

Using robotSim

This is a general guide to using robotSim. This section includes help on the different menus in robot sim, toolbars, and windows that you will interact with. This section is divided into the following subsections:

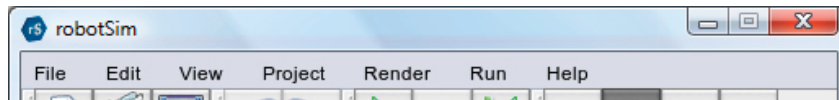
Menus

Toolbars

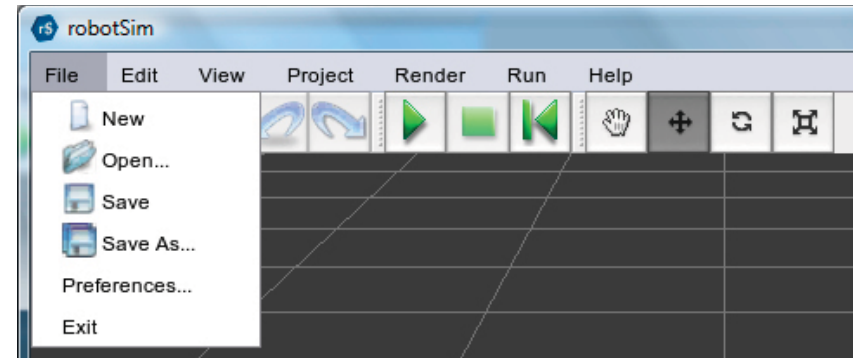
Windows

MENUS

The menus in robotSim control many different aspects of the program. The menus available in robotSim are listed as follows.



File



The File menu contains menu items that allow you to manage the creation, saving, and opening of your projects. There are also menu items that let you adjust the preferences for robotSim, and quit the robotSim application.

New

The “New” menu item creates a new robotSim project. You can choose between an empty project, or one of the available environments to start with. Be sure to save your current project before creating a new one.

Open

The “Open” menu item allows you to open an existing project. Be sure to save any changes to the current project before opening a different one.

Save

The “Save” menu item allows you to save the current project. It will save the project as the same name, or prompt you to choose a name if it is your first time saving that project.

Save As

The “Save As” menu item allows you to choose the name of the save file to save your project in.

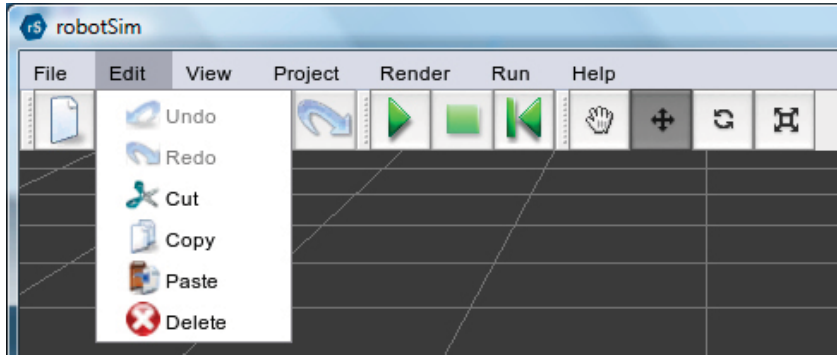
Preferences

The “Preferences” menu item opens the Preferences dialog where you can change the robotSim settings.

Exit

The “Exit” menu item will close robotSim. This is equivalent to clicking the red ‘X’ to close the application. Be sure to save your project before exiting.

Edit



The Edit menu contains menu items that allow you to undo and redo the last actions performed, as well as cut, copy, paste, and delete objects.

Undo

The “Undo” menu item reverses the last change made to the project.

Redo

The “Redo” menu item will apply the command that was last reversed using the “Undo” command.

Cut

The “Cut” menu item removes the selected object from the simulator. The last object cut (or copied) can then be added back to the sim using the “Paste” command.

Copy

The “Copy” menu item makes a copy of the selected object without changing or removing the selected object. The last object copied (or cut) can then be added to the sim using the “Paste” command.

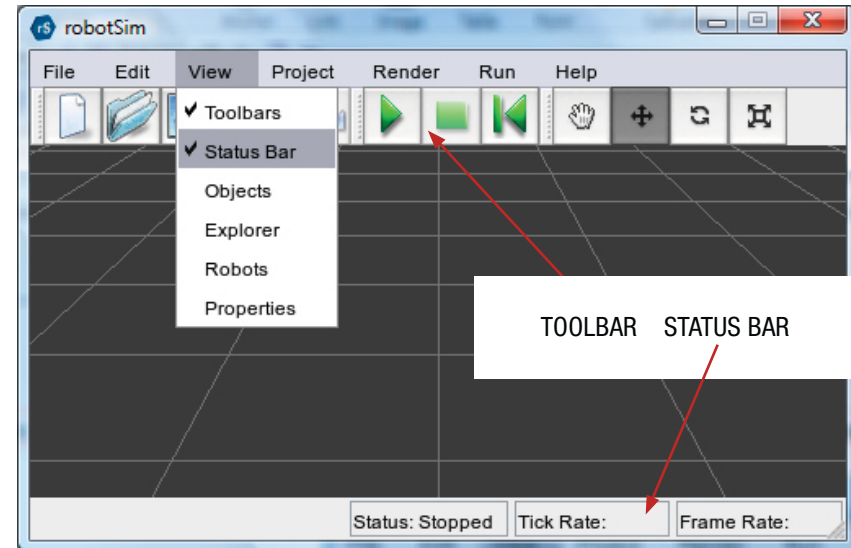
Paste

The “Paste” menu item adds the last object that was cut or copied from the simulator. If no object is on the clipboard (cut or copied) nothing will be pasted.

Delete

The “Delete” menu item deletes the selected object from the simulator.

View



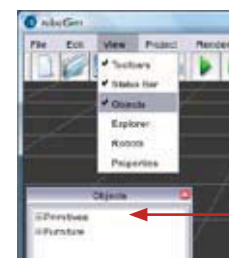
The View menu is where the view settings for the toolbars and various windows are changed. To show or hide one of these windows or the toolbars, simply select the menu item corresponding to it.

