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ANIMATION SPECIAL EDITION

- **ANIMATOR BASICS**

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ANIMATION 101: SOLIDWORKS ANIMATOR BASICS

Brian Hill

SolidWorks Animator can create animations for anything from dazzling client presentations to adding a multimedia experience to your web page. This is the first article of a two-part series covering the basics of making your SolidWorks models move.

Open a model that you want to animate, and let's get started. Go to the Animation Wizard, which you can access from the Animator menu or the Animation toolbar. It allows you to create turntable rotations as well as exploding and collapsing animations of your SolidWorks models (see *Figure 1*).

Rotate model

After choosing **Rotate model** from the Animation Wizard and clicking **Next**, you can choose whether to rotate about the X, Y or Z axis. These axes refer to the coordinates of your screen rather than the coordinates of the model. The X-axis being a horizontal line across the center of your screen, the Y-axis a vertical line across the center of your screen and the Z-axis a line coming directly out of your screen (see *Figure 2*). The preview window will show you how your model will rotate. In SolidWorks 2000, you may also choose **Clockwise** or **Counterclockwise** for the direction of the rotation.

The next page of the Animation Wizard allows you to set the duration of the animation as well as the start time. You can manipulate the start time of the animation to sequence multiple events accurately. We'll discuss more about sequencing a little later. For creating your everyday simple rotation, set the duration to how long you want the animation to last and leave the Start Time at 0 seconds. If you check **Play animation** and click the **Finish** button, you will see your rotation animation play in the SolidWorks window. You now have access to the Play buttons from the animation toolbar, so hit **Play** and watch your part spin around again.

You may find that the animation displayed on the screen is very choppy. SolidWorks Animator is probably displaying the animation to the screen at 1 frame per second (FPS). Until you record your animation to a file, the Animator will default the display in the SolidWorks graphics window to 1 FPS. If you look in the lower right corner of the SolidWorks window, you will see the FPS that SolidWorks is going to use for the display of the current animation (see *Figure 3*). This display includes the current frame of the animation (in seconds) as well as the total animation length.

Likewise, the actual time that the animation played on the screen may not be the same as the duration that you entered in the wizard. The duration will be correct when the animation is recorded to a file (usually an AVI file). The actual speed at which the animation is played in the graphics window depends on the complexity of the model as well as the power of the graphics card being used on your machine.

Explode/Collapse

If the SolidWorks model that you are animating is an assembly and you have already added an exploded view to a configuration of that assembly, the Animation Wizard can be used to animate the exploding or collapsing of the assembly. From the first page of the wizard, select **Explode** or **Collapse** and click **Next**. The second page is the same as when animating a rotation. You can set the duration of the animation in seconds as well as the start time. Check **Play animation**, and click **Finish** to watch your assembly explode or collapse in the SolidWorks graphics window.

Do you want to animate an assembly exploding and then collapsing in the same animation? That's not a problem in SolidWorks 2000. This is where using the
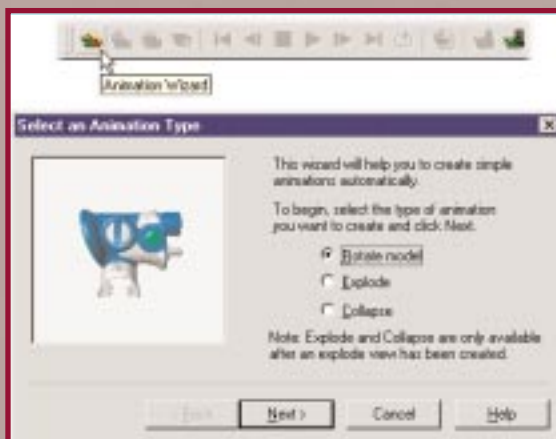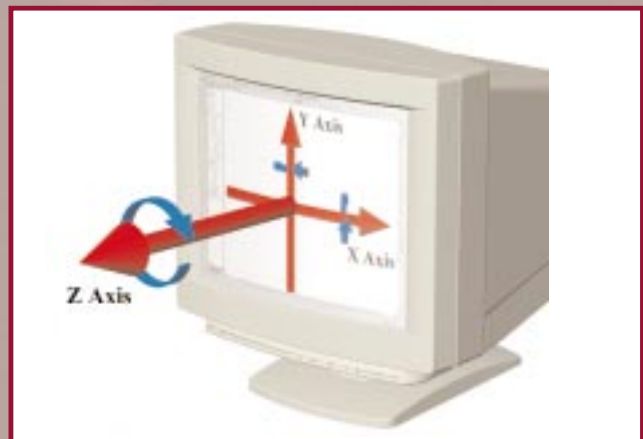

