VASSAR COLLEGE | UNDERGRADUATE RESEARCH SUMMER INSTITUTE (URSI) SYMPOSIUM | 2020

POSTER TITLE: VIDEO BASED ANALYSIS PROBLEMS
POSTER SUBTITLE: CREATION AND INTEGRATION INTO EXPERT TA

Saumya Arya'23 and Prof. Cindy Schwarz; Physics

INTRODUCTION

Due to the recent crisis of COVID-19, we decided to create a substitute for introductory physics laboratory classes. While nothing can replace an in-person lab with hands-on experience, in the current circumstances we have no choice but to rethink our lab experiences. We have created a series of video-based graphical analysis questions that focus on concepts taught in introductory undergraduate level (also useful for high school physics and AP physics I).

The videos we used are of real life activities such as someone shooting a basketball, billiard ball collisions, a diving board undergoing damped oscillatory motion etc. These activities test concepts such as conservation of energy, simple harmonic motion, angular momentum, friction and forces. In developing these, a very important goal was to address many of the common misconceptions that are held by students. Videos were analyzed using Logger Pro and each activity has the video shot, tracked motion images, graphs of relevant quantities and physics concept questions that rely primarily on getting information from the graphs.

EXPERT TA

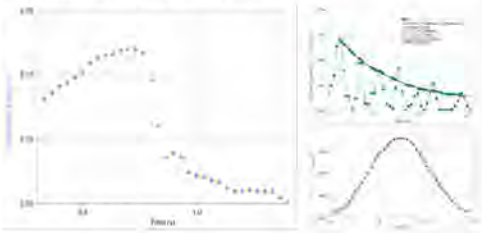
Expert TA is an online homework and tutorial system, with unique software to improve student learning and teaching. The video series we have created is being implemented on their system under the title of 'Physics Video Analysis". The 16 problems fall in the general categories of 1D kinematics, 2D motion, Newtons Laws, Work and Kinetic Energy, Momentum, Collisions, Rotation of Rigid Bodies and Periodic Motion. Below is an example of how it looks in the system -

FEATURES

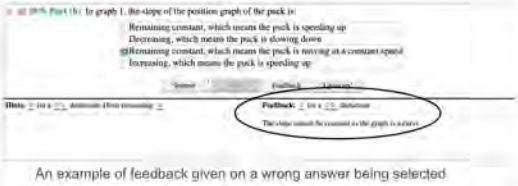
Each question has a video of the activities we are analyzing and a tracked motion image.

An example of a tracked motion image from the video series

Another important feature of this is series is the graphs that the questions are based on. These graphs are based on real world data and are graphs students would encounter in lab classes. The graphs teach students to learn to estimate and read data.

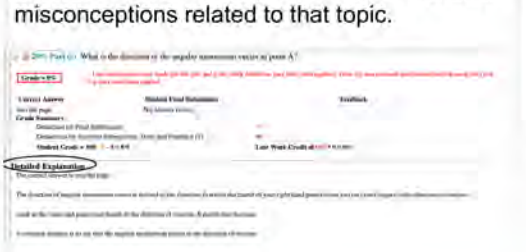


Each question has multiple parts either in a multiple choice formal or to enter a numerical answers. Depending on the answer the student enters, there is specific feedback available to target commo



An example of feedback given on a wrong answer being selected

A special feature is the availability of a correct answer displayed at the end of each sub part, whether the student has got the question right, given up or used up all their answer attempts. This feature will explain how to get to the answer and help clear common misconceptions related to that topic.



WHY IS THIS USEFUL?

The questions in this compilation focus on developing student skills such as –

- Estimation
- Analyzing real world data
- Graphical Interpretation

The video series will help students clarify common misconceptions prevalent such as they think -

- When a ball is thrown in the air, at the top point of its trajectory no force acts on it.
- If the speed value increases, the acceleration value must be positive.
- The tension in a simple pendulum is always equal to the weight of the object.
- If the speed does not change, there is no acceleration.
- When 2 balls collide, initially with no y velocity, but have a y velocity after the collision, there is a y momentum.
- Heavier objects exert more force on lighter objects during a collision

WHAT DID I GET OUT OF THIS EXPERIENCE?

Working on these problems cleared up misconceptions I didn't even realize I had.

I learned to work with real world data and make estimations

I was responsible for creating reasonable feedback and it forced me to not only think of correct answers but also incorrect answers that could be expected, and how to phrase an explanation and feedback that would truly prove helpful to students.

I learned how difficult it is to make a problem that students would find useful and this is something that will help me in my future physics and math classes.

FUTURE WORK

Inclusion of additional problems (new topics) into this series.