RollerCAD
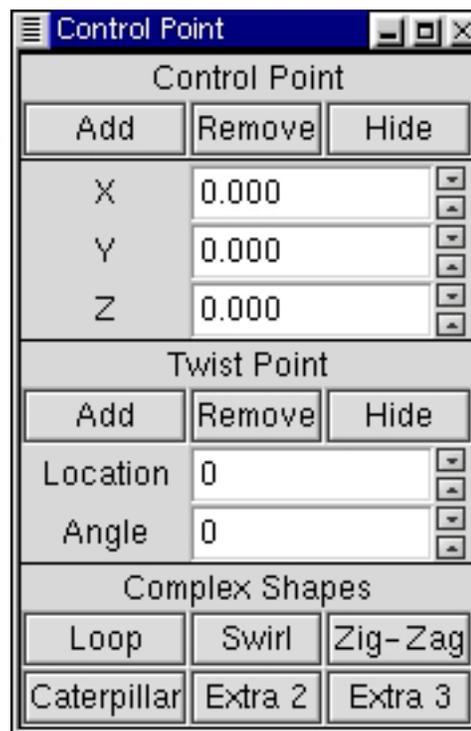## The User's Manual

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User interaction with RollerCAD was designed to be simple and intuitive. Interactions occur in one of two ways: through the four menus, and with mouse actions within the rendering window. A number of actions have been redundantly defined with both of these, providing novice users with the straightforward and self-explanatory menus, and providing more experienced users with the faster and simpler mouse events within the roller-coaster rendering window. The following pages briefly outline the interactions supported.

Control Menu

The Control menu facilitates manipulation of the actual structure of the roller coaster track. Control points determine the shape of the curve, and twist points specify the orientation of the cart on that curve (as an angle of rotation.) Higher-level features can also be inserted with this menu, allowing the user to design in a more conceptual manner.

For both the control points & twist points: "Add" inserts a new point after the currently-selected point, "Remove" deletes the currently-selected point, and "hide" hides all points, without altering any.

Control Point

Control Point		
Add	Remove	Hide

X	0.000	
Y	0.000	
Z	0.000	

Twist Point		
Add	Remove	Hide

Location	0
Angle	0

Complex Shapes		
Loop	Swirl	Zig-Zag
Caterpillar	Extra 2	Extra 3

The coordinates of the selected control point can be specified directly.

The characteristics of the selected twist point is controlled here.

Higher-level features: Several pre-defined features can be added to the current track with these buttons. The chosen feature is inserted after the currently-selected control point (and ending before the following control point.) The goal is to allow the user to first "sketch" a track (roughly) with a set of more natural primitives. The resulting track can then be adjusted using the more fine-grained controls.

Physics Menu

The Physics menu presents users with calculations of speed, momentum, and G-force of a cart riding on the user's current track. These calculations aid in designing a roller-coaster that is not only interesting or complicated, but also physically safe for humans riders.

Rows:

Three calculations are made during the simulation: speed, momentum, and G-force. G-force measures the total acceleration felt by a person riding the roller coaster, allowing feedback about the safety of the ride. Speed simply measures the cart's velocity module. Momentum measurements could be useful in finding the appropriate amount of braking necessary to stop the cart at the end of the ride.
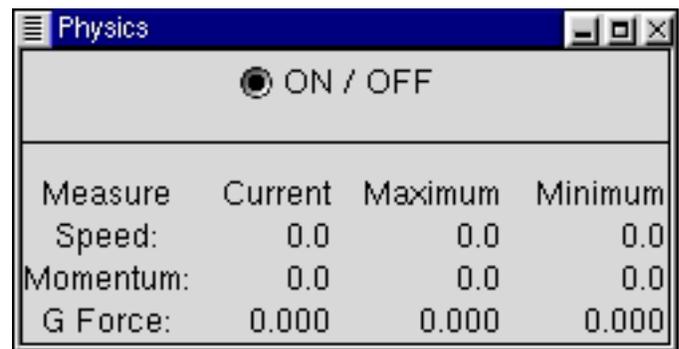
Physics			_□×
⦿ ON / OFF			
Measure	Current	Maximum	Minimum
Speed:	0.0	0.0	0.0
Momentum:	0.0	0.0	0.0
G Force:	0.000	0.000	0.000

Columns:

The "current" column displays the real-time values for each of the three calculations, as a simulation progresses. The maximum and minimum columns provide feedback useful in assessing the overall safety of the track in its entirety. "Current" values are also presented to the user by a color-coding of the track, in which G-Force determines the color. This allows for a quick feedback mechanism, making clear to the user which turns, for instance, are too sharp.

<u>G-Force Color Key</u>
Negative G-force values can be dangerous if at the top of a loop. Values of 0-1 can give a weightless feeling (thrilling to riders.) Values above 8 often cause riders to faint, values above 20 often cause injuries, and values above 40 are often deadly.

Color	Range
(blue)	negative
(teal)	0 to 0.5
(green)	0.5 to 1
(yellow-green)	1 to 4
(orange)	4 to 8
(dark orange)	8 to 20
(red)	20 to 40
(magenta)	over 40

Simulation Menu

The Simulation menu provides the user with control over the environment within which the track is tested. This includes the relevant cart characteristics, the viewpoint, and the user-mode.

User-Mode:

The "Edit" mode is ideal for use when intially developing and adjusting the track. "Simulate" mode is more elaborate but also more realistic. Context-specific isual cues are provided.

Initial Parameters:

Start location indicates the absolute position (in units of length) from which the cart is initially started. Initial speed is an important parameter to set, since most carts with no initial speed lead to unsuccessful roller coasters. Mass and friction coefficient values can be set, allowing the user to experiment with the track under various conditions.

