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Liceo Buonarroti Monfalcone

TRACKER: AN OPEN-SOURCE VIDEO ANALYSIS AND MODELING TOOL FOR PHYSICS EDUCATION

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Armando Pisani

Liceo M. Buonarroti Monfalcone (Gorizia)



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The physics course at “Liceo Linguistico”

- After the last reform: two hours per week from the 3-rd to the 5-th year
- The physics laboratory is generally available, but the technical support is not guaranteed.
- Reduced time to prepare lab experiences.
- Generally students have difficulties when writing reports of the lab experiences .



The teaching of physics

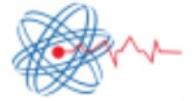


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- **“Tell me and I forget, teach me and I may remember, involve me and I learn.” (B. Franklin).**
- **The research in physics pedagogy has consistently shown that the traditional lecture is the least effective teaching method for teaching physics.. (“Teachers' approaches to teaching physics”, The Physics Teacher, nr. 50, pag. 565, 2012 (AAPT).**
- TPT Jan 2013: Nationwide Survey of High School Physics teachers

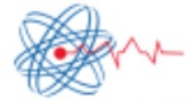


The teaching of physics



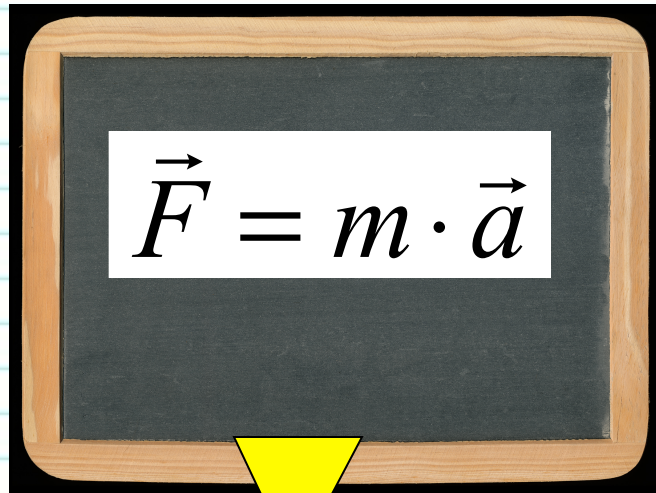
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- “[...] Physicists are consistently among the most creative and inventive of all scientists. [...] But as teachers, we tend to be among the most conservative, repeating the content and methods that we had received as students from our teachers and that they had from theirs. For the coming generations of students, that’s not going to be good enough. We are going to have to understand their ways of thinking and their learning styles. We are going to have to find new ways to hold their interest and keep them excited about learning physics. Increasingly, the tools we use to achieve those goals are going to involve computers.”
- Prof. Edward F. Redish Univ. Maryland (in “Physlets - teaching physics with interactive curricular material”, di W. Christian e M. Belloni, Ed. Prentice Hall, 2001).



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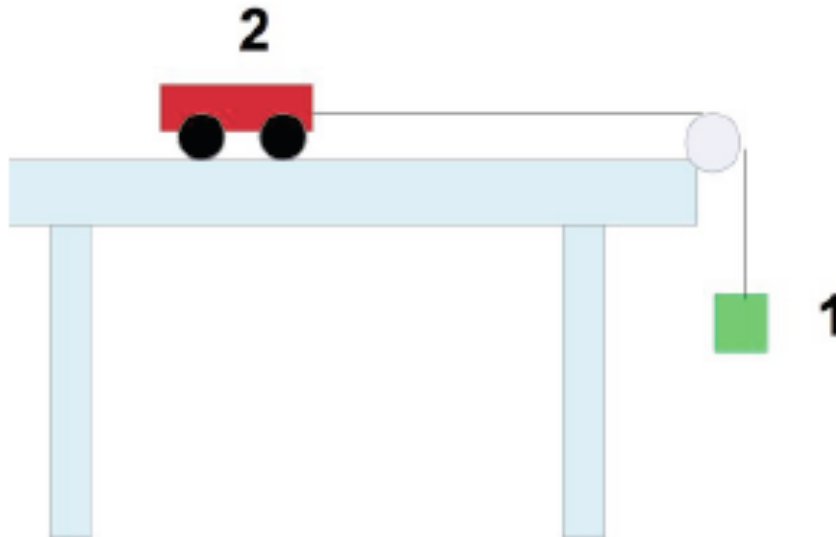
Teaching tools





