Animations for Physics and Astronomy

Michael R. Gallis
Penn State Schuylkill
mrg3@psu.edu

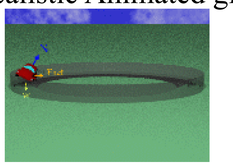
The *Animations for Physics and Astronomy Project* has been producing short visuals for key topics in introductory courses for over 20 years. Materials are released as Open Education Resources under a Creative Commons license. As a measure of impact, the project YouTube channel has garnered over 6 ½ million views in the channel's 18-year history. In this poster we will present a brief history of the project and its products as well as some recent work. We will also discuss some opportunities available through evolving and in emerging technologies. Finally, we will outline some future efforts to enhance accessibility of the project's creations.

Project History

- Origin Story: Late 1990's: Line Figures and animated gif's

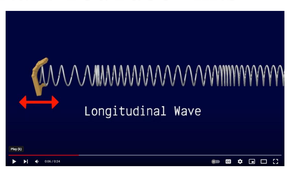
A single frame of a 20 fps animated gif showing velocity and acceleration during uniform circular motion. The line drawing animation frames were created with Mathematica.

- 2003: More Realistic Animated gif's



A single frame of a 20 fps animated gif showing the forces on a care on a banked curve. The animation frames were created with POV-Ray, "a free software tool for creating stunning three-dimensional graphics."

- Evolving from cyclic 10-20 second animations designed to be looped. Media files originally needed to fit on a floppy. Current animations are short, often less than 1 minute.
- To the present: Improved media formats as technology advanced, animations rendered in high-definition video, lengthier and more elaborate animations, with narration as warranted.
- Some important YouTube "hits"

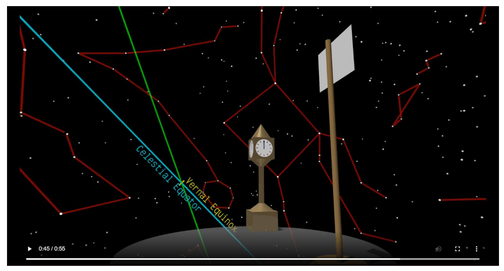


Longitudinal and Transverse Waves is the single most popular video on the project's YouTube channel. It has nearly a million hits since it was posted 11 years ago. Favorite comment: "Just these 24 seconds made so much more sense than the textual information I was trying to comprehend. Thanks!"

Density Waves and the Stability of Galactic Spiral Arms doesn't have a large number of views overall, but the daily view rate spikes to nearly 1000 when the animation has been used as supporting material for the Astronomy Picture of the Day.

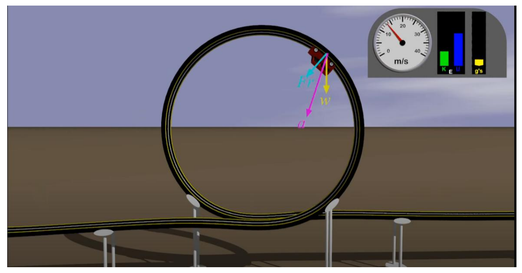
"Modern" Topical Examples

Astronomy



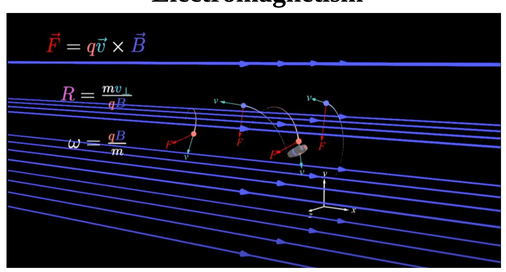
The origin and use of the Equatorial System

Mechanics



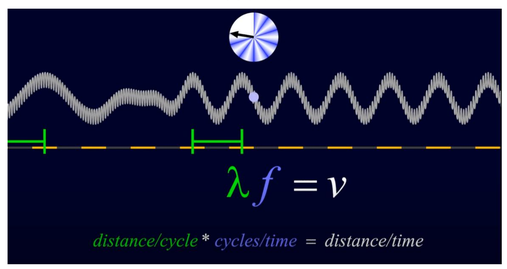
The Physics of Driving Through a Vertical Loop

