5.6.1 Modeling - Metas - Introduction

Metas

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Introduction

Reference
Mode: *Object* or *Edit* modes Menu: Add ‣ Meta Hotkey: `Shift-A`

Meta objects are *implicit surfaces*, meaning that they are *not explicitly* defined by vertices (as meshes are) or

control points (as surfaces are): they exist *procedurally.* Meta objects are literally mathematical formulas that are calculated on-the-fly by Blender.

A very distinct visual characteristic of metas is that they are fluid *mercurial*, or *clay-like* forms that have a “rounded” shape. Furthermore, when two meta objects get close to one another, they begin to interact with one another. They “blend” or “merge”, as water droplets do, especially in zero-g (which, by the way, makes them very handy for modeling streams of water when you don’t want to do a fluid simulation). If they subsequently move away from one another, they restore their original shape.

Each of these is defined by its own underlying mathematical structure (Technical Details), and you can at any time switch between them using the *Active Element* panel.

Typically *Meta* objects are used for special effects or as a basis for modeling. For example, you could use a collection of metas to form the initial shape of your model and then convert it to another object type (well, only meshes are available...) for further modeling. Meta objects are also very efficient for ray-tracing.

Note that *Meta* objects have a slightly different behavior in *Object* mode.

Primitives

There are five predefined meta “primitives” (or configurations) available in the Add ‣ Meta sub-menu:

Meta Ball
: adds a meta with a point underlying structure.

Meta Tube
: adds a meta with a line segment underlying structure.

