

Surface Physics Demonstrator

Build 1.0

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Introduction

This sample Surface application demonstrates an alternative to using the Surface “ScatterView” control. While not all of the features of ScatterView are available in this release (e.g. resize, rotate manipulations), this control enables an extremely simple integration of a basic physics engine with WPF Surface applications.

The sample has a number of pages, each of which illustrates a particular concept. Each page is accessible from a set of radio buttons, and within each page there may be a further choice of options.

For videos demonstrating the functionality, see the following links:

- <http://drdave.co.uk/blog/post/Surface-Physics-Demo-Part-1.aspx>
- <http://drdave.co.uk/blog/post/Surface-Physics-Demo-Part-2.aspx>
- <http://drdave.co.uk/blog/post/Surface-Physics-Demo-Part-3.aspx>

Requirements

The following is required to run the sample:

- .NET 3.5 SP1

Clearly the best experience will be when running this sample on Microsoft Surface, however it is also possible to use the Microsoft Surface Simulator, available from the MSDN website as part of the Microsoft Surface SDK 1.0 SP1 Workstation Edition.

In order to demonstrate object interaction this sample requires a number of tags for the following behaviours:

- Point gravity attractor (0xCC)
- Light or gravity direction (0xAA)
- Spring connector (0xDD)
- Solid object (0xEE)

These tags are detailed in the FAQ below and by default are assumed to be attached at the centre of standard-sized poker chips. Labels to attach to the front of the chips are available in the Appendix.

Installation

Double-click the installation file "Surface Physics.msi".

If the application install directory is changed from "c:\program files\surface physics\", the configuration file "c:\programdata\microsoft\surface\programs\surface physics.xml" needs to be manually edited to point to the new location.

Shapes Page

The “Shapes” page is shown below in Figure 1 This page demonstrates basic interactions between shapes of various types.

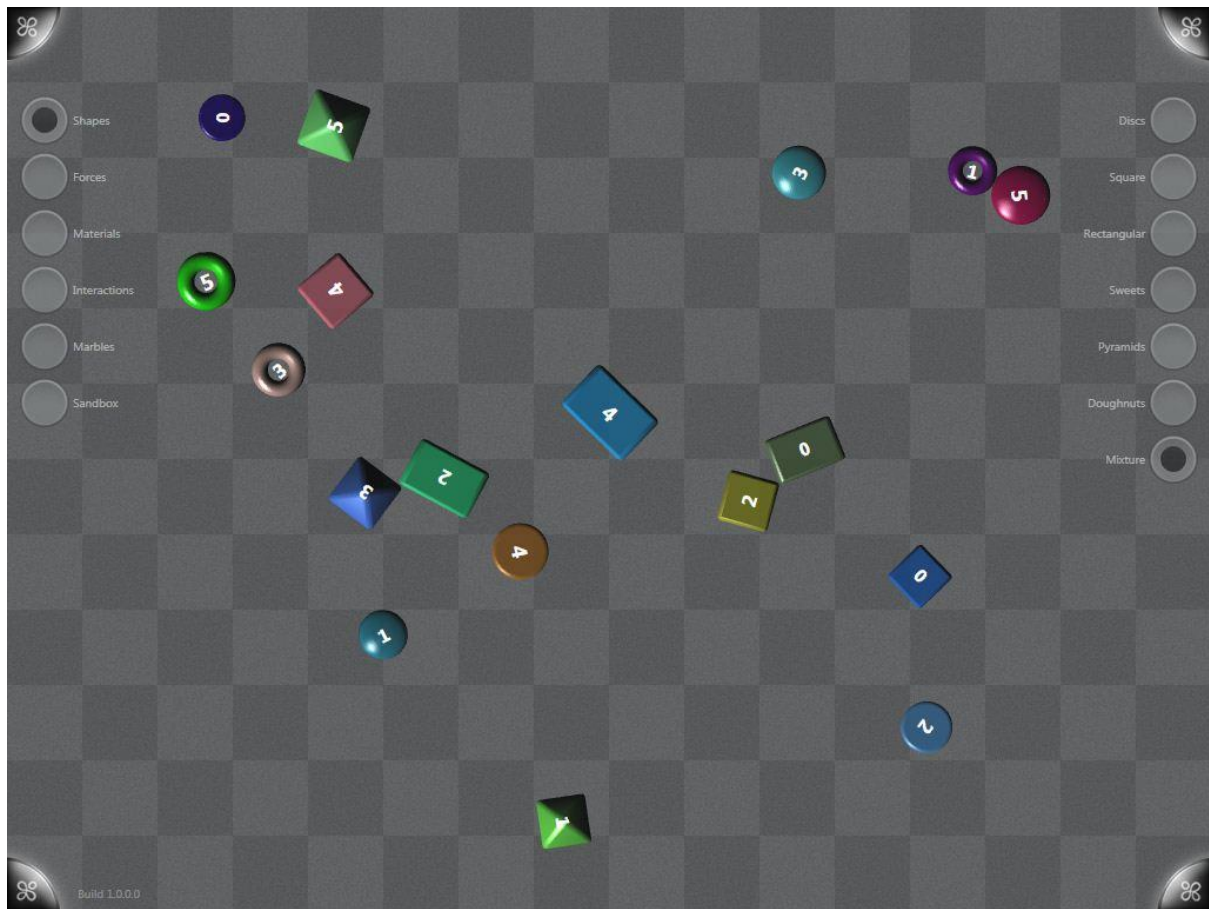


Figure 1 Mixture of shapes

Try the following on the “Shapes” page:

- Select a shape by touching it and then move it around. It will collide with other shapes.
- Select a shape and “Flick” it into other shapes or into a wall. The walls are “soft” and springy.
- Select two shapes with separate hands and “Flick” one into the other. Notice that the selected object gives a little, but springs back into place.

Note the following on the “Shapes” page:

- The size of a shape determines its mass (they all the same density). If a “light” (small) shape is flicked into a “heavy” (large) shape, it bounces back. A “heavy” shape will cause a “light” shape to be knocked away at higher speed.
- Rectangular collisions impart angular momentum, i.e. the objects “spin”, whereas collisions between circular objects do not (there is no friction component).