Toolbars

The “Toolbars” menu item allows you to show or hide the toolbars. When the Toolbars item has a check beside it the toolbars are shown. When the Toolbars item is not checked the toolbars are hidden.

Status Bar

The “Status Bar” menu item allows you to show or hide the status bar. When the Status Bar item has a check beside it the status bar is shown. When the Status Bar item is not checked the status bar is hidden.

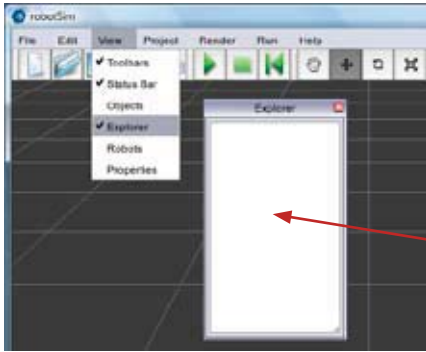


Objects

The “Objects” menu item toggles between showing and hiding the Objects window. The Objects window is covered in more detail in the “Objects Window” section of this manual.

OBJECTS WINDOW

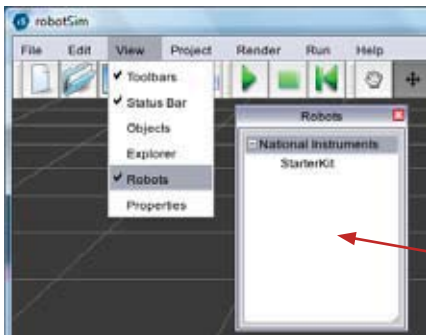
View



Explorer

The “Explorer” menu item toggles between showing and hiding the Explorer window. The Explorer window is covered in more detail in the “Explorer Window” section of this manual.

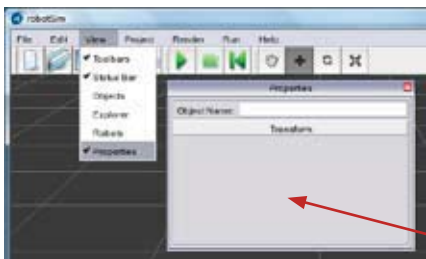
EXPLORER WINDOW



Robots

The “Robots” menu item toggles between showing and hiding the Robots window. The Robots window is covered in more detail in the “Robots Window” section of this manual.

ROBOTS WINDOW

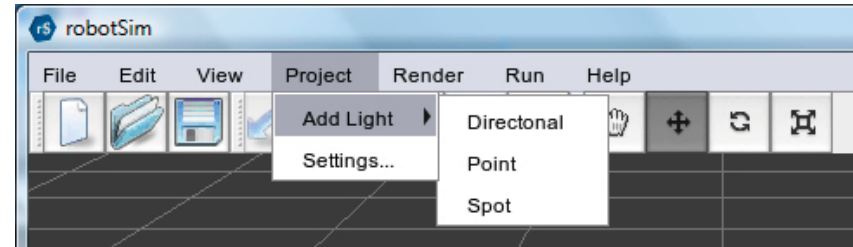


Properties

The “Properties” menu item toggles between showing and hiding the Properties window. The Properties window is covered in more detail in the “Properties Window” section of this manual.

PROPERTIES WINDOW

Project

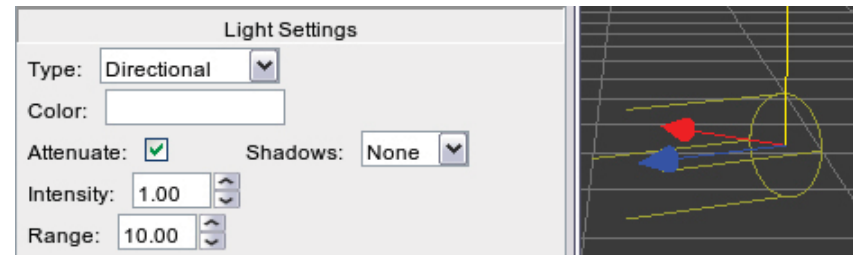


The Project menu is where the settings for the current project can be changed. You can also add lights to the current project using the “Add Light” submenu.

Add Light

The “Add Light” menu item opens up a submenu containing the various lights that can be added to the current project.

The “**Directional**” submenu item adds a Directional Light to the current project. Directional Lights are considered infinitely far away and affect everything in the scene.

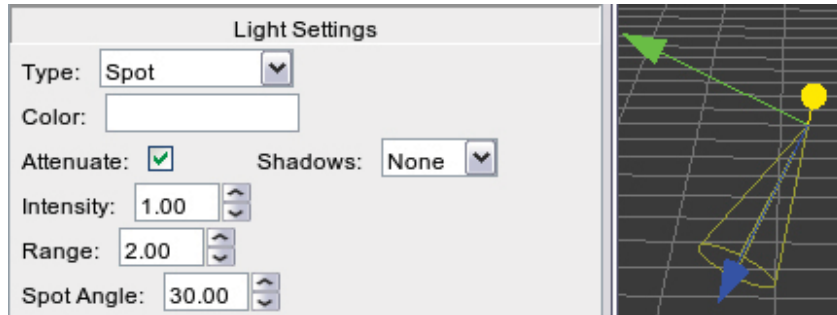


The “**Point**” submenu item adds a Point Light to the current project.



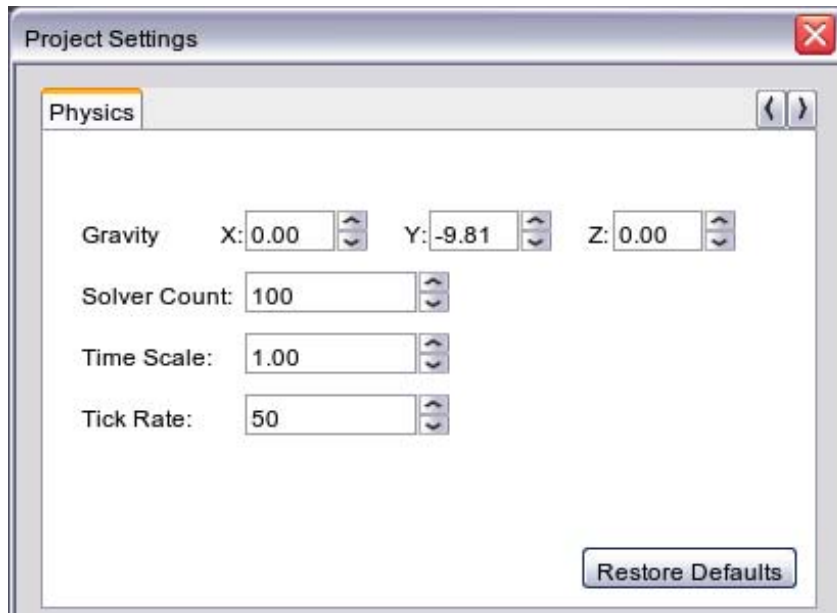
Project

Point Lights emit light equally in all directions up to objects within their range. The “**Spot**” submenu item adds a Spot Light to the current project. Spot Lights emit light within a cone.