Figure 1: Animation Wizard.

Figure 2: Animation Wizard rotation axes.

Start time setting in the wizard comes into play. The easiest way to do this is to create the explode animation using the wizard as mentioned above. When done, re-enter the Animation Wizard and set it to perform a collapse. Think back to the values you entered for the duration of the explode animation. Rather than entering 0 for the Start time of the collapse, enter the time when your explode was finished. For example, let's say you would like your assembly to explode in ten seconds and then collapse in five seconds. The settings for the explode would be a Start time of **0 sec.** and a Duration of **10 sec.** The settings for the collapse would be a Start time of **10 sec.** and a Duration of **5 sec.** (see *Figure 4*).

If you want to add a pause between the explode and the collapse, all you have to do is modify the Start time of the collapse accordingly. If you want your assembly to explode, spin around and then collapse, you run through the wizard three times—each time adjusting the type of animation and Start time accordingly

SolidWorks Animator can only work with components at the top level in the assembly. If you have explode paths defined for subassembly components, these will not appear in the explode animation. The easiest way to work around this is to create another copy of your assembly where you have dissolved all of the subassemblies that you want to animate.

Manually adding component paths

The Animation Wizard can create simple animations of your SolidWorks models, but what if you want to make something more complex? The Animator enables you to add animation paths manually to the components in your assembly. An animation path is what the component will follow as the animation is taking place.

Open an assembly, and find the tab toward the bottom of the FeatureManager with a small green camcorder. It is called the AnimationManager. If you click this tab, you will see a familiar tree format with three sections:

❑ viewpoint

❑ list of all the components in the assembly

❑ schedule

To start, right click on one of the components listed in the AnimationManager, and select **Create Path**. Manually creating paths with the Animator works on the premise that you manually move the component in the SolidWorks graphics window and add path points at various intervals along the path. The Create Path dialog should open, giving you the ability to **Add Path Point** and set the **Start Time** and **Duration** for the path (see *Figure 5*).

Click **Add Path Point** to add the starting point for the component's path. Using the **Move Component** tool from the SolidWorks Assembly toolbar, move the component to where you would like the end of the path to be and click **Add Path Point** a second time. Enter a Start time and Duration for this path, and click **Done**.

At this point if you click **Play** from the Animation toolbar, you should see the component move between the two path points you have specified. To see your component move along a more complex path than a straight line, add additional path points between your start and end points.

Creating viewpoint paths

The viewpoint icon in the Animation Manager can be used to record view orientation changes (pan, zoom, rotate) that you would like to incorporate into your animation. These can be used to simulate a fly-by or a turntable animation. The easiest way to see how this works is to right click on **viewpoint**, and select **Create Path**. Click the **Add Path Point** button to add a starting point for the viewpoint path. Using the view orientation tools from the VIEW toolbar, zoom in to a portion of your model and add another path point. Using the view rotate tool (also in the VIEW toolbar), rotate the view of your SolidWorks model and add another path point. Zoom back out, and add a final path point.

When you play this animation, you will see that the animator zooms into a region of your model, rotates the model slightly and then zooms back out. By adjusting the Start Time of this path, you can combine this animation path with others in your assembly, so you can have two things happening at once. For example, you can slowly rotate an assembly while components of the assembly are moving.