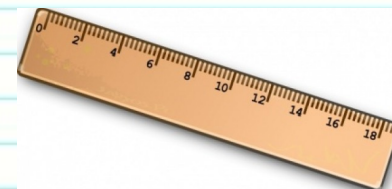
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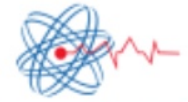
An example



$$a = g \frac{m_1}{m_1 + m_2}$$

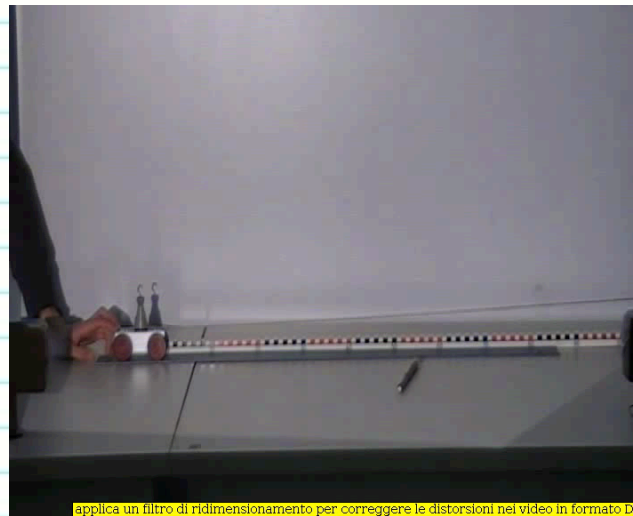
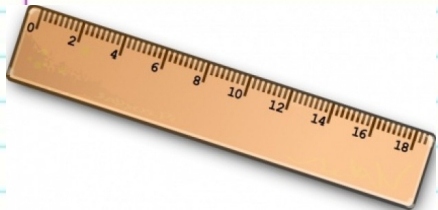
Tolls suited to record time, position and mass.





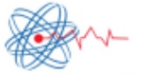
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Analysis of a video



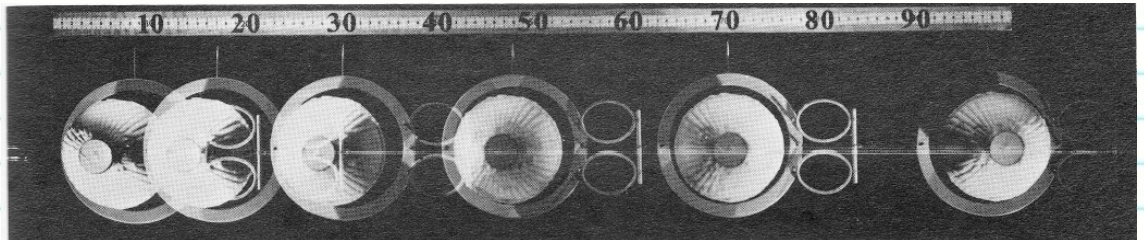
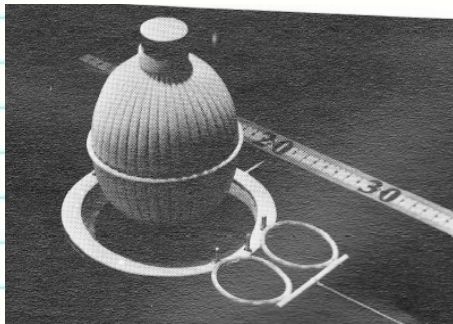
applica un filtro di ridimensionamento per correggere le distorsioni nel video in formato DV

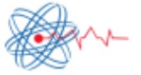
Video: a simple tool to record the relation between position and time (the law of motion).