Settings

The “Settings” menu item opens up the settings dialog for the current project.



Gravity

Sets the acceleration of gravity in the simulator in the X, Y, and Z directions.

Solver Count

Sets the accuracy of the simulator’s physics. A higher solver count will give more accurate physics, but lower performance.

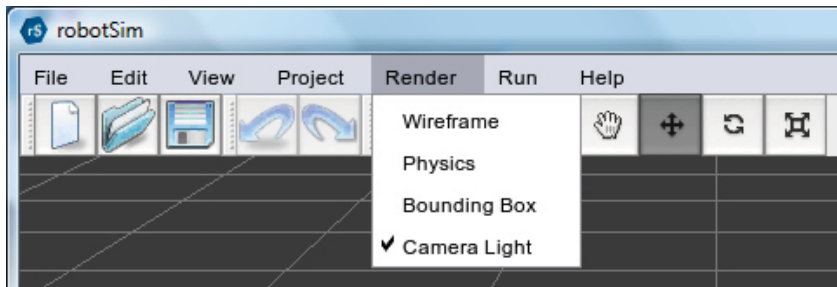
Time Scale

Sets the rate that time passes in the simulator. For example, a time scale of 2.0 would move at double the speed of real time, and a time scale of 0.5 would move at half the speed of real time.

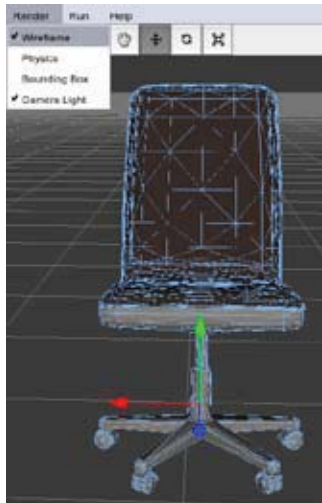
Tick Rate

Sets the frequency per second that the simulator’s physics are updated. A higher tick rate will give smoother, more accurate physics, but lower performance.

Render

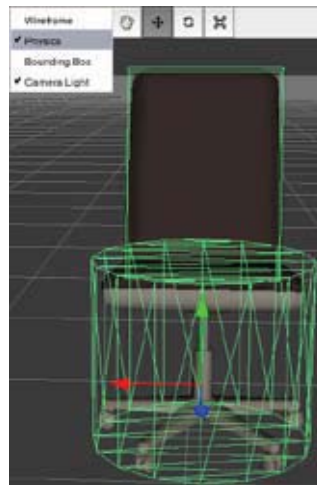


The Render menu is where you can change how the selected item in your project is drawn to the screen. Aside from “Camera Light” all rendering options are only applied to the currently selected object. Most rendering options are only useful for debugging purposes, so it is recommended to keep them off to maintain performance.



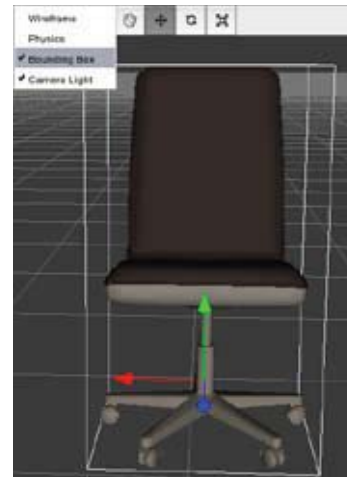
Wireframe

The “Wireframe” menu item toggles between showing and hiding the wireframe model of the selected object.



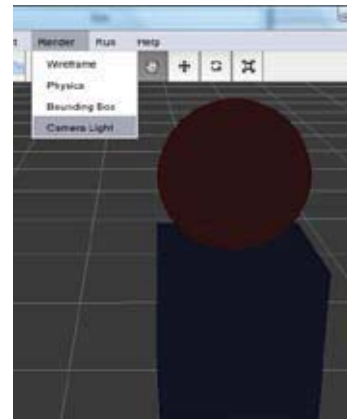
Physics

The “Physics” menu item toggles between showing and hiding the physics collider of the selected object. The physics collider is the physics object that will cause collisions. More information on colliders can be found in the Properties Window Collider section.



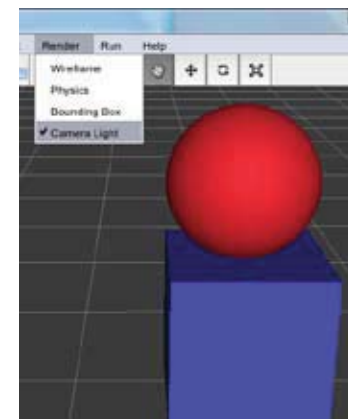
Bounding Box

The “Bounding Box” menu item toggles between showing and hiding the bounding box of the selected object. The bounding box is the area that the can be clicked in to select an object.

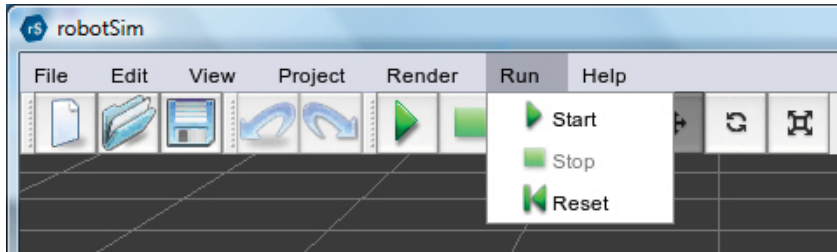


Camera Light

The “Camera Light” menu item toggles between turning on and turning off the camera light. The default is to turn the camera light on, so that the objects can be seen properly. Turning off the camera light will make the objects dark, unless you have added an additional light source. In the first image the camera light is off, making it hard to see the objects. In the second image the camera light is on (as it is by default), so the objects are much easier to see.