Materials Page

Windows Presentation Foundation (WPF) supports realistic textures and lighting in 3D, as shown by the “Materials” page in Figure 2 below.

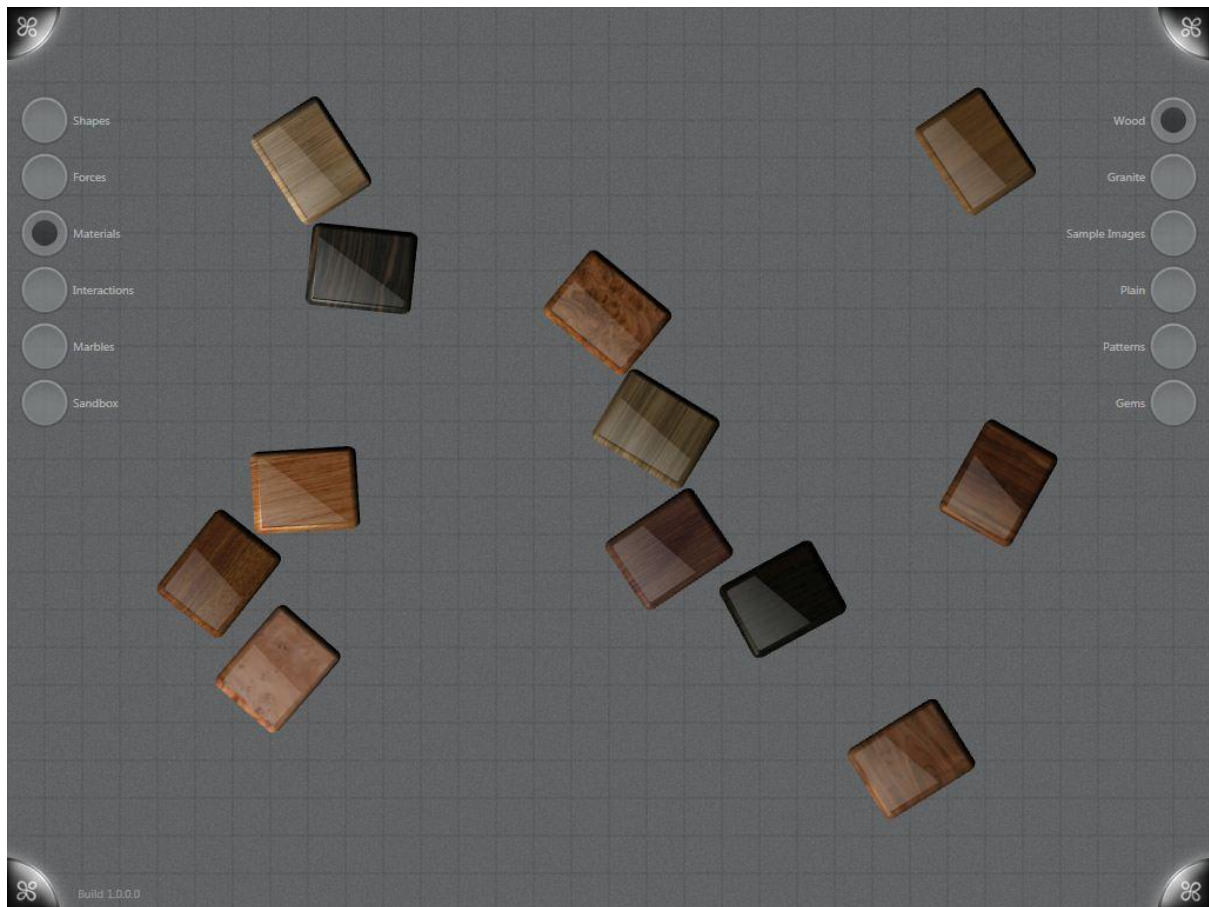


Figure 2 Wooden material

Note the following on the “Materials” page:

- A light source from a consistent direction reflects from the shapes’ edges, and a glossy “sheen” has been added.
- A selection of “patterns” have been added using simple black and white brushes, as shown below in Figure 3.
- A different lighting model is used for the “Gems”. It is possible to alter the direction of the lighting on the “Gems” page. Add a `0xAA` tag (for how to re-configure the tag id or size see the FAQ below). Turn the tag to control the direction of the light, as shown below in Figure 4.