Viewing Mode:

Two different viewing modes are supported. "Ride It!" provides a viewpoint similar to one seen by a person actually experiencing the ride. "Observe" toggles between two view types. The first provides a view from a fixed location in a fixed direction. The second constantly updates the direction such that the cart is always centered in the window.

Basic Control:

Basic controls including play, stop, and pause are provided. The corresponding simulation acts according to the specified parameters, user-mode, and viewing-mode.

View Menu

The Viewport menu provides control over the view of the track. Many of its features are supported redundantly, both here and via (3-button) mouse control within the rendering window.
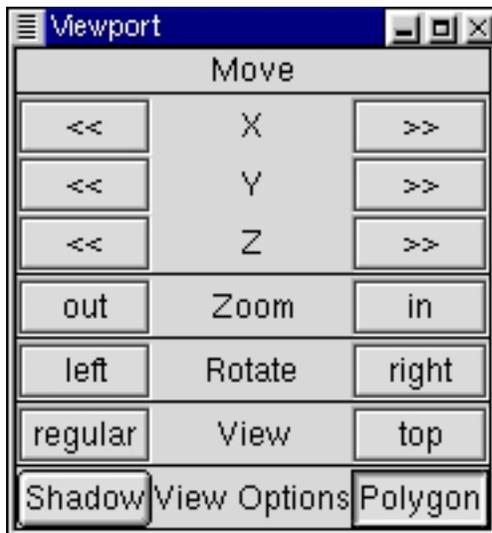
Redundant View Control:

Each of the buttons in this portion of the menu correspond to viewing transformations that can also be triggered through mouse control. In order to make the program as intuitive as possible, these commands are available here, where they are clearly labeled (rather the faster but hidden mouse control.) Manipulating the X, Y, and Z values translates the view, Zoom scales the view, and Rotate rotates the view.

Viewing options:

Two toggle buttons are provided to show/hide visual characteristics of the track. The first is "shadow," which can display the shadow cast by the track onto the ground (from sunlight.) This can provide clues of visual space perception when the viewing angle is in motion. The second option is to show/hide the control polygon. Often, this is needed when designing, but not when simulating, the roller coaster track.

View-mode:

Regular view allows for viewing from an arbitrary viewpoint, while Top displays a bird's-eye view of the track (which looks like a 2-D NURBS curve.)

Mouse Interactions

Most control point manipulations and viewing transformations can be performed directly within the rendering window with the mouse. A three-button mouse is necessary for full functionality.
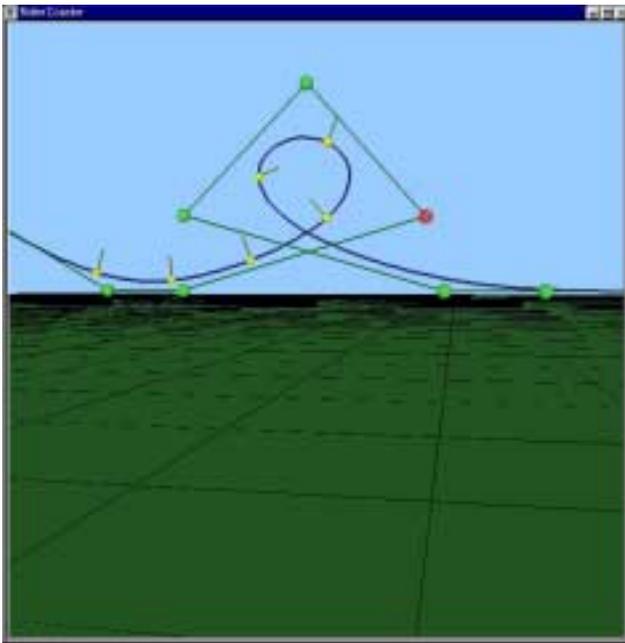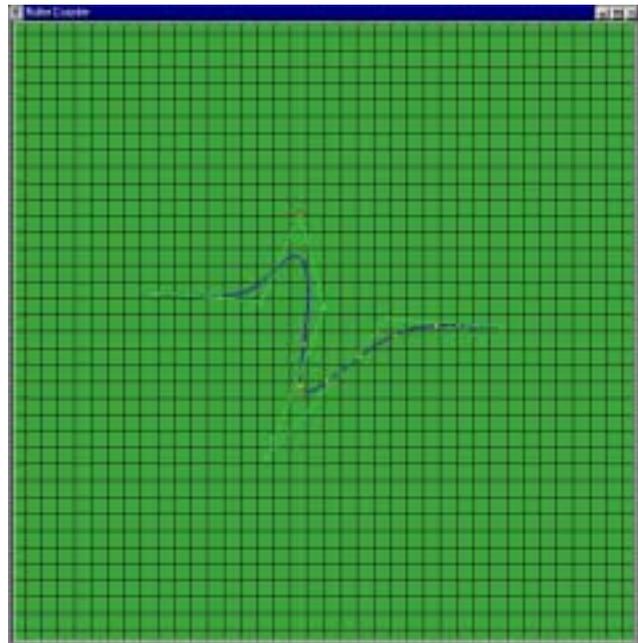

REGULAR VIEW

TOP VIEW

Left-mouse click: selects the nearest point.

Middle-mouse click: toggles between the coordinate axes to specify one axis along which the control point can be moved.

Right-mouse click: Centers the rendered viewing display on the selected point.

Left-Button drag: drags the selected control point along the specified axis.

Middle-Button drag: Up/down dragging zooms in/out. Left/right dragging rotates the view around the current view direction.

Left-mouse click: selects the nearest point.

Right-mouse click: Centers the rendered viewing display on the selected point.

Left-Button drag: drags the selected control point freely within the X-Z plane.

Middle-Button drag: Up/down dragging zooms in/out.