Run



The Run menu is where the controls to start, pause, or stop the simulator are located. These controls can also be accessed from the toolbar.

Start / Pause

The “Start” menu item starts the simulator. Physics calculations are performed, and robots can be controlled. While the simulator is running, the “Start” menu item will become the “Pause” menu item, which pauses the simulator. Choosing “Start” while the simulator is paused will allow the simulator to continue running. The state the simulator is in is saved when it is started, and once stopped, the reset action will reset the simulator to that state. Choosing “Start” always overwrites the reset state.

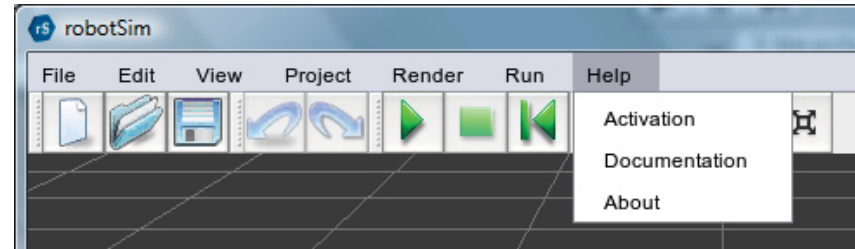
Stop

The “Stop” menu item stops the simulator until it is started again. Once the simulator is stopped, the reset button will reset the simulator to the state it was in before it was started.

Reset

The “Reset” menu item will reset the simulator to the state it was in before it was started. Any objects added to the simulator while it is running will be reset to the state they were in when they were first added.

Help



The Help menu is where you can access assistance such as this user manual.

Activation

The “Activate” menu item launches the robotSim activation program. You can use the activation program to activate or deactivate robotSim and its modules.

Documentation

The “Documentation” menu item opens this user manual in your default browser.

About

The “About” menu item displays information about robotSim and Cogmation Robotics.

TOOLBARS



The toolbars in robotSim control many different aspects of the program.

File Management

The file management toolbar allows easy access to common File menu actions “New”, “Open”, and “Save”.



New: creates a new robotSim project. You can choose between an empty project, or one of the available environments to start with. Be sure to save your current project before creating a new one.



Open: opens an existing project. Be sure to save any changes to the current project before opening a different one.



Save: saves the current project. It will save the project as the same name, or prompt you to choose a name if it is your first time saving that project.

Undo / Redo

The undo / redo toolbar allows easy access to the common Edit menu actions “Undo” and “Redo”.



Undo: reverses the last change made to the project.



Redo: applies the command that was last reversed using the “Undo” command.

Simulator Control



Start / Pause: starts the simulator. Physics calculations are performed, and robots can be controlled. While the simulator is running, the “Start” button will become the “Pause” button, which pauses the simulator. The state the simulator is in is saved when it is started, and once stopped, the reset action will reset the simulator to that state. Choosing “Start” always overwrites the reset state.



Pause: Pauses the simulator while it is running. When the simulator is paused or stopped, the “Pause” button will become the “Start” button. Clicking “Start” while the simulator is paused will allow the simulator to continue running.



Stop: stops the simulator until it is started again. Once the simulator is stopped, the reset button will reset the simulator to the state it was in before it was started.



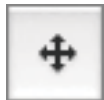
Reset: resets the simulator to the state it was in before it was started. Any objects added to the simulator while it is running will be reset to the state they were in when they were first added.

Object / Camera Manipulation

The object / camera manipulation toolbar allows easy switching between interaction modes between the mouse and the simulator. Only one mode can be active at any one time. Aside from the move camera option (which appears as a hand) the modes allow you to perform various transforms on objects. The currently selected mode will appear darker than the rest, as the “Move Object” crosshairs do in the above image.



Move Camera: allows you do move the camera’s position by dragging on the screen. To interact with objects, be sure to select one of the object manipulation modes.



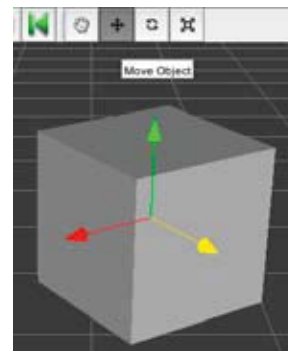
Move Object: allows you to adjust the selected object’s position by clicking and dragging on the axis handles (which appear as arrows for moving).



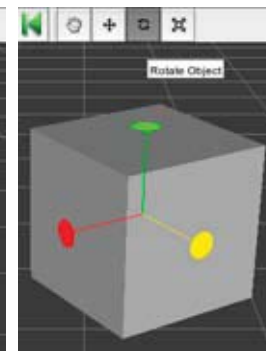
Rotate Object: allows you to adjust the selected object’s rotation by clicking and dragging on the axis handles (which appear as circles for rotating).



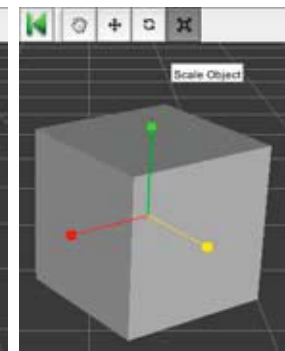
Scale Object: allows you to adjust the selected object’s scale by clicking and dragging on the axis handles (which appear as cubes for scaling).