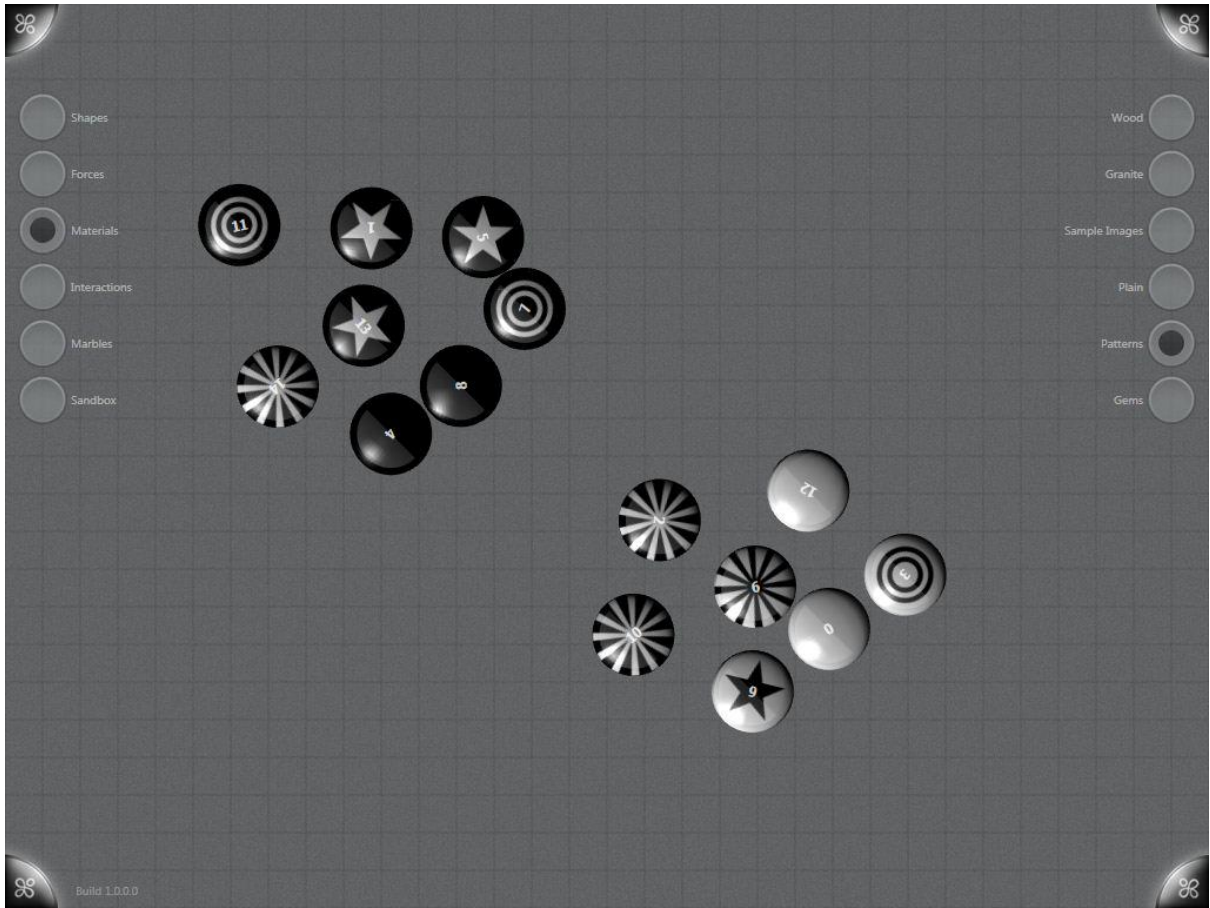


Figure 3 Custom texture patterns

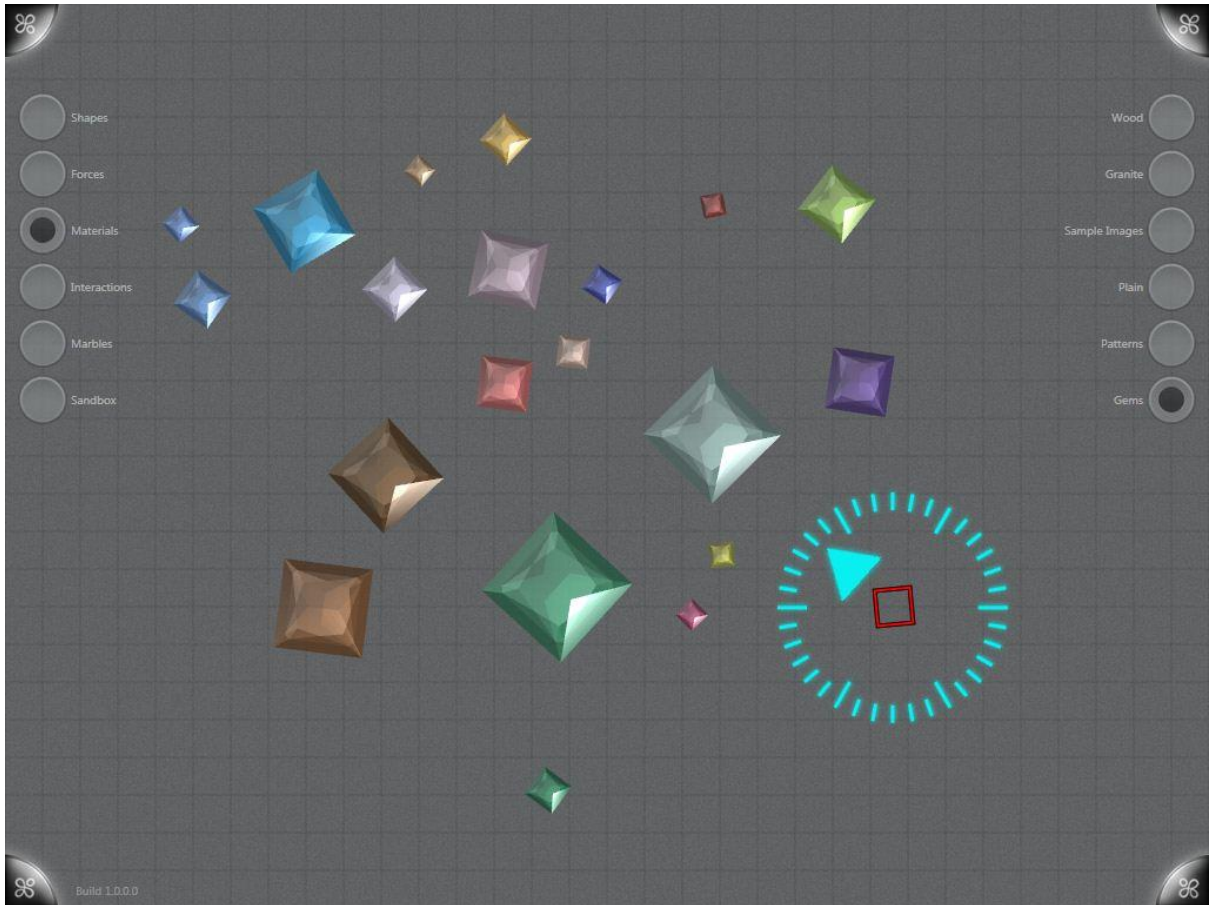


Figure 4 Changing the direction of the light source

Forces Page

Some basic forces have been implemented, such as gravity, as shown in Figure 5 below.