To help you organize the sequencing of all these paths, each path has a unique path name and lists the time that this portion of the animation will take place, in the form of (Start time, End Time) in seconds. At the bottom of the tree in the AnimationManager is the schedule. The schedule is a sequential list of all of the individual animation paths that have been added to the assembly components. It can be used to visualize which parts of the animation come first and which come later.

Editing existing paths

If you need to go back and edit an animation path that you have already created, right click on the path in the Animation Manager, and select **Edit Path**. This dialog allows you to change the path name, step through each of the path points you have defined, edit those points or add additional path points and modi-
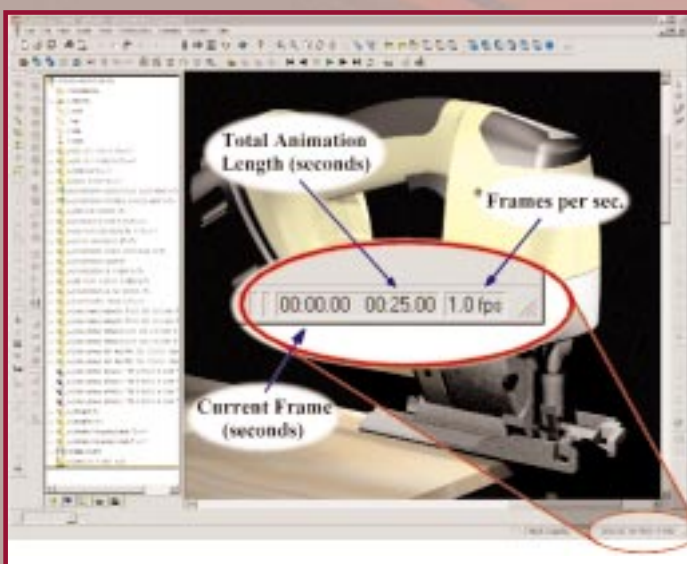

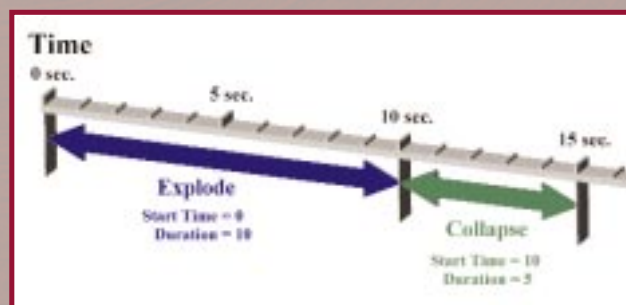*Figure 3: Animation duration.*

Figure 4: Sequencing multiple events.

fy the Start time and Duration of the animation path.

If you would like to edit an existing point in a path, click the **Next** or **Previous** buttons in the dialog, until the component is at the point along the path that you would like to edit. Set the **Action** pull-down menu in the Edit Path dialog to **Update Current**, and reposition the component on the screen as necessary. When you are satisfied with the new location for the component, click **Apply**. Similarly, you can delete the current path point or add additional path points among existing ones.

Some things to think about when manually creating and editing path points for components:

❏ The Animator will observe the current mating scheme when animating components in an assembly. If you have a component that is fully constrained, there is no way that you can move it with the Move Component tool, so there is no way to add path points. You may have to suppress some of the mates in your assembly to get the movement that you want. Note that the only instance where this does not apply is when performing an explode/collapse with the wizard.

❏ The animator takes advantage of dynamic assembly motion. If you have other components mated to the component you are moving, these components will move accordingly when you animate the motion of this component.

Figure 5: Sequencing multiple events.

As mentioned above in the Explode/Collapse section, SolidWorks Animator can only work with components that are at the top level in the assembly. Look in the AnimationManager, and you will see that

you only have the ability to add paths to components that are in the top level.

In SolidWorks 2000 you can add multiple paths per component. Let's say, for example, you would like a component to move to a set location, pause for a few seconds and then move to another location. After adding the path for the first portion of the movement, right click on the component in the AnimationManager and select **Create Path** again. Use this path to define the second part of the motion of the component, and set the Start time, such that this path won't start animating until a few seconds after the first one is complete.