Move Object

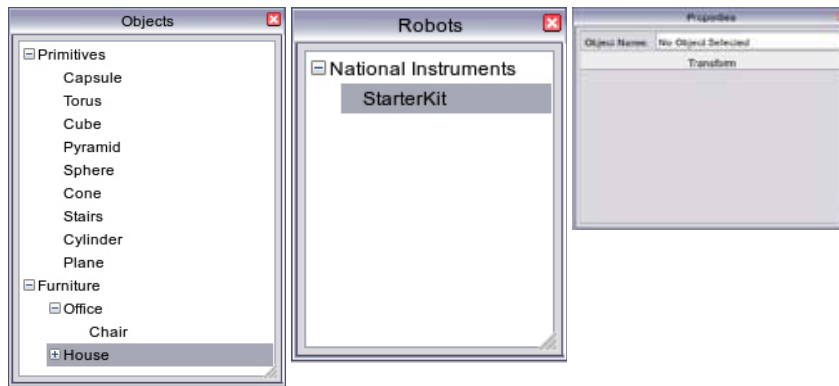


Rotate Object

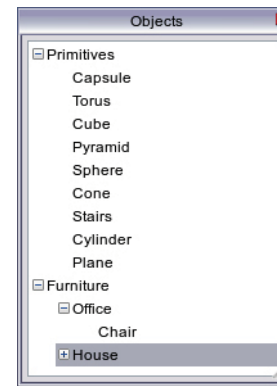


Scale Object

WINDOWS



Objects Window



The various windows in robotSim allow you to interact with the simulator and its objects in many different ways.

The **Objects Window** contains all of the objects that can be added to robotSim (except for Robots and Lights). The objects are broken up into categories.

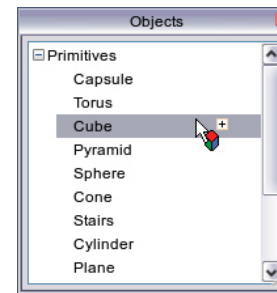
To add an object simply drag it on to the simulation area. Objects can be altered using the Object Manipulation Toolbar and the Properties Window.

Working with Objects

There are three main types of Objects in robotSim, objects, robots, and lights. This section deals with how to work with objects generally. To get more information on working with lights and robots, please see the sections on lights and robots.

Adding Objects

The Cube object was selected. Once the mouse is dragged, the cursor changes to indicate that there is an object on it. You can drop it in the Objects window to get rid of it, or hit the escape key.



Here the cursor is directly over the spot where we want to add it to the simulator. Now we simply need to release the mouse button to have the Cube added at this location.



The cube is added once the mouse is released.

Robots Window



The **Robots Window** contains the list of available robots that you can use in robotSim. As you upgrade and add more robot modules, this list will reflect the robots that you have added. To add a robot to the simulator, simply click and drag it on to the area you would like to place it. When you release the mouse, the robot will be added to the simulator. For more information on robot settings, please see the section on the Properties Window.

Working with Robots

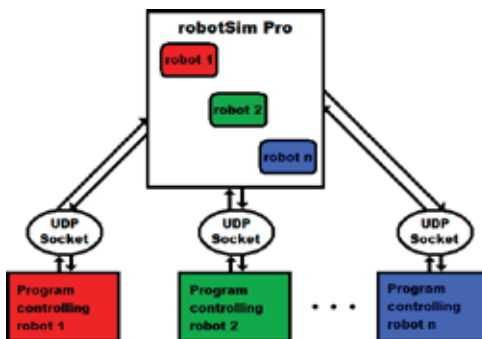
Robots in robotSim are special objects because they can receive connections and be controlled by external programs. For more information on working with robots, please see the sections on the Properties Window and Robots Window.

Connecting to a Robot

Each robot simulated by robotSim can be connected to and controlled by separate programs (or separate UDP connections within a program) or computers. Each robot has an IP address and port used to connect to and control it. The control programs must ensure they are connected to the correct robot when controlling them.

When connecting to a robot in robotSim, first ensure that the robot has been added, and that the robot's IP address and port are correct. You can check them both in the Properties Window's Robot Settings. The IP address of the robot should be the IP address of the computer that is running robotSim. The default IP address

is 127.0.0.1, which is the local computer. If you wish to connect to the robot over a network, change the IP address of the robot to the computer's network address. The default port for robots is 13000, incrementing for each additional robot added. Change the port to the desired port for your robot before connecting.

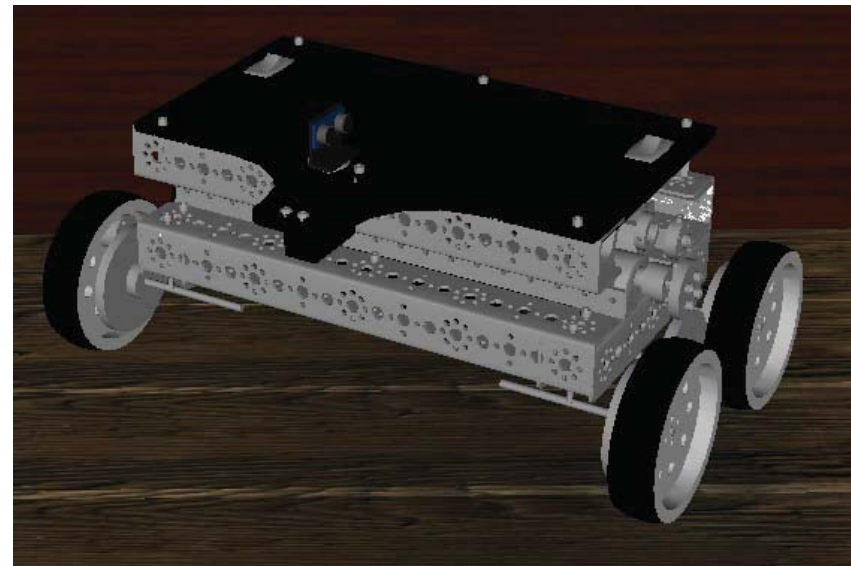


Once the robot is set up to connect in robotSim, be sure to start the simulation. Now any program that can create UDP connections can connect to and control the robot. To see specific APIs relating to specific robots, please refer to the sections specific to those robots.

NIStarterKit

The NIStarterKit robot is a four wheeled robot controlled by two motors. The robot can be controlled by setting the left and right motor velocities. The NIStarterKit robot also has a sonar sensor mounted on a servo. The servo can be moved, and the sonar distance data can be read.

A sample Visual Studio C++ application that controls the NIStarterKit robot can be found here: [NIStarterKitSample](#)



Be sure to have robotSim running with a NIStarterKit robot ready to connect. Double check the IP address and port to make sure they match in the main.cpp file, as well as in robotSim.