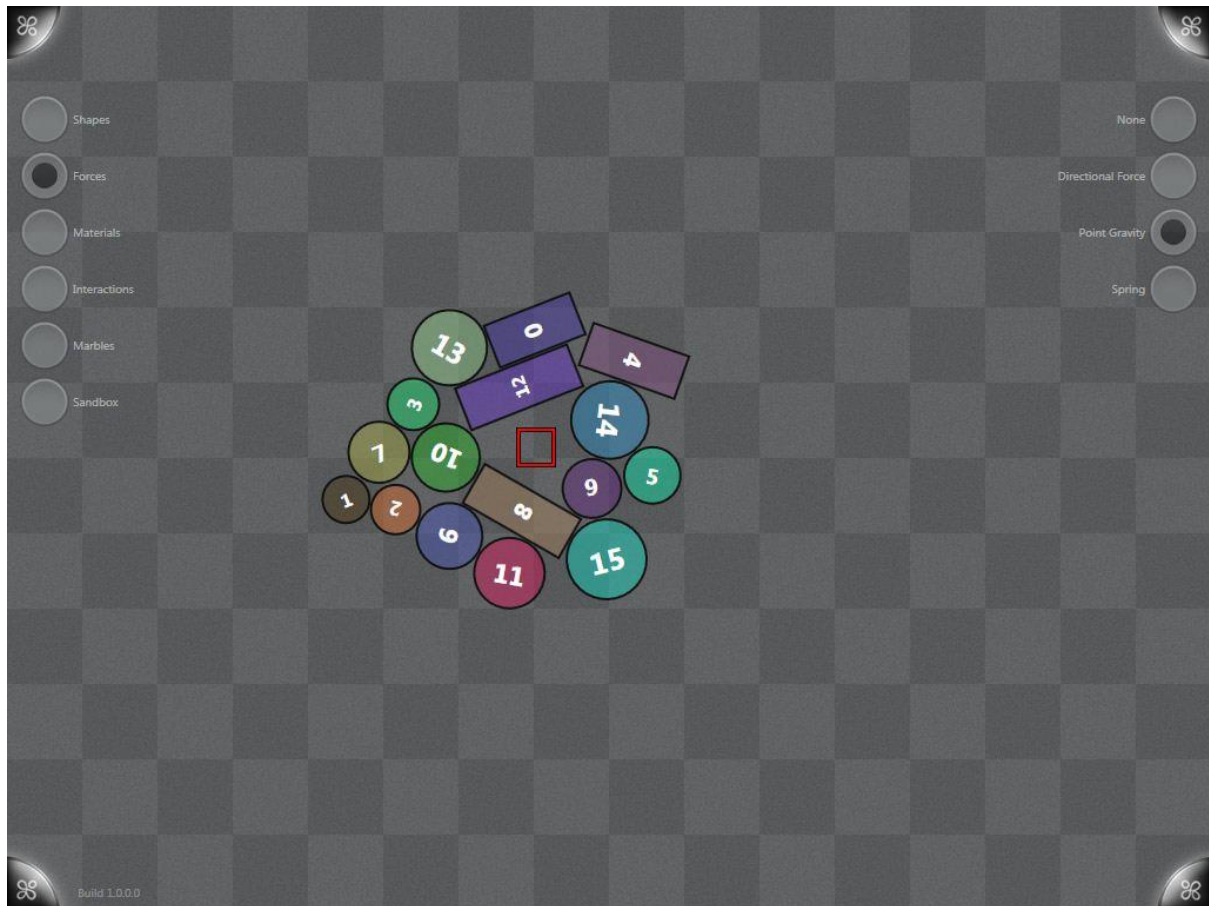


Figure 5 Point gravity tag

Try the following on the “Forces” page:

- Select “None” and add a poker-chip with a 0xEE tag (for how to re-configure the tag id or size see the FAQ below. Items “flicked” at this “Solid” tag will bounce off.
- Select “Directional force” to apply a constant force in a pre-defined direction.
- Select “Point Gravity” and add a poker-chip with a 0xCC tag (for how to re-configure the tag id or size see the FAQ below). Items will be attracted to the tag.
- Select “Directional force” to apply a constant force in a pre-defined direction, and add a 0xAA tag (for how to re-configure the tag id or size see the FAQ below). Turn the tag to control the direction of the force, as shown below in Figure 6.
- Select “Spring” and while selecting one or more items, add a poker-chip with a 0xDD tag (for how to re-configure the tag id or size see the FAQ below). The selected items will be attached to a spring which originates at the tag. Multiple springs can be attached to one or more items, as shown below in Figure 7.