Recording your animation

When you are comfortable with the way your animation is playing in the SolidWorks graphics window, it is time to create the finished product, the AVI file. To record your animation to an AVI file, click the **Record animation** button from the Animation toolbar. This will open the Save animation to file dialog box, allowing you to specify the following options you would like for your AVI file:

❏ **Renderer**. You can choose the SolidWorks screen or, if you have purchased PhotoWorks, the PhotoWorks buffer for your animation. When using the SolidWorks screen as the renderer, the Animator will simply use the colors that appear in the SolidWorks graphics window. If you use the PhotoWorks buffer as the renderer, the animation will take much longer to generate (as it has to use PhotoWorks to render each frame), but it will take advantage of all the benefits of PhotoWorks (shadows, texture maps, reflections, etc.).

❏ **Frame information**. You can set the fps for your animation. Basically, the more frames per second you have in your animation, the smoother it will appear when it is played on the screen.

❏ **Image size and aspect ratio**. These options become active only if you are using the PhotoWorks buffer as your renderer. Using these options, you can explicitly define the physical size (in pixels) of the AVI file that is output.

❏ **Video compression**. After clicking **Save**, the final dialog you will encounter is Video Compression. This allows you to specify the video compressor to be used to create your AVI file. The AVI file format is a compressed video format that requires a

video compressor to create (compress) and play back (decompress) the data. These video compressors are sometimes referred to as CODECs, which stands for COmpressor/DECompressor. There are countless numbers of AVI CODECs available for download on the web, and each uses a different series of algorithms for the compression of the animation frames. Because the CODEC is used to create and to play back the animation, it is essential that the machine you use to view the AVI file has the same CODEC as was used to create the AVI. For this reason, it is usually best to stick with one of the default compressors installed with your operating system. Most CODECs allow you to specify a **Compression Quality** setting as well; higher values translate to higher quality images, but with increased file size.

AVI tips

Some things to keep in mind when specifying your AVI options are:

❏ Unless you are using the PhotoWorks buffer and have explicitly defined an Image Size, the resulting AVI file will be the same size as your SolidWorks graphics window. The larger the AVI is on the screen, the larger the file size will be. Therefore, it is usually best to reduce the size of the graphics window before creating the AVI.

❏ Don't go crazy with too many frames per second. Most feature length films shown in the theater are shot at roughly 24 to 30 fps; anything higher and the human eye can't really distinguish the difference. Keep in mind that the more frames you have in your animation, the longer it will take to generate (especially if you are using PhotoWorks as your renderer) and the larger the size of the resulting AVI file will be. In most situations you can get decent results with settings in the range of 15 to 20 fps.

See part II of this publication for a more advanced look at SolidWorks Animator, including how to stretch and deform parts, how to animate a cut-away view and how to work faster.

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ADVANCED ANIMATOR TECHNIQUES

Fading is easy with a mouse on the right path

Brian Hill

> *This is the second part in a two-part series on working with the SolidWorks Animator. "Animation 101: SolidWorks Animator Basics" discussed some of the basic principles of the SolidWorks Animator and offered several examples of how to make simple animations using the Animation Wizard and manual path creation.*

Have you ever wanted to animate a cut-away view of your assembly or fade out an assembly component to see inside a complex model? Have you even wanted to animate a color change of an assembly component or stretch and deform your SolidWorks models? Did you know that you could do all of these things and more using the SolidWorks Animator? Curious? Read on!

ANIMATING TRANSPARENCY AND COLOR

This first, and perhaps most useful, technique that we will discuss is animating the transparency of an assembly component. Have you ever worked with a complex assembly and wished that you could get that darn component out of the way so you could see the complex motion of parts inside your model? Using the Solid-Works Animator you can do just that.