A brief overview of the API used in the NIStarterKitSample program is available here: [NIStarterKitSample API Reference](#)

Properties Window

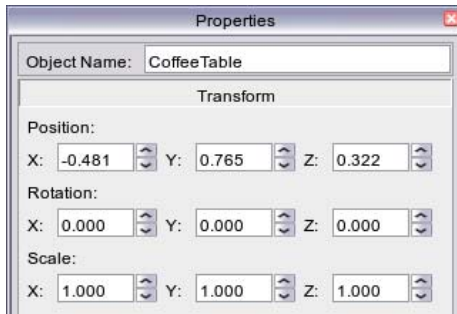


The **Properties Window** contains all of the properties that can be modified for the selected object. The selected object's name is displayed at the top, and can be changed there as well. The available properties within the Properties Window will change depending on what type of object is selected. To expand any section of the Properties

Window, simply click the button such as the "Transform" button. The different sections of the Properties Window are as follows:

Transform

The "Transform" properties deal with an object's position, rotation, and scale (size).



Position: the location of the selected object on the x, y, and z axes.

Rotation: the angle of the selected object relative to the x, y, and z axes.

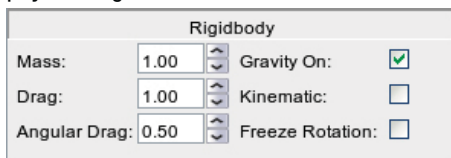
Scale: the size of the selected object in the x, y, and z directions

These values are updated as an object moves, but can also be changed by typing new values, or using the up and down buttons on the spinboxes.

All objects in robotSim have transform properties.

Rigidbody

The "Rigidbody" properties control how an object interacts with gravity and other objects in robotSim. An object must have a rigidbody if it is to be moved by the physics engine.



Mass: the mass of the selected object. Objects with higher mass move less in collisions, and cause objects of lower mass to move more in collisions.

Drag: the amount an object is slowed when moved by the physics engine. For example, when falling from gravity, an object with higher drag will fall slower (which can simulate air resistance).

Angular Drag: the amount an object is slowed when rotated by the physics engine.

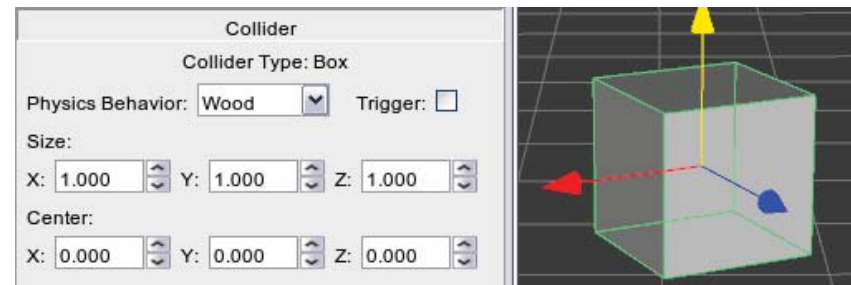
Gravity On: whether or not this selected object is affected by gravity. If it is checked, the object is affected by gravity, if unchecked it is not.

Kinematic: whether or not the selected object is affected by forces or collisions. If turned on, the object will be stationary and not moved if hit by a different object, though the other object will still react to the collision.

Freeze Rotation: whether or not the selected object's rotation can be affected by the physics engine.

Collider

The "Collider" properties control how an object reacts to collisions with other objects. All colliders can be seen as green outlines if the "Physics" option is enabled in the "Render" menu.



Box Collider

Box colliders are a simple box shape.

Properties Window

Physics Behaviour: how the physics engine handles collisions with the object. The physics behaviour can be altered by changing the value in the combobox. The 6 types of physics behaviours available in robotSim are:

None: the default physics behaviour will be applied.

Metal: the object will behave as though it were made of metal.

Rubber: the object will behave as though it were made of rubber.

Wood: the object will behave as though it were made of wood.

Bouncy: the object will behave as though it were bouncy.

Ice: the object will behave as though it were made of ice.

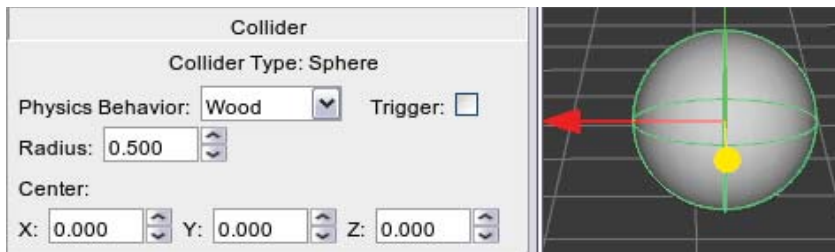
Trigger: If checked, the object will not collide with anything, and instead an event can be hooked up to react to the object being entered by another. This event handling is currently unavailable, but will be available in a future version of robotSim.

Size: the size of the collider. Most colliders should be tightly fit to the object they are attached to. Size can be altered in the x, y, and z directions relative to the object.

Center: the center of the collider, essentially its position on the x, y, and z axes relative to the object.

Sphere Collider

Sphere colliders are a simple sphere shape.



Physics Behaviour: how the physics engine handles collisions with the object. The physics behaviour can be altered by changing the value in the combobox. The 6 types of physics behaviours available in robotSim are:

None: the default physics behaviour will be applied.

Metal: the object will behave as though it were made of metal.

Rubber: the object will behave as though it were made of rubber.

Wood: the object will behave as though it were made of wood.

Bouncy: the object will behave as though it were bouncy.

Ice: the object will behave as though it were made of ice.

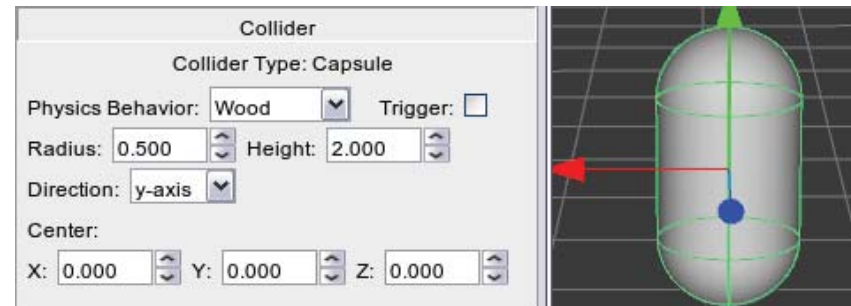
Trigger: If checked, the object will not collide with anything, and instead an event can be hooked up to react to the object being entered by another. This event handling is currently unavailable, but will be available in a future version of robotSim.