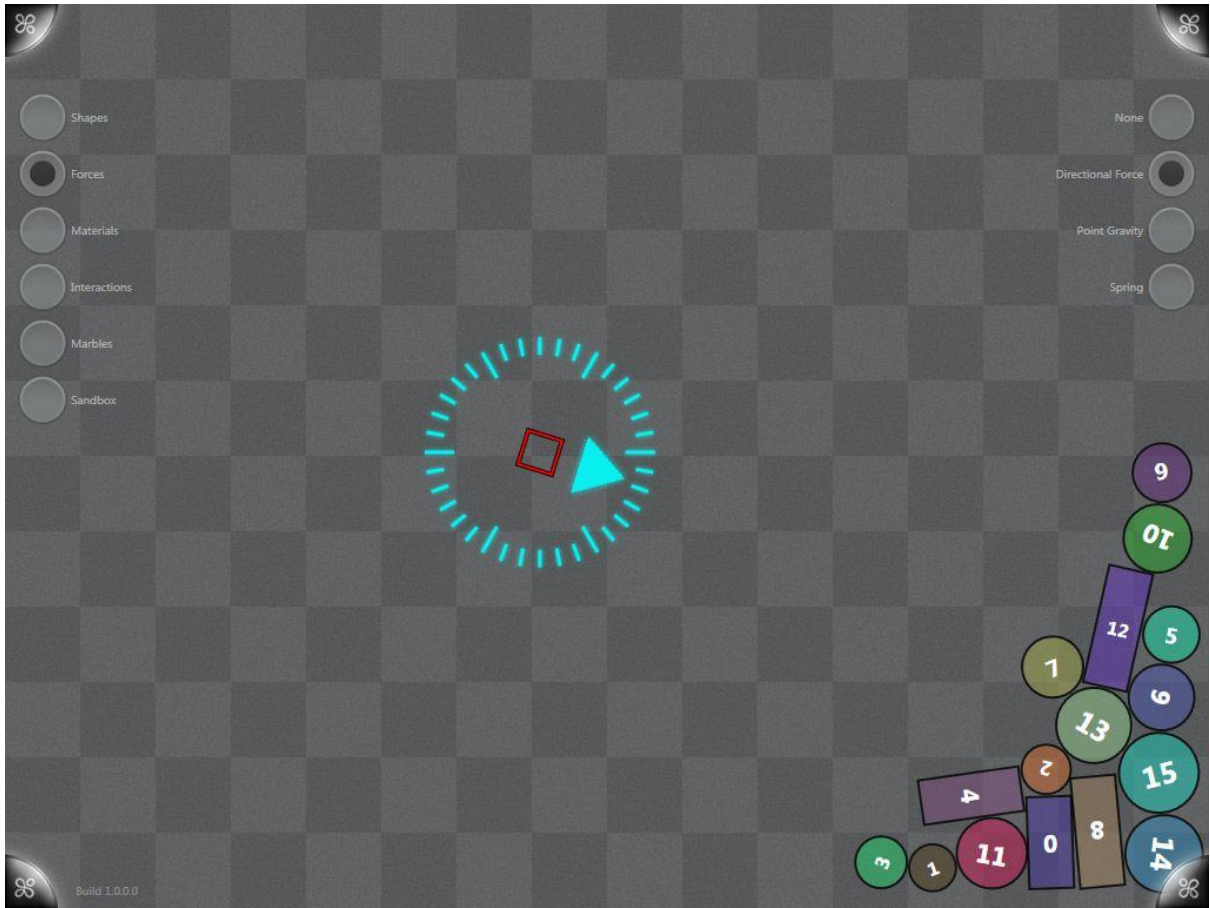


Figure 6 Changing the force direction

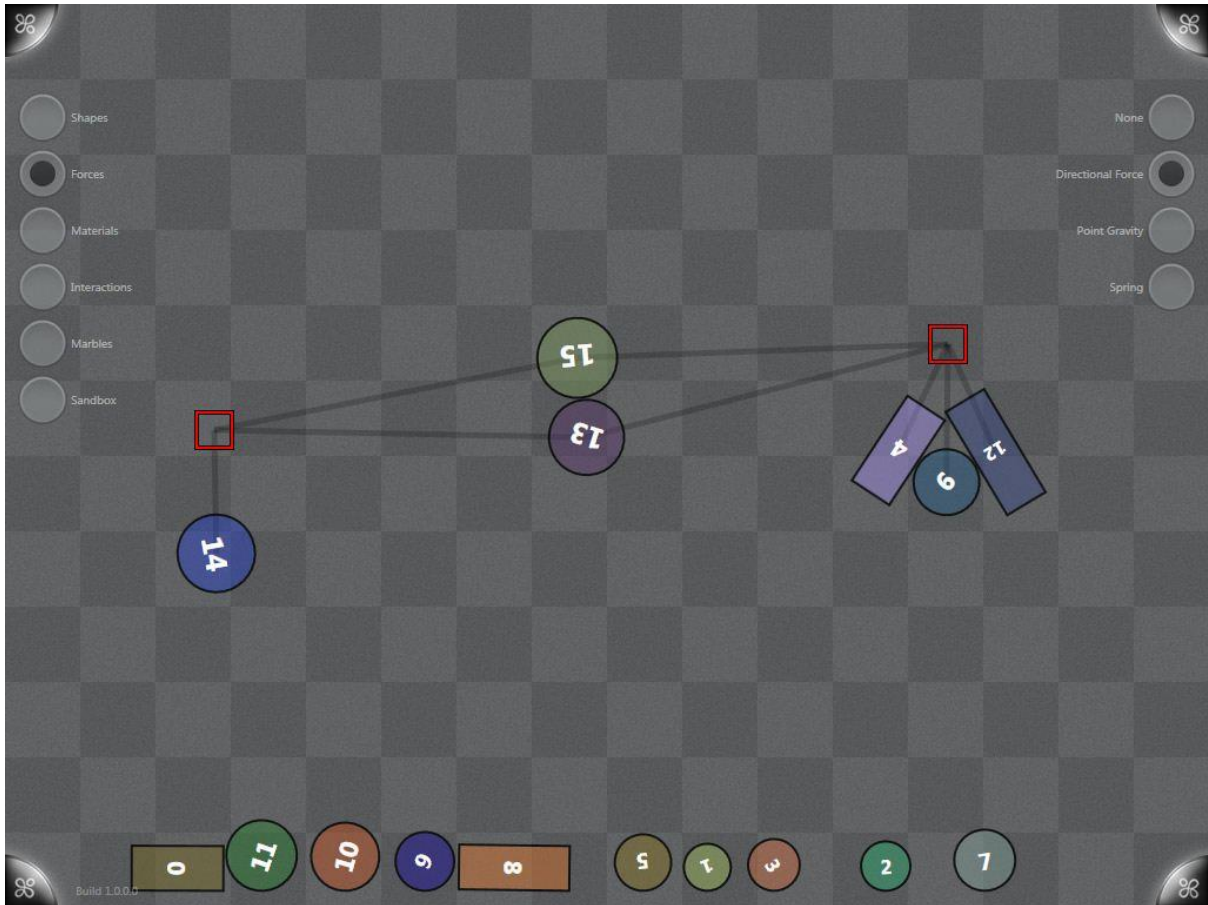


Figure 7 Spring Forces

Note the following on the “Forces” page:

- If a “Point Gravity” tag is left on the Surface for a short period of time, the attracted objects start to rotate around it, with the heavier objects eventually migrating closer to the tag.
- If a “Point Gravity” tag is left on the page and a directional force added, it is possible to attach heavy (larger) objects to the tag. Lighter objects will fall away.
- When “Springs” are used, it is possible to generate some motion feedback. Selecting “None” will maximise the drag to reduce this feedback and dampen the motion of the springs.

Interactions Page

It is possible to interact with the objects on this page, shown in Figure 8 and Figure 9, in a number of ways.