Electromagnetism



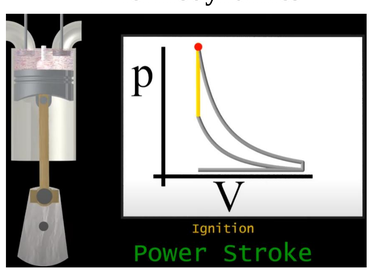
Motion of an Electric Charge in a Magnetic Field

Waves



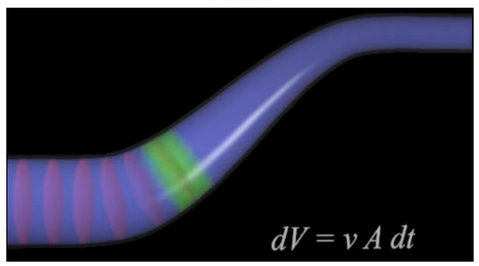
Basic Properties of Waves

Thermodynamics



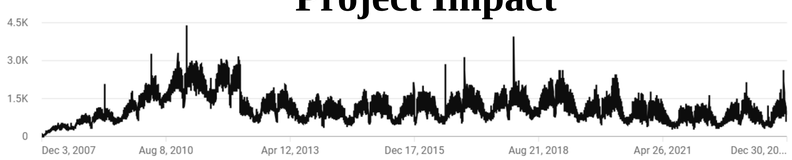
The Otto Thermodynamic Cycle

Fluids



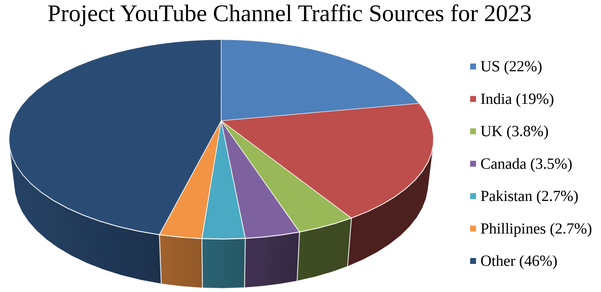
Uncompressible Flow and Fluid Velocity

Project Impact



Lifetime Project YouTube Views, 6.8 Million as of end of 2023

Project YouTube Channel Traffic Sources for 2023



Experiments and developments

Improving Dissemination Technology (bandwidth and display resolution)

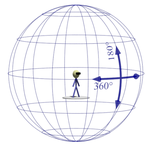
- All new animations rendered in 1080p at 30 fps
- Old topics revisited/re-rendered (especially consider oldest, shortest popular animations)
- Longer animations now practical to deliver (but must still be scripted, rendered, etc)
- Interactive still not practical for a small projects that need detailed graphics

Improving Accessibility

- Closed captioning for those animations with narration. YouTube auto cc plus editing.
- Future: provide detailed descriptive transcripts for visual impaired

360 Imagery/Animations with POV-Ray

- Attempting to leverage VR viewing technology



- Headsets are not plentiful. (Shared headsets in the time of Covid???)
- YouTube/Google abandoned support for google cardboard (and phone based headsets).

WebVR interactives:

- Identification games: electric field sources (uniform field, point charges, and dipoles) explored with a field detector, and uniform electric/magnetic fields explored by launching electric charges and interpreting resulting trajectories. "Playable" on PC as well as in VR, but some tech is being deprecated.

Future and in progress topics

- A visual derivation of Gausses Law (field lines and flux, projection, and integration)
- Classical Wave Equation from Maxwell's Equations
- Improved RHR trainer

Where to Find the Project

Project Home Page

Project YouTube Channel

https://phys23p.sl.psu.edu/phys_anim/Phys_anim.htm

https://www.youtube.com/mrg3