Radius: the radius of the collider. Most colliders should be tightly fit to the object they are attached to.

Center: the center of the collider, essentially its position on the x, y, and z axes relative to the object.

Capsule Collider

Capsule colliders are a simple capsule shape.



Physics Behaviour: how the physics engine handles collisions with the object. The physics behaviour can be altered by changing the value in the combobox. The 6 types of physics behaviours available in robotSim are:

None: the default physics behaviour will be applied.

Metal: the object will behave as though it were made of metal.

Rubber: the object will behave as though it were made of rubber.

Wood: the object will behave as though it were made of wood.

Bouncy: the object will behave as though it were bouncy.

Ice: the object will behave as though it were made of ice.

Properties Window

Trigger: If checked, the object will not collide with anything, and instead an event can be hooked up to react to the object being entered by another. This event handling is currently unavailable, but will be available in a future version of robotSim.

Radius: the radius of the collider. Most colliders should be tightly fit to the object they are attached to.

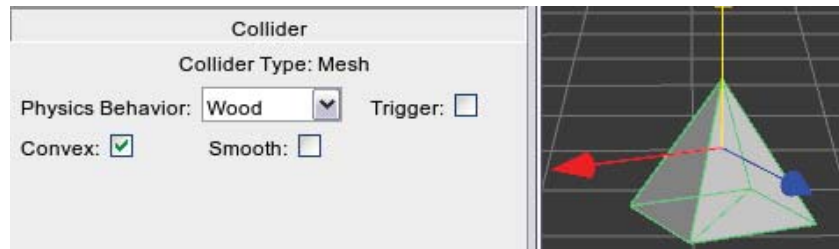
Height: the height of the collider. Most colliders should be tightly fit to the object they are attached to.

Direction: the direction of the collider, which can follow the x, y, or z directions relative to the object. Most colliders should be tightly fit to the object they are attached to.

Center: the center of the collider, essentially its position on the x, y, and z axes relative to the object.

Mesh Collider

Mesh colliders allow collisions between objects with meshes and other objects.



Physics Behaviour: how the physics engine handles collisions with the object. The physics behaviour can be altered by changing the value in the combobox. The 6 types of physics behaviours available in robotSim are:

None: the default physics behaviour will be applied.

Metal: the object will behave as though it were made of metal.

Rubber: the object will behave as though it were made of rubber.

Wood: the object will behave as though it were made of wood.

Bouncy: the object will behave as though it were bouncy.

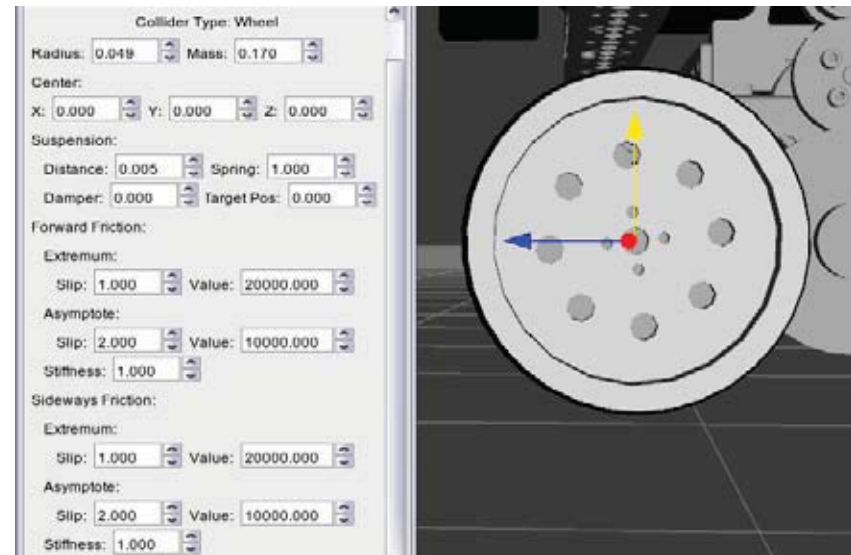
Ice: the object will behave as though it were made of ice.

Convex: If checked, the mesh collider will be forced to be convex. Convex mesh colliders will collide with other convex colliders as well as non-convex meshes. At this time two non-convex meshes will not collide. The mesh must have less than 255 polygons for this to work.

Smooth: If checked, the mesh will have smooth collisions with sphere colliders rolling over smooth surfaces.

Wheel Collider

Wheel colliders are used to simulate wheel friction. Wheel colliders will not respond to other colliders' physics behaviours.



Radius: the radius of the collider. Most colliders should be tightly fit to the object they are attached to.

Mass: the mass of the collider. Objects with higher mass move less in collisions, and cause objects of lower mass to move more in collisions.

Center: the center of the collider, essentially its position on the x, y, and z axes relative to the object.

Properties Window

Suspension: simulates a vehicle's suspension system for the wheel.

Distance: the maximum distance for the wheel suspension, relative to the collider on the y-axis.

Spring: a higher value causes the suspension to reach the target position faster.

Damper: a higher value causes the suspension to reach the target position more slowly.

Target Pos: the target position that the suspension tries to reach. A fully extended suspension is 0, and a fully compressed suspension is 1.

Forward Friction: friction properties in the forward direction. Wheels follow a friction curve, whose points can be controlled with the extremum and asymptote values.

Extremum: the peak of the friction curve. The slip is the x-axis, the value is the y-axis (force).

Asymptote: the point after the extremum where the curve levels off. The slip is the x-axis, the value is the y-axis (force).

Stiffness: the stiffness of the friction. This value is used as a multiplier with the extremum and asymptote values. A stiffness of 0 will remove all friction from the wheel.

Sideways Friction: friction properties in the sideways direction. Wheels follow a friction curve, whose points can be controlled with the extremum and asymptote values.

Extremum: the peak of the friction curve. The slip is the x-axis, the value is the y-axis (force).