Try the following on the “Interactions” page:

- Select “Fixed” objects to add fixed, randomly positioned shapes. Select “Use Gravity” and see how the shapes bounce off or are held by the fixed shapes.
- Un-check “Fixed Objects” (if checked) and select “Use Gravity”. Place rectangular objects (business cards, for example) on the screen, making sure they do not overlap. Shapes will interact with these objects. Try making a “slide”, or a “funnel”.

- Un-check “Fixed Objects” (if checked) and select “Use Gravity”. Flick a shape away from the force direction, then place your arm across the Surface to block the shape’s return. Remove your arm from the Surface to let the shape fall through.
- Un-check “Fixed Objects” (if checked) and un-check “Use Gravity”. Try “sweeping” the objects using hands or a (straight) reflective, flexible object such as a small white brochure or envelope.

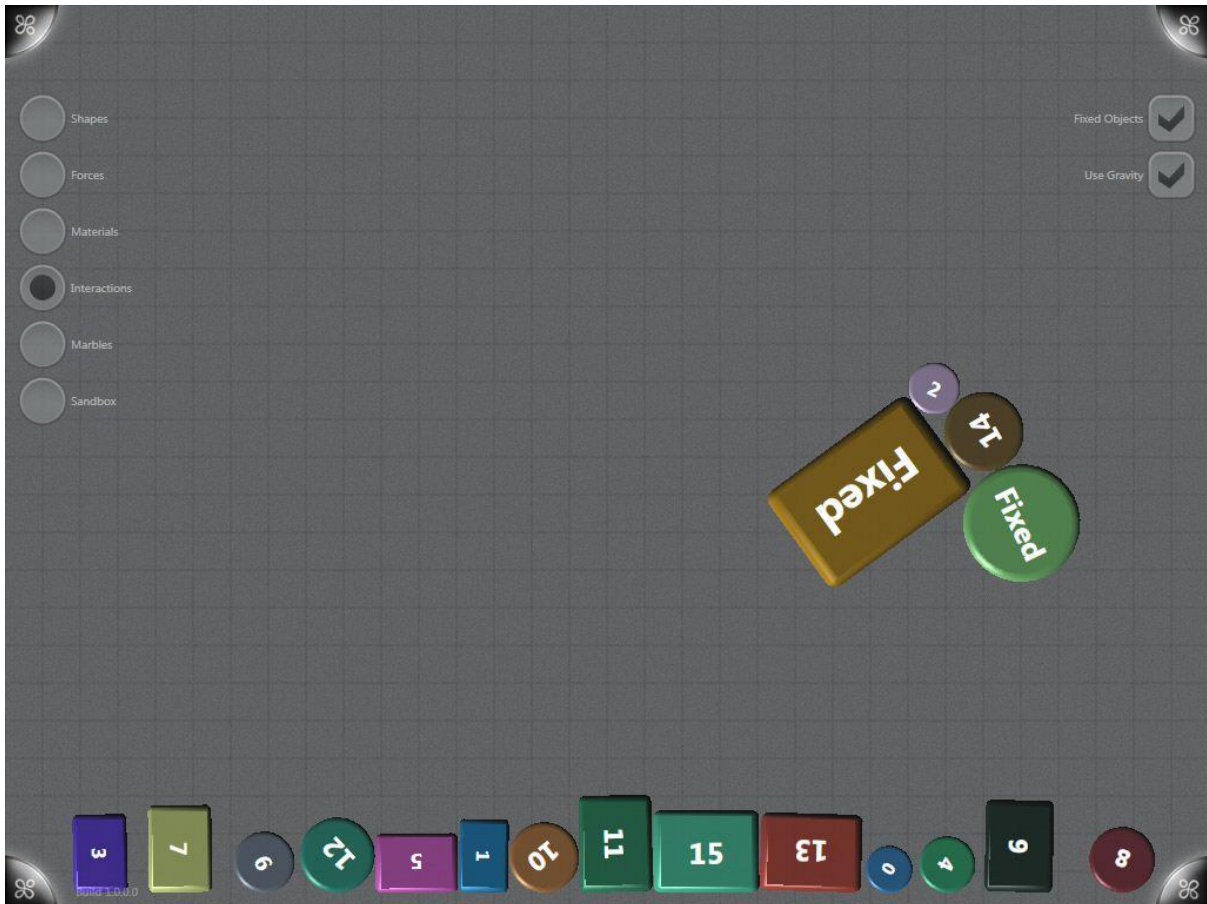


Figure 8 Shapes interacting with “Fixed” shapes

Note the following on the “Interactions” page:

- The “Fixed Objects” checkbox can be un-checked and re-checked if objects they do not appear in a favourable position.
- These interactions are not available on the other pages.
- Only rectangular interactions with non-overlapping blobs are currently supported. Using square, circular blobs or overlapping blobs (or even a “Solid” poker chip tag) will give unpredictable results.
- When using hands, try to keep them straight, as curves are not currently supported in this sample.

