About the Mathematics

These documents are designed to examine the rectilinear (straight line) motion of an object. One key distinction that is particularly difficult for students is between position and distance traveled. These documents help to make that distinction.

The *Position_Distance_Velocity* documents allow the user to provide a position function to "drive" the rectilinear (straight line) horizontal motion of an object. The documents produce a corresponding velocity function by differentiating the given position function. A "trail" of the path of the object is left so that users can distinguish between the current location of the object and the actual distance it has traveled. The position function drives the motion of the object as the user advances the value of time *t* via a slider.
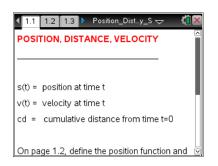
Math Objective

- Students will have an opportunity to work with linked graphical and physical (in the virtual environment of the TI-Nspire document) representations of the horizontal motion of an object.

TI-Nspire™ Navigator™ System

- Send the TI-Nspire documents.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

POSITION, DISTANCE, VELOCITY

s(t) = position at time t
v(t) = velocity at time t
cd = cumulative distance from time t=0

On page 1.2, define the position function and

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is appropriate for use with any of the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions might be required if using other technologies beside the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

- Position_Distance_Velocity_ S.tns
- Position_Distance_Velocity_ PWL.tns

Visit www.mathnspired.com for lesson updates.

Using the Documents

The two documents differ in how the user sets the position function. In *Position_Distance_Velocity_S.tns,* the user defines the function $s = pos(t)$. In *Position_Distance_Velocity_PWL.tns,* the position function $pos(t)$ is presented as a continuous piecewise linear graph that can be directly manipulated by moving the vertices that connect the linear pieces of the graph up or down.

First, users define the position function and/or reset the time to $t = 0$. On Page 1.3, the position function is displayed in the graphing window on the right, with time, position, cumulative distance, and velocity at that time displayed. The user advances time through the use of the slider arrows at the top right. On Page 1.4, the corresponding velocity function is displayed.

On both Pages 1.3 and 1.4, a visualization, or trail, of either the position or velocity is displayed as t varies. The user can grab and move the point on the horizontal axis corresponding to time, and a virtual representation of the object's motion is generated dynamically.

Possible Applications

Natural questions to ask with these documents concern physical interpretations of the graphical characteristics of the position and velocity functions, especially in terms of direction of movement, and distinctions between position and cumulative distance traveled. A common mistake is to think of the direction of the velocity graph as corresponding to the direction of the object's movement (as opposed to the sign of the velocity function).

With the piecewise linear position function, it is important to discuss why the velocity function is undefined when the slope of the position function changes at a vertex. Relating the value of the velocity to the slope of the height function graph is key. Being able to manipulate the graph allows for questions that ask for graphs that "tell a story" about the object's movement.

NOTE: These documents are intended to run on the software versions of TI-Nspire. Their complexity is such that they run very slowly on the handheld TI-Nspire units.