Asymptote: the point after the extremum where the curve levels off. The slip is the x-axis, the value is the y-axis (force).

Stiffness: the stiffness of the friction. This value is used as a multiplier with the extremum and asymptote values. A stiffness of 0 will remove all friction from the wheel.



Material / Texture

The Material / Texture section of the Properties Window allows you to change the appearance of your objects. At this time only the colour of each material on an object can be changed.

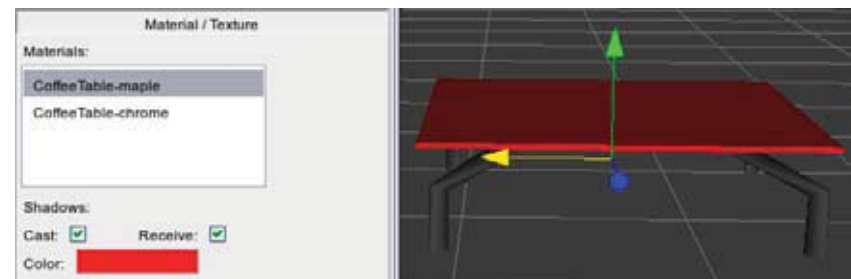


Color Wheel

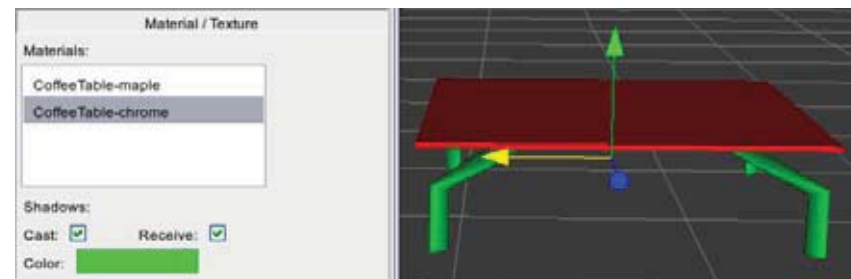
Color Spectrum

RGB Sliders

In this example we have a coffee table that has two different materials on it. We can click on the “Color” box to give us a color choosing dialog. The Color dialog has 3 different ways to choose a color, show above. If we change the “CoffeeTable-maple” color, it is reflected in the part of the object that had that material applied to it.



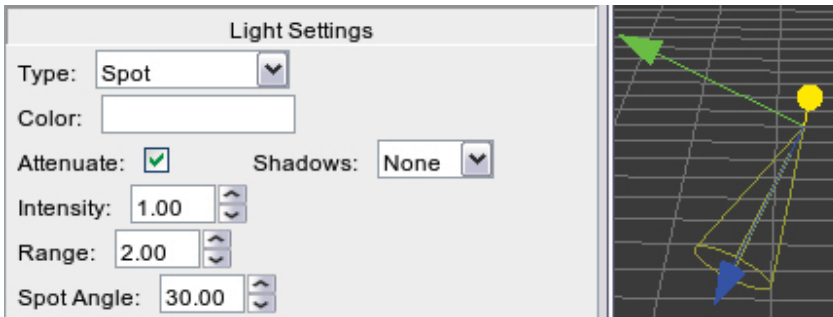
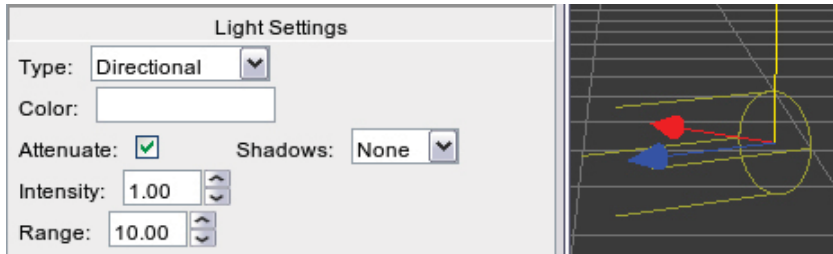
If we change the “CoffeeTable-chrome” color, it is reflected in the part of the object that had that material applied to it:



Properties Window

Light Settings

There are 3 types of lights in robotSim, Directional, Point, and Spot. Their settings vary slightly in the Properties Window.



Type: the type of light can be changed with the combobox (choices are Directional, Point, or Spot).

Color: the color of the light emitted.

Attenuate: check if you want the light to attenuate over distance. Does not affect directional lights.

Shadows: the type of shadows cast by the light (choices are None, Hard, and Soft). Using shadows may reduce performance, soft shadows will degrade performance more than hard shadows.

Intensity: how bright the light is. A high intensity can wash out the light color.

Range: the distance that the light can reach.

Spot Angle (Spot lights only): the angle of the spot light.

Robot Settings

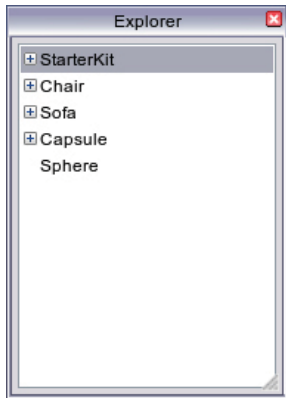
The "Robot Settings" section of the Properties Window allows you to change settings for the robots in the simulator. The current settings that can be changed are the Port and IP address that are used to control the robot from an external program (such as LabVIEW or a C++ application).



Port: the port that the robot is using. Use this port to connect to the sim from another application to control the robot.

Address: the address of the computer running the simulator. If you are connecting to the sim from a program on the same computer, the default localhost address (127.0.0.1) will work. If you are connecting to the simulator from a different computer over a network, you will need to enter the IP address of the computer running the simulator here.

Explorer Window



The Explorer Window shows all of the objects that are currently in the simulator. If an object has child objects inside it, they will be displayed underneath (if the object is expanded in the Explorer Window) or hidden (if the object is collapsed as they are in the image above).

When you click on an object in the Explorer Window it will be selected in the simulator. If you click on an object in the simulator, it will be highlighted in the Explorer Window.

Items can be reordered by dragging them in the Explorer Window.

You can reparent items by dragging them in the Explorer Window. Just click and hold while dragging to the desired parent of the object you have selected.