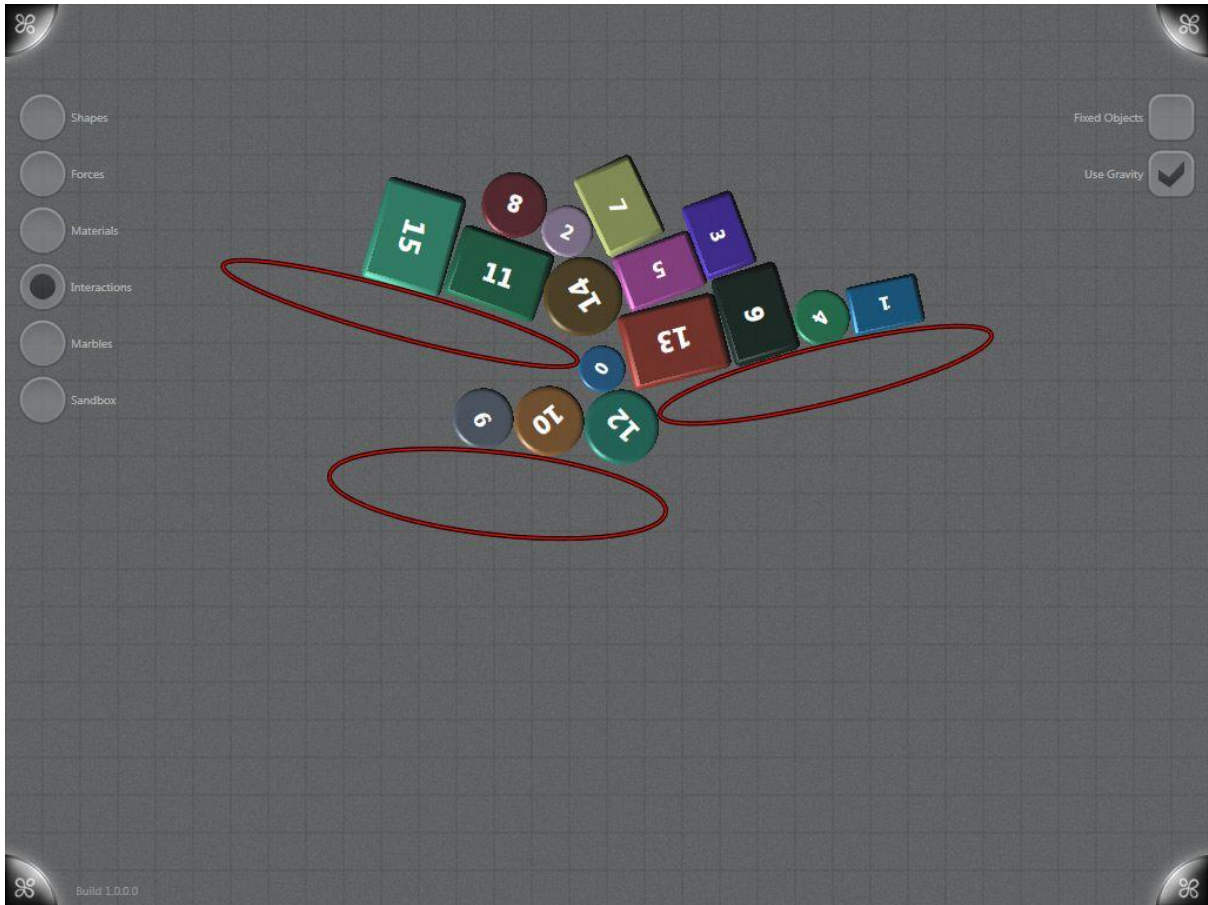


Figure 9 Shapes interacting with Blobs

Marbles Page

The “Marbles” page demonstrates 3D rolling spheres, as shown below in Figure 10. Several different textures have been provided.

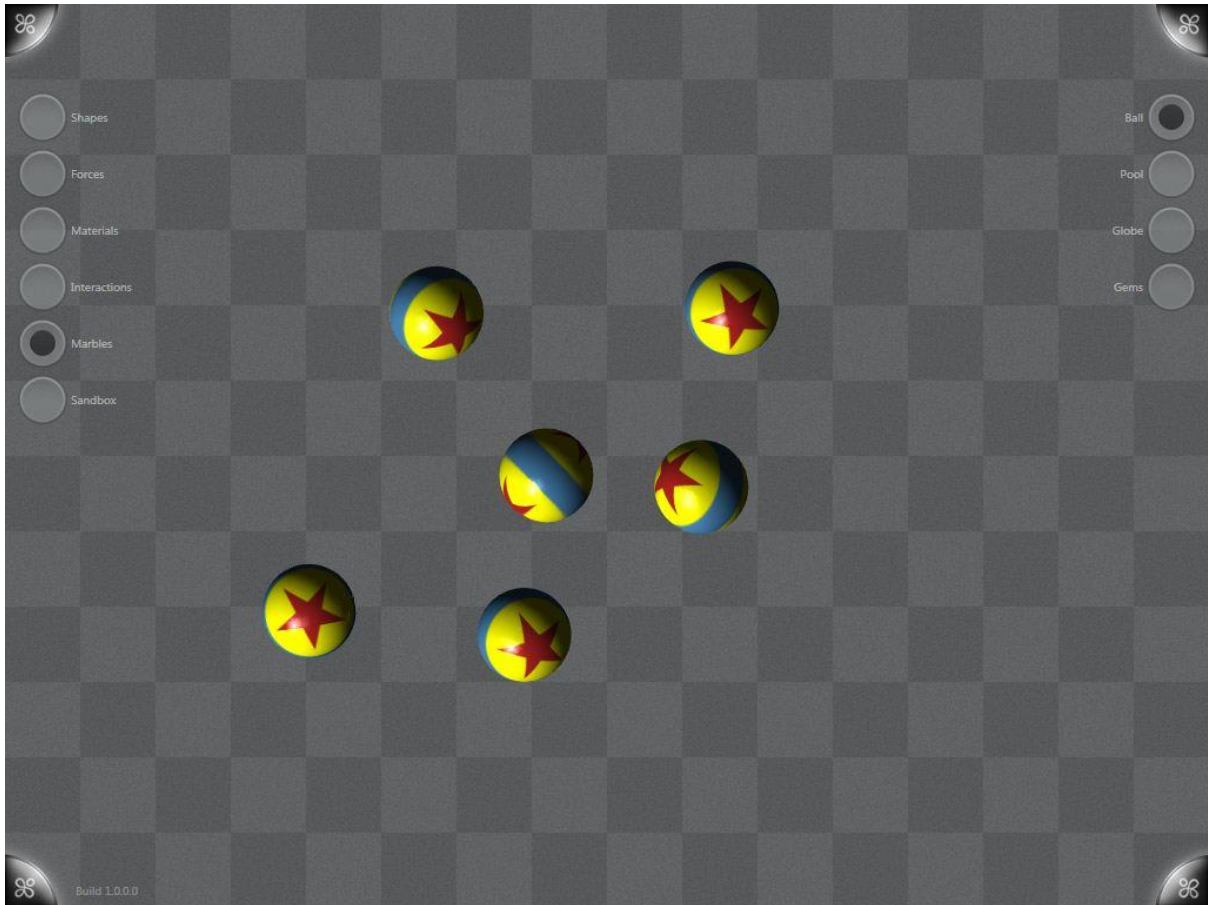


Figure 10 3D Rolling Spheres

Sandbox Page

The “Sandbox” page, shown in Figure 11 below, allows experimentation with just some of the configurable parameters.

