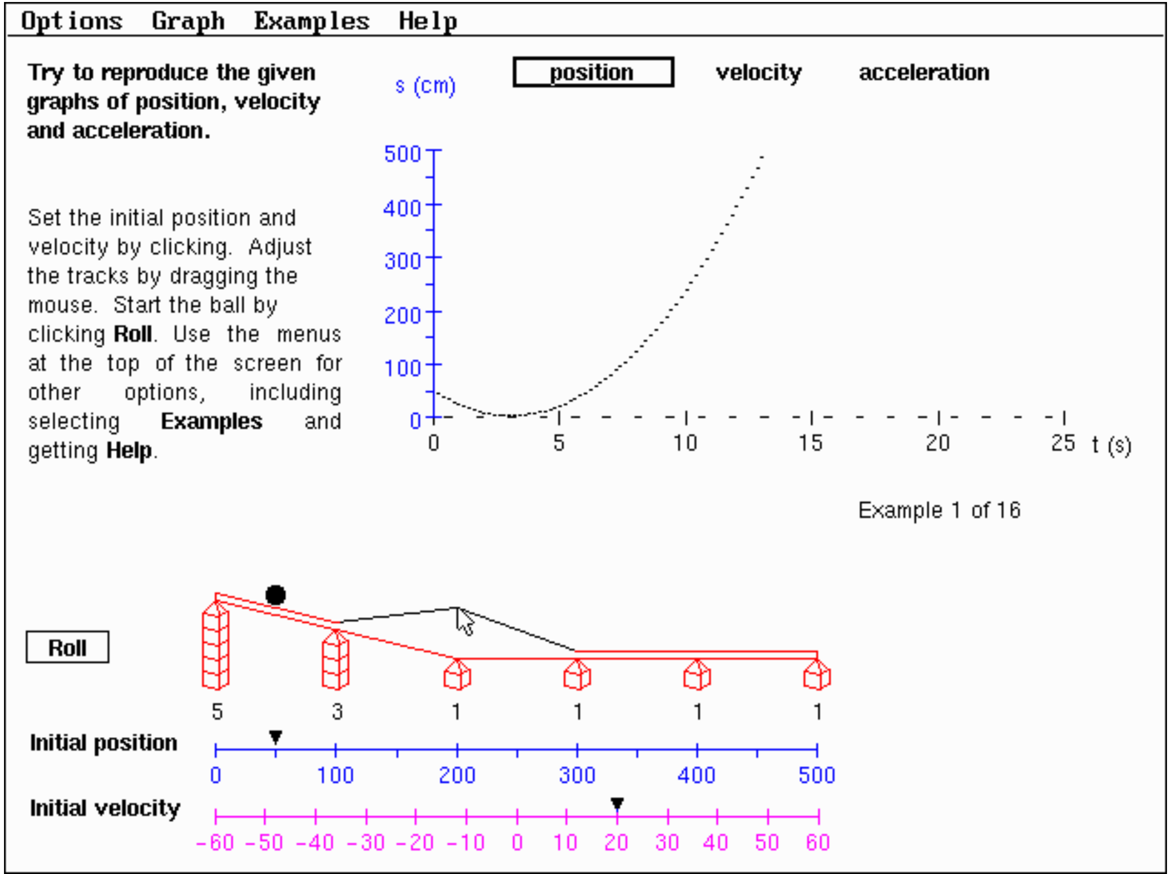


EM Field 6.4
File
Option
Sources
Field and Potential
Display
3D Electric Field Lines
7
5
-2
Electric field is tangent to field lines; color indicates magnitude.
(Field lines may be drawn inaccurately in regions of very small field.)
FullShot

Free-Body


FREEBODY 1.0
Option
Exercises
Exercise 1
A light string is used to suspend a rock from the ceiling so that it cannot move.
Free-Body Diagram for the rock
Descriptions of forces
Dialogue
>> Read the description carefully.
>> You are being asked to draw a free-body diagram for the rock.
>> When you are ready to draw a vector to represent one of the forces, click the mouse in the 'Free-Body Diagram' section of the screen.