Video-analysis: the origin

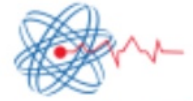
- 1956: PSSC (Physics Science Study Committee) reform the teaching of physics in high school.
- 1960: first edition of a textbook that was available until 2014 in Italy (Zanichelli).
- It trains students to think and to solve problems like a physicist.
- Teaching support material (many videos now available also on youtube) aimed to help students to understand the main physical principles.
- First examples: analysis of multiframe photos to study the dynamics.





Video-analysis: the origin

- 1990, prof. Joel Brian (High School, USA) uses a videocamera to film the parabolic motion of some objects. He stores the film on a VHS videocassette. To analyse the video, he plays the VHS on a player connected to a TV and he places an overhead transparency on the TV screen so that he can mark the position on the transparency frame by frame. Problems: image quality too poor, fast objects gave blurred images.
- THE IDEA IS GOOD.
- Bryan, J. (2005). Physics instruction using video analysis technology. College Board *AP Central*® Feature Article. Available to registered members:
http://apcentral.collegeboard.com/apc/members/courses/teachers_corner/48402.html



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Video-analysis software

- Not free (must pay to use): VideoPoint, LoggerPro
- Free: Tracker, Physics ToolKit, KCS Motion, DataPoint
- My choice: Tracker. Prof. Douglas Brown.
- <http://www.cabrillo.edu/~dbrown/tracker/>



Tracker

Video Analysis and Modeling Tool

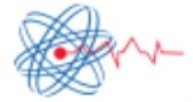
OSP
open source physics

dobrown@cabrillo.edu





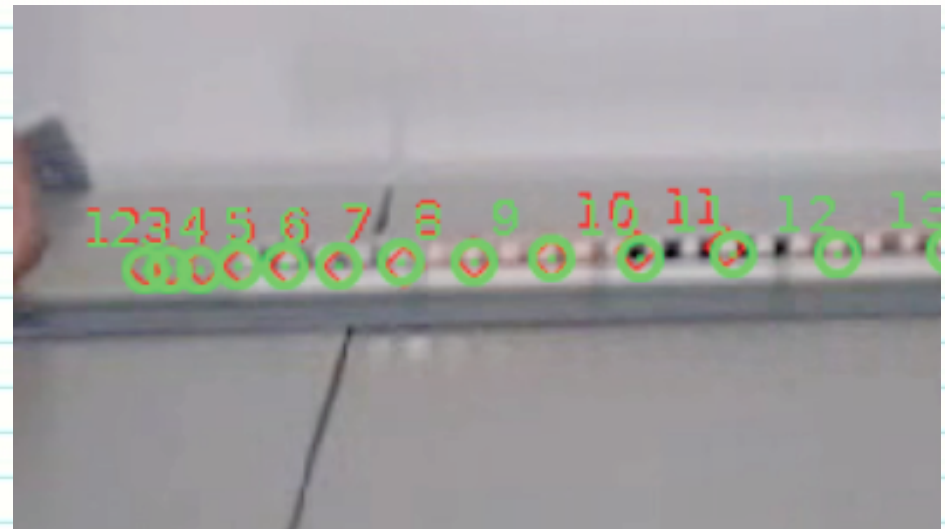
Using Tracker



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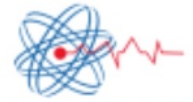
- It allows to individuate a particular object within each frame of the video and to mark it in all the frames.
- It is fundamental in the study of kinematics and dynamics.
- It simplifies both the collecting and analysis of the data.

It allows modeling
the motion of filmed objects!