Try the following on the “Sandbox” page:

- Play with the “Item Bounce” setting to see how the collisions are affected.
- Enable “Play Sound” and flick items into one another.

Note the following on the “Sandbox” page:

- To reset the settings to their default values, navigate away and back to the “Sandbox” page.

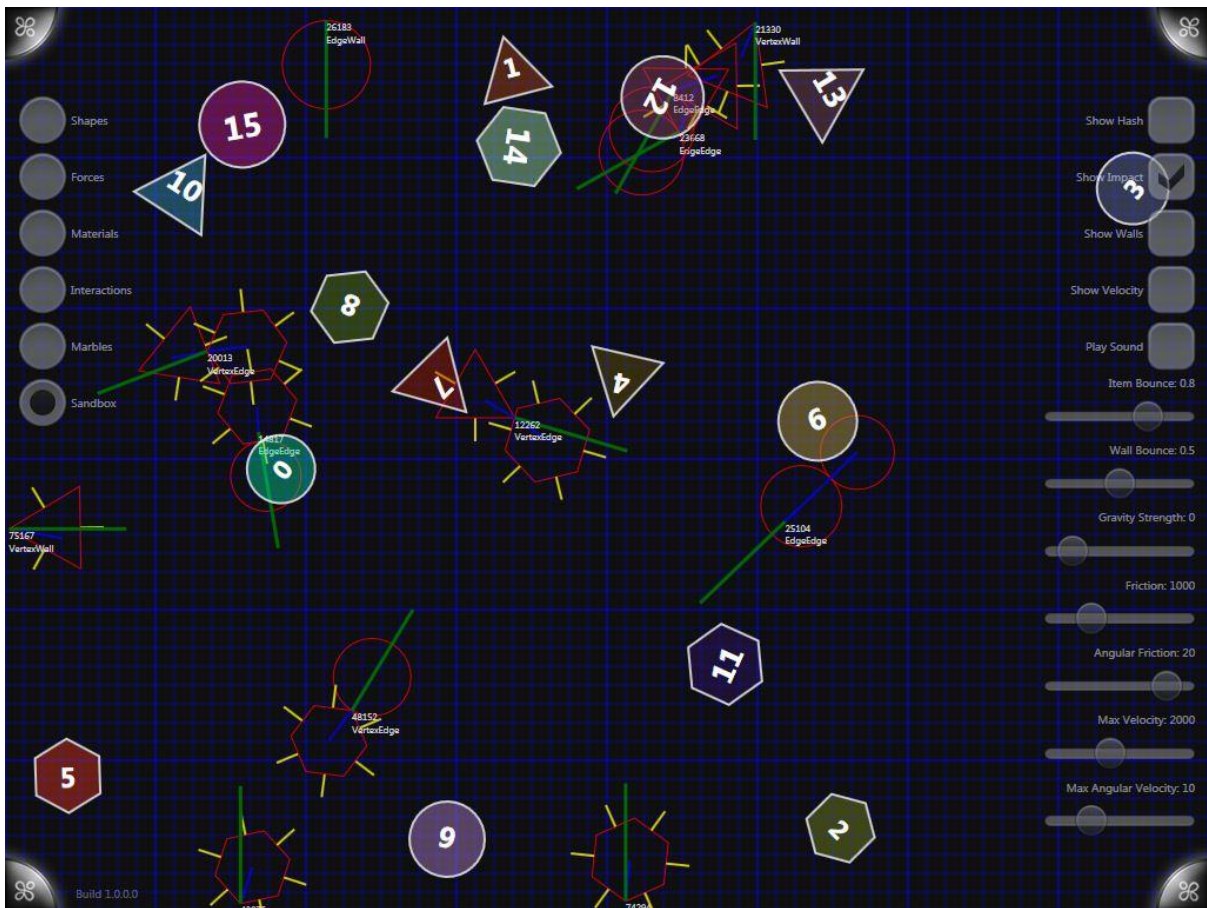


Figure 11 Sandbox page

Bugs

- It is currently possible to “nudge” a “fixed” object on the interactions page.
- If multiple tags are left on the Surface and the page is changed, the application may throw an exception. It is recommended that tags be removed before changing pages

Acknowledgements

The image of the earth is courtesy NASA/JPL-Caltech.

FAQ

How do I change the tag for controlling force or light direction?

Edit the `app.config` file and change the “DialTagId” to the decimal value of the tag. The tag used should be circular, and its width entered (in mm) into the “DialDiameterMm” setting.

```
<add key="DialTagId" value="170" /><!-- 0xAA -->
<add key="DialDiameterMm" value="39" />
```

How do I change the tag for a “Point Gravity” source on the forces page?

Edit the `app.config` file and change the “AttractorTagId” to the decimal value of the tag. The tag used should be circular, and its width entered (in mm) into the “AttractorDiameterMm” setting.

```
<add key="AttractorTagId" value="204" /><!-- 0xCC -->  
<add key="AttractorDiameterMm" value="39" />
```

How do I change the tag for a “Spring” source on the forces page?

Edit the `app.config` file and change the “SpringTagId” to the decimal value of the tag. The tag used should be circular, and its width entered (in mm) into the “SpringDiameterMm” setting.

```
<add key="SpringTagId" value="221" /><!-- 0xDD -->  
<add key="SpringDiameterMm" value="39" />
```

How do I change the tag for a “Solid Object” on the forces page?

Edit the `app.config` file and change the “SolidTagId” to the decimal value of the tag. The tag used should be circular, and its width entered (in mm) into the “SolidDiameterMm” setting.

```
<add key="SolidTagId" value="238" /><!-- 0xEE -->  
<add key="SolidDiameterMm" value="39" />
```

Appendix

Tag Stickers