Graphs and Tracks



Current Alternatives to Graphs and Tracks

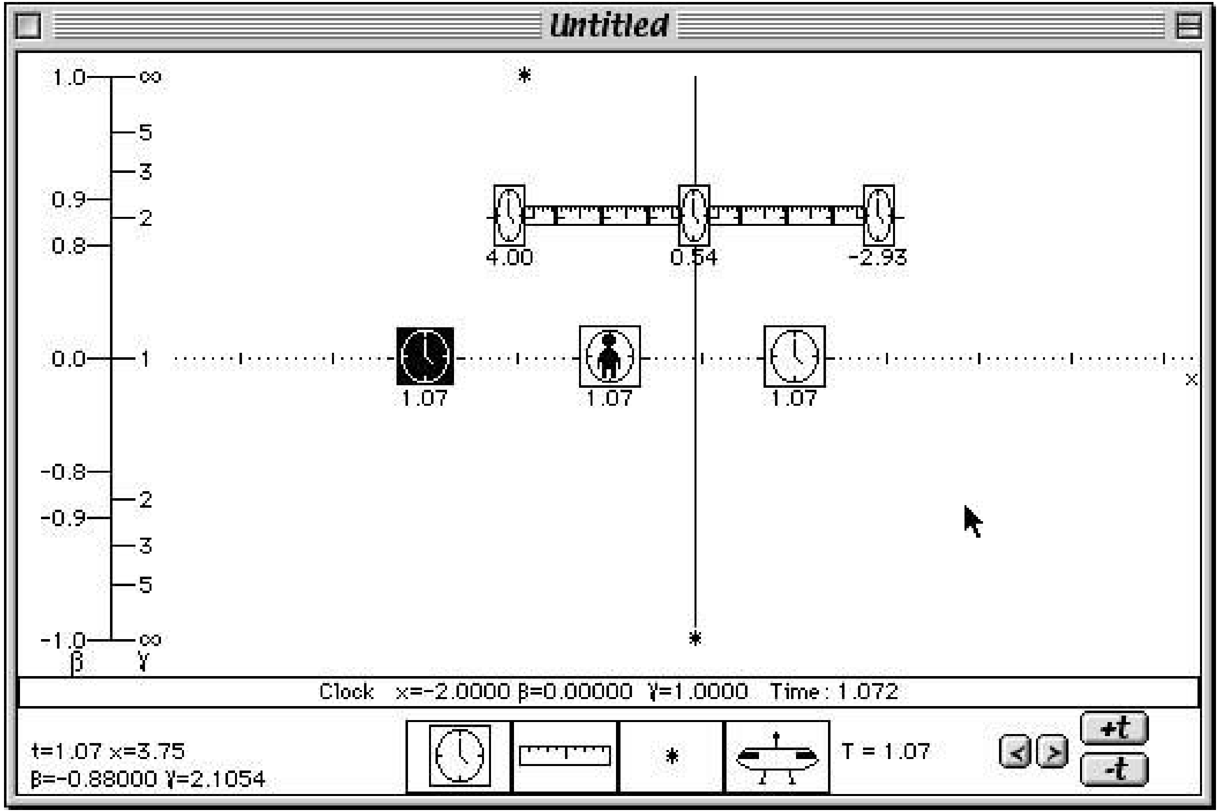
Ramp n' Roll

(http://www.laboutloud.com/rampnroll/)

Graphs and Tracks Model

(http://www.compadre.org/portal/items/detail.cfm?ID=12023)

Spacetime


Untitled
1.0
∞
5
3
0.9
2
0.8
4.00
0.54
-2.93
0.0
1
1.07
1.07
1.07
x
-0.8
2
-0.9
3
5
-1.0
∞
β
γ
Clock x=-2.0000 β=0.00000 γ=1.0000 Time: 1.072
t=1.07 x=3.75
β=-0.88000 γ=2.1054
T = 1.07
+t
-t

PAS to ComPadre

April 17, 2012.

John Risley, Department of Physics, North Carolina State University and editor of PASPO, noted, “PASPO was created to provide an opportunity for physics teachers to publish educational software for students and make the software available to the physics teaching community. Over time, educational materials have transitioned from standalone products that run on specialized computers to online applications that everyone can access easily. As part of the final disposition of PASPO assets, ComPADRE was chosen to receive the remaining funds as a gift because ComPADRE is continuing to carry out the mission of physics teaching using technology. It is with pleasure that we are able to help support their work.”

WebAssign History and Background

1996 Summer AAPT Meeting at University of Maryland.

Larry Martin (WWWAssign)

Aaron Titus (PhysWeb)

WebAssign Timeline

- Summer 1997 - WebAssign is developed
- Fall 1997 - WebAssign used for all physics classes and some math classes at NCSU, some physics classes at Georgia Tech, some physics classes in a HS, and some physics classes at UMich Dearborne (Paul Zitzewitz).
- 2001-2003 - FIPSE grant to support commercialization and content development
- 2003 - Advanced Instructional Systems was incorporated with WebAssign as the flagship product.

WebAssign Significant Features

- Developed by teachers for teachers
- Shared database of questions and assignments
- Teachers can create their own questions
- Publisher independent
- Grading lab reports
- Delivery of new question types
- Get away from plug and chug?

WebAssign Commercialization

In 2012, WebAssign became an employee-owned Benefit Corporation.

"As a benefit corporation, WebAssign's purpose is to create a general public benefit that has a material positive impact on society and the environment."

A Common Thread in John’s Vision

Simulations available to all students and teachers, easy to run on any platform and easy to implement for every teacher.