Through the SolidWorks Animator you have the ability to control the color of assembly components (including their transparency) as defined by their assembly-level Component Properties. Note that this control only exists at the assembly level. The Animator does not have the ability to control colors at the part level. Using this example, we will cover how to animate the outer shell of this cordless saber saw so that it's fading away in color properties.

For the animator to have control over the color properties (color, transparency, etc.) of the shell of the saw, you need to assign an assembly component color to the part. To do this, right-click on the component in the assembly, select **Component Properties**, select

Figure 1: Changing assembly component instance color.

Color, select **Change Color**, and assign an assembly component color to the part (see *Figure 1*). This color will take precedence over the color that you have assigned to the entire part at the part level.

The next step is to create an animation path that controls the transparency of the component. To do this, click on the **AnimationManager** tab near the bottom of the **FeatureManager**, right-click on the component on which you would like to control the transparency and select **Create Path**.

With the **Create Path** dialog open, add a path point using **Add Path Point**. Keeping the **Create Path** dialog open, switch back to the **FeatureManager** and access the component color properties for the component again (right-click **Component Properties, Color**). Click on **Advanced** button and slide the **Transparency** slider all the way to the right. **OK** all of the component property dialogs and click **Add Path Point** a second time in the **Create Path** dialog. Select the start time and duration for the fade-away and click **Done**. Click **Play** on the animation toolbar and there you have it (see *Figure 2*).

Remember that this only works for assembly components that have their color specified as an assembly component color. This technique will not work if the assembly component color isn't assigned to the component that you are animating.

Note that you also can use the same technique to have an assembly component fade from one color to another. Instead of adjusting the transparency for the second path point, simply change the color. This technique is great for showing something heating up or
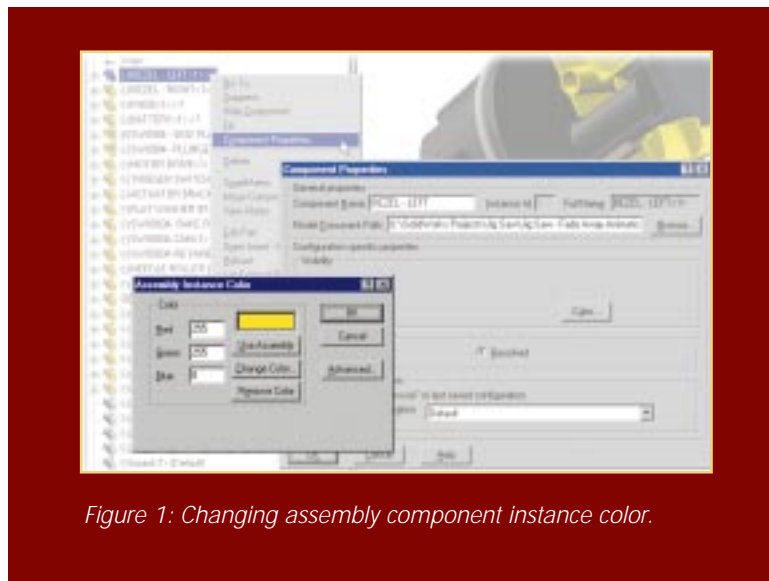
Figure 2: Animation transparency.

to draw attention to a particular component in the assembly.

As mentioned in "Animation 101: Solid-Works Animator Basics", if you have purchased the photo-realistic rendering add-in PhotoWorks you can create fully rendered animations that incorporate the photo-realistic effects possible with this package. Some of these features include: shadows, reflections, refraction, and different material textures. If you would like to incorporate the fading component technique into an animation that uses PhotoWorks to render the animation, make sure you have **Apply SolidWorks properties for render** checked under **Photo-Works**, **Options**, **Materials**. This will force PhotoWorks to use the SolidWorks colors (and transparency settings) in the rendering. For this to come out as well as you want, you need to make sure your Solid-Works part colors resemble the colors of the material that you would have assigned in PhotoWorks.

ANIMATING A CUT-AWAY VIEW

Rather than fading a component away by animating its transparency, another method of opening it up is to animate an assembly cut through your model.