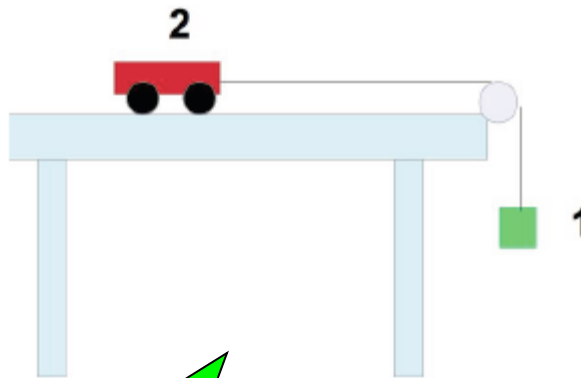


Tracker in classroom

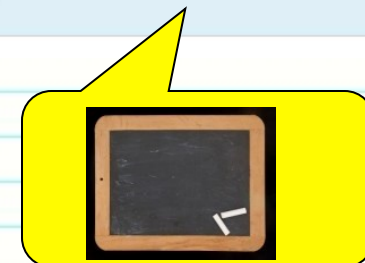
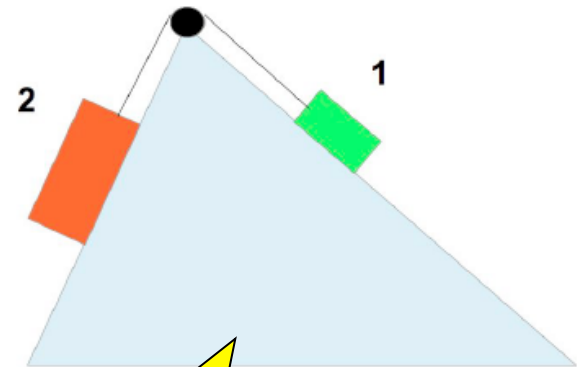


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- Two examples of the law of dynamics.
- Same discussion in classroom (theory and exercises).
- Only one of the two examples was also treated in lab by using Tracker

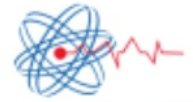


TEST





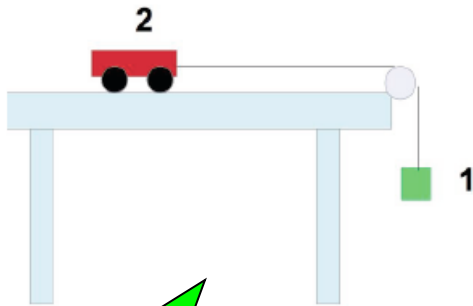
Results



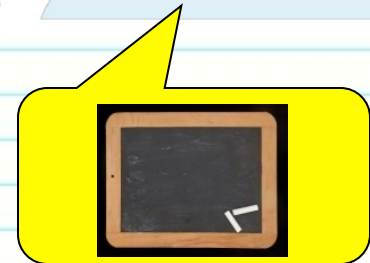
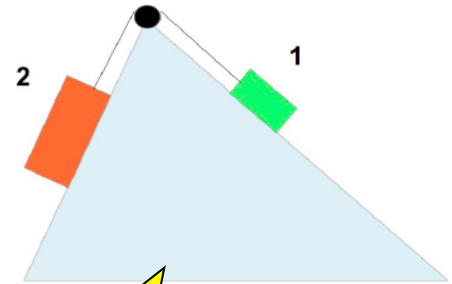
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- Written test including questions and exercises of both examples.

Number of correct answers:

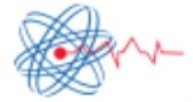


= 3 x



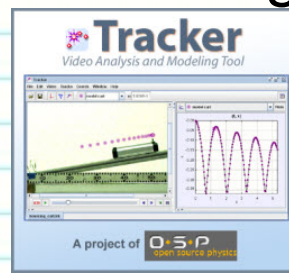


Conclusion



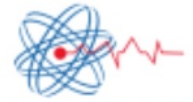
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- The video-analysis in physics teaching is a very useful tool both in classromm and in lab.
- It is rather easy to learn and can be used by students at home.
- It is free. You aonly need a average quality videocamera.
- It has a very important effect since it allows to compare the motion of a real object with the prediction of a model: it allows to see **equations coming alive**.
- Tracker allows to share teaching materials.





After this ...



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- Some case study...

