

# Complex Motion

## Equipment

- LoggerPro v3.3
- Motion Detector
- Track, cart and masses
- Various objects and fan cart

## Objective

### Data collection

- Refine techniques for using computer probes
- Use video analysis software to analyze motion (Logger Pro v3.3)

### Graphical analysis

- Graph measured quantities with error bars.
- Identify regions of interest (relevant portions of motion)
- Find velocity from position vs time graphs and compare to average velocity
- Find acceleration from velocity vs time graphs and compare to average acceleration

### Physics Concepts

- Vector components, addition and subtraction
- Equations of motion for constant acceleration

## Conceptual (C-Level)

You throw a heavy object off of a flat roof. You release the object at an angle of approximately 45 degrees. Draw graphs of the position, velocity and acceleration as a function of time in both the horizontal and vertical directions.

- How would these graphs change if the object were much less massive but you threw it with the same velocity?

### SIMULATION:

- Check your understanding by trying to hit a target with a projectile fired at different angles.
- Examine the velocity and acceleration vectors for a particle in 2D. In particular run the linear and circular motion examples. What do you note about the relationship between acceleration and velocity?

## Basic Lab (B-level)

- Using video analysis software, analyze the motion of an object (use the basketball toss movie). Produce graphs of the position, velocity and acceleration as a function of time in both the horizontal and vertical directions.
- Find velocity from position vs time graphs and compare to average velocity
- Find acceleration from velocity vs time graphs and compare to average acceleration
- Graph the acceleration as a function of mass for a cart traveling down an incline.

## Advanced/Extended Lab Ideas (A-level)

- Pick another variable and determine how it effects an objects motion (velocity, acceleration or position)
- Experimentally determine how a ball's horizontal and vertical velocities change after a bounce. What is the difference between different balls?
- What are you curious to investigate?