Before we can work on creating the animated cut-away view of this model, we need to understand some of the limitations of the SolidWorks Animator, which is designed to animate the motion of components in an assembly. The animator, however, is not designed to dynamically change

the depth of a cut or the value of a dimension. In order to animate a cut-away view of this assembly we will have to insert a dummy part into this assembly. This dummy part is a part that does not contain any solid geometry; it contains only a planar surface. Once the dummy part has been inserted, position it in front of the assembly using the Move Component tool.

Next, while still editing the main assembly, select the planar surface from the dummy part and create a sketch on it that you would like to use for your assembly cut. Using this sketch, insert a blind assembly cut (**Insert**, **Assembly Feature**, **Cut**, **Extrude**). Set the depth of the cut such that it comes close to the model, but doesn't actually cut the assembly. *It is important that this cut come close to the model, but not actually cut the components.*

At this point we now have a dummy part in the assembly that has a negative volume in front of it. Using the SolidWorks Animator, we can move this component through the assembly and have it cut through whatever geometry we want. To do this, simply right-click on the dummy part component in the AnimationManager tab and select **Create Path**. To create the path points for the component click **Add Path Point**, which will add the starting point. Then, using the SolidWorks Move Component tool, move the dummy part closer to the model so the assembly cut (that was set to a blind distance in front of the surface) is cutting through the assembly

and click **Add Path Point** a second time. (See *Figure 3*)

The finishing touch in the animation is to hide the planar surface in the dummy part. To do this, simply right-click on the surface in the FeatureManager tree and select **Hide**. Now when you play the animation of this dummy part moving through the assembly (with the surface hidden) it will appear that you have created an animated assembly cut.

Note that SolidWorks allows you to define the Feature Scope of assembly cuts. This feature allows you to choose which components get cut by the assembly cut and which components are ignored. In this example, the desired effect was to see the components that were inside of the engine block. To prevent these components from being cut, they were removed from the Feature Scope list of the assembly cut.

The reason why this technique worked is because the SolidWorks Animator performs a limited rebuild on the assembly during the generation of the animation.

STRETCH THAT PART!

Using the same limited rebuild that was mentioned in the previous section you can dynamically change the shape of assembly components that are defined in-context. The assembly that will be used in this example is a small foam dart gun. Note the black rubber band toward the top of this assembly (see *Figure 4*). This rubber band is defined in the context of the assembly (top-
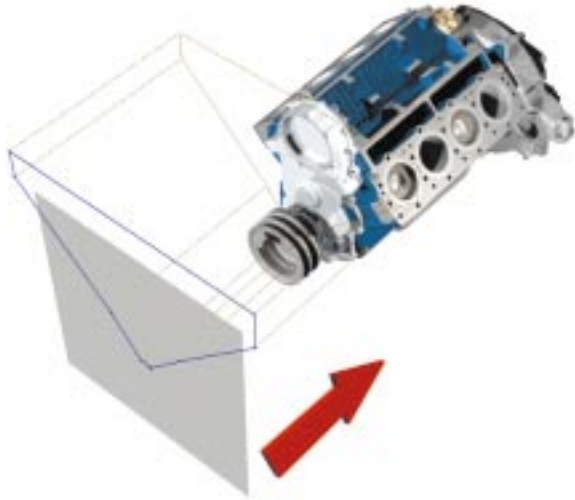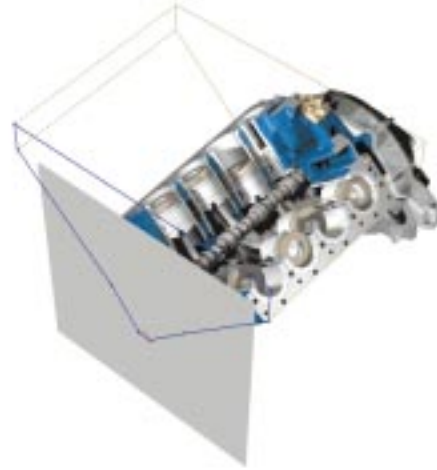
First Path Point **Last Path Point**

down) so that it will always grow to cover the distance between the yellow pull-ring and the blue body of the dart gun.

