

***Modeling Real World Events and Video Data Collection
Workshop
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Source: <http://www.nhtsa.dot.gov/airbags/stills/>

INTRODUCTION

Physics teachers have long used visual media to teach. Well before any form of motion picture was available, lecture demonstrations provided visualizations of the basic concepts of physics. Video and films for physics teaching date from at least the early 1950s when the American Association of Physics Teachers sponsored a set of films, which have since been lost. Harvey White's televised physics programs date from the latter half of the 1950s. The PSSC films and the Super-8 film loops produced by Franklin Miller, Project Physics and others became important tools in physics teachers' collections in the 1960s.

But while film and videotape can in principle bring some of the knowledge and experience of outstanding teachers into any classroom, they have a major limitation. The control exercised by the classroom teacher or the student is limited to turning the film on or off. Once the film or videotape is turned on, the flow of information is controlled by the film production team. Thus one of the most important capabilities of the experienced teacher is limited by the choices about how to use a film. In fact, the choices are binary - it is either off or it is on. Once the film or videotape is turned on, the control of information is in the hands of a film production team which is separated in space and time from the teacher and the students who are trying to learn. Thus, one of the most important capabilities of the experienced teacher - the ability to respond immediately and appropriately to the needs of the students - is not available in these media.

Interactive video gives teachers a variety of audiovisual materials and techniques that they can control. Should teachers wish, they can pass that control to the students and so enable them to answer their own inquiries at a pace that is comfortable for them. In many ways interactive video makes physics teachers a part of the media production and instructional design team even though they never visit a television studio. (Zollman & Fuller, *Physics Today*, 1994)

In this workshop we will explore one of the most useful forms of interactive video—collecting data from a video scene. Using software, some of which is free, students can analyze and model a variety of events and activities. They can use videos of experiments that they have recorded themselves, videos specially prepared for physics classrooms, television scenes, or research videos. Here we will focus on three recorded scenes. One is an automobile crash test which was recorded by the German insurance company Allianz. Another car crash comes from General Motors and was used on the *Physics and Automobile Collisions* videodisc. The final scene is a recording of a high jumper from the *Physics of Sports* videodisc.

CAR CRASHES, AIR BAGS & NEWTON'S LAWS

The pictures below show a series of stills from a video that Allianz Forschung created in an apparent attempt to show the value of seat belts. The front seat passenger is slightly constrained by a shoulder belt while the rear seat passenger is free to move. Take a look at the pictures below and discuss how you might use the video to teach some aspects of Newton's Laws.



Source: <http://www.physik.uni-muenchen.de/didaktik/Computer/DAVID/david.htm>

Now, we will use the video and some analysis software to make this lesson more complete.

We can also develop mathematical models from scenes similar to the one we just looked at. As an example consider another research car crash. For this one, students have taken data, imported that data into a spreadsheet, and fit them to curves. They find that the car's motion can be modeled rather well with separate equations representing

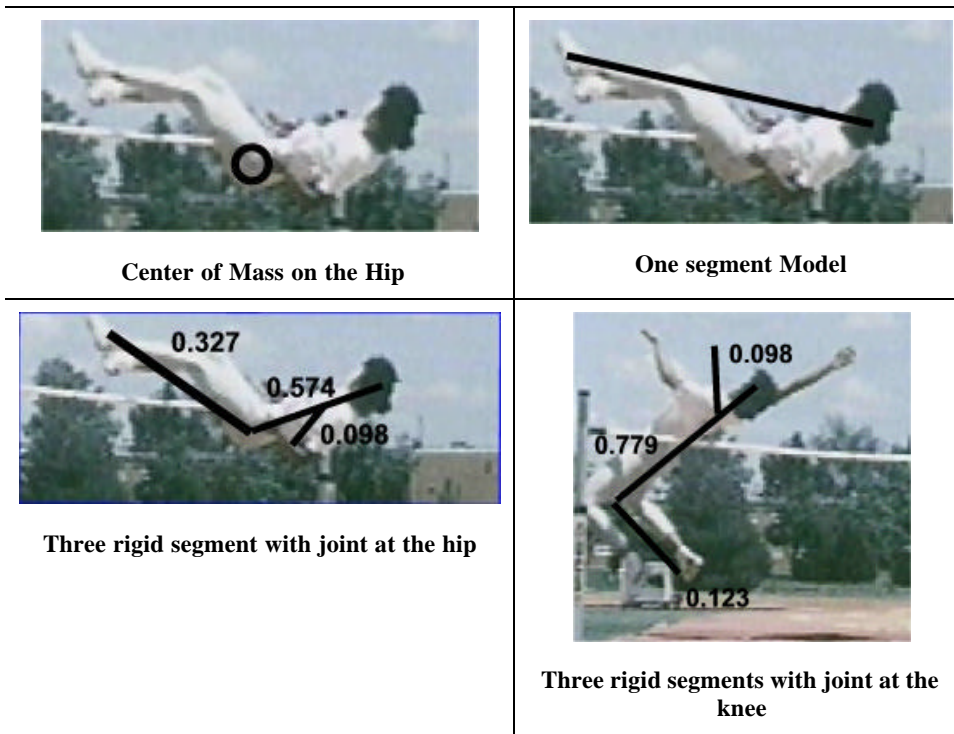
- ?? A constant velocity until the car strikes the barrier,
- ?? A large constant acceleration while the car is in contact with the barrier, and
- ?? A small constant acceleration after the car ceases interacting with the barrier.

Given the complexity of the interaction between the car and the barrier, it is rather remarkable that these simple equations fit as well as they do.

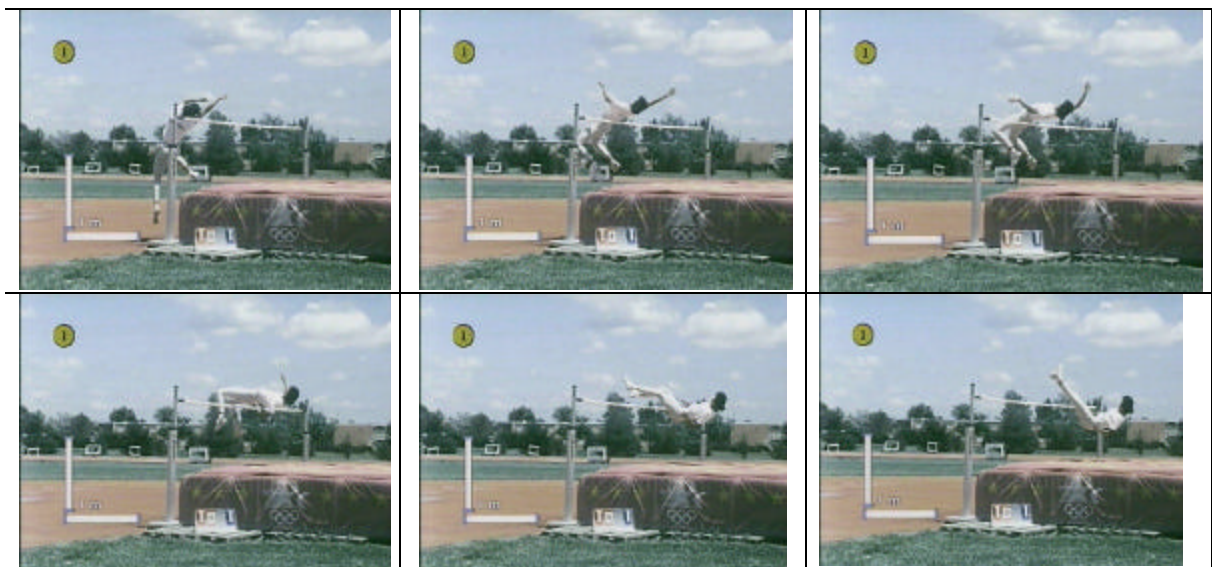
QUALITATIVE MODELING

In addition to collecting data students can compare models of various types with real motion. One method that we have found effective follows the research techniques used by researchers who study human motion. They create stick figures to model the human body. Each stick in the figure is rigid and has uniform mass. The fraction of body mass associated with each segment are based on "average" people.

Typically, researchers will use 25-30 segments for the body. We use one to three. These models are represented in the figure below.



Use one of the models to analyze the motion of the high jump pictures below.



Source: Physics of Sports videodisc

SOFTWARE LINKS

VideoPoint

Information & Download Demonstration version: <http://www.lsw.com/videopoint/>

Sales: <http://www2.pasco.com/products/>

Price: US\$167.00 (Teachers' Version), US\$52.00 (Students' Version), Site Licenses available

VidShell

Information & Download: <http://192.233.237.47/vidshell/vidshell.html>

Price: Free

Worlds in Motion

Information: <http://members.aol.com/raacc/wim.html>

Sales: <http://www.logint.com.au/worldinm.htm>

Price: Single User A\$218.00, Site License A\$347.00

DAVID - Digitale Auswertung von Videos

Information & Download: <http://www.physik.uni-muenchen.de/didaktik/Computer/DAVID/david.htm>

Price: Free

DIVA -Digitale Video-Analyse

Information & Sales: <http://www.physik.uni-augsburg.de/did/diva.htm>

Price: DM30.00

LINKS FOR DOWNLOADING VIDEO CLIPS

VidShell

<http://192.233.237.47/vidshell/clips.html>

Student experiments, sports, some car crash

DAVID - Digitale Auswertung von Videos

<http://www.physik.uni-muenchen.de/didaktik/Computer/DAVID/video.htm>

Car, bike and motorcycle crashes into a wall, sports, roller coaster, falling objects, etc.

Descriptions are in German but mostly decipherable (e.g. Crashtest = Crash test). Right click on a title to download it.

Worlds in Motion

<http://members.aol.com/raacc/wima.htm#database>

Lab experiments

National Organization for Automotive Safety and Victims' Aid (Japan)

http://www.osa.go.jp/anzen/html2001e/qt_f01.html

Many automobile crash tests. Right click on a title to download it.

National Highway Traffic Safety Administration (U.S.)

<http://www.nhtsa.dot.gov/airbags/abvideos.html>

Car Crashes on split screens with one passenger protected by an airbag; the other not protected. Videos are not available for download but series of stills could be used in video analysis

<http://www.nhtsa.dot.gov/cars/testing/ncap/>

European New Car Assessment Programme.

<http://www.euroncap.com/>

No downloadable videos here, but lots of useful information on automobile crash testing.

NRMA Insurance Limited

http://www.nrma.com.au/Page/Public?PageId=mot_ctsearch

No downloadable videos here, but lots of videos and data from the Australian New Car Assessment Program

**INTERACTIVE VIDEO REFERENCES FROM THE KSU PHYSICS EDUCATION GROUP
Papers**

Dean Zollman, Interactive Video Activities for Elementary Education Students, in *101 Success Stories of Information Technology in Higher Education: The Joe Wyatt Challenge*, J. V. Boettcher, ed. (McGraw-Hill, 1993) <http://www.phys.ksu.edu/perg/papers/concepts/wyatt.pdf>

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- Dean Zollman, Interactive Technologies in a Large Enrollment Class (draft)
<http://www.phys.ksu.edu/perg/papers/concepts/concepts-tech.pdf>

Videodiscs (NTSC only)

- R. G. Fuller, D. Zollman and T.C. Campbell, *The Puzzle of the Tacoma Narrows Bridge Collapse* John Wiley & Sons, New York, 1982.
- Dean Zollman, *Physics and Automobile Collisions*, John Wiley and Sons, New York, 1984*
- Dean Zollman and Robert Fuller, *Studies in Motion* Great Plains Television Library, 1984*
- Robert Fuller and Dean Zollman, *Energy Transformations* Great Plains Television Library, Lincoln, NE, 1984*.
- Dean Zollman and M. Larry Noble, *Physics and Sports* Videodiscovery, Inc., Seattle, 1989
- * = out-of-print