We can see this in the SolidWorks window by dragging the yellow pull-ring away from the body of the dart gun using the Move Component tool. Note that after moving the pull-ring, there will be a rebuild icon in the FeatureManager tree. If you hit rebuild at this point you will see that the rubber band elongates to solve the in-context relation that its sketch has with the rest of the model.

Using this in-context part to our advantage, we can use the SolidWorks Animator to create a component path for the pull-ring, one that pulls it away from the model. To do this, right-click on the pull-ring component in the AnimationManager tab and select **Create Path**. To create the path points for the component, click **Add Path Point**, which will add the starting point. Then, using the SolidWorks Move Component tool, move the pull-ring to its final position and click **Add Path Point** a second time.

When the animation is played, the in-context part (the rubber band) updates between each frame so it appears to be getting longer

(stretching) as the pull-ring is pulled back. This technique can be used in many situations where a component needs to change size during an animation. Note that this technique is limited to parts that are defined in the context of the assembly. Equations will not update between frames of an animation; only in-context relations will update.

Simulating movement

Task: You need to animate a toy truck assembly driving around the screen.

Problem: The mating scheme in the assembly prevents the truck from being moved with the Move Component tool.

Solution: Simulate the movement!

Let's step away from your computer for a moment and imagine that you are in charge of filming a TV commercial for a new truck. The producer has requested that the next shot needs to have the truck speeding straight at the camera and passing it on the left. The easiest way to film this shot would be to firmly attach the camera to the ground and have someone drive the truck straight at you as you stood behind the camera and filmed the shot. Fearing for your life, you come up with a better alternative: why not

move the camera rather than the truck? Looking through the camera, the image will be the same: as you run toward the truck it will appear that the truck is getting closer and closer. No one really has to know that the truck never moved.

This same effect can be applied to your SolidWorks models if for some reason you cannot or do not want to move them with the Move Component tool. If you look at the top of the AnimationManager tab of any SolidWorks part or assembly file you will see that there is a viewpoint icon. This icon allows you to add animation paths to the file that control the view orientation (pan, zoom, rotate) of the model. To animate the view of the toy truck, and to give the illusion that it is driving straight at you, simply right-click on the viewpoint and select **Create Path**. Using the Zoom In/Out tool from the **View** toolbar, zoom out and away from the truck model so it appears to be far in the distance, and add a path point (by clicking **Add Path Point**) for the beginning of the animation. Next, using the **View Orientation** tools, zoom into the model so it appears larger in your screen, and add a final path point. Click **Done** and

Figure 4: In-context part updating.

Figure 5: Simulating movement with view orientation.

play your animation. Note that it appears that the truck is driving straight toward you. By adding additional path points to this animation path that combine both zoom and view rotation you can make the truck appear to drive straight toward you, turn around, back up, or anything else you can imagine (see *Figure 5*).

WORKING FASTER

Creating a long complex animation can be a time-consuming task. Here are a few tips that should help you get to that final product faster:

- **Take small steps**. If your animation involves several different events that all happen at different times, it is usually easiest if you work in small steps. For example, if your animation is going to be 20 seconds long, try working in five-second intervals. Finish each five-second interval, making sure that all of your animation paths are synchronized correctly, before moving on to the next five-second interval.

- **Save PhotoWorks for the end**. If you are going to be using PhotoWorks to render the frames of your animation, don't use it every time you want to test your animation to see how it is progressing. When you use PhotoWorks in the animation it has to render each frame individually and while this certainly produces a beautiful result, it is usually a time-consuming process.

- **When testing your animation, try creating several rough-test AVIs to make sure that everything is synchronized correctly**. These AVIs should be made at a low Frame Per Second (FPS), so they can be quickly generated and evaluated. The more frames per second in your animation the smoother the final result, but the longer it takes to generate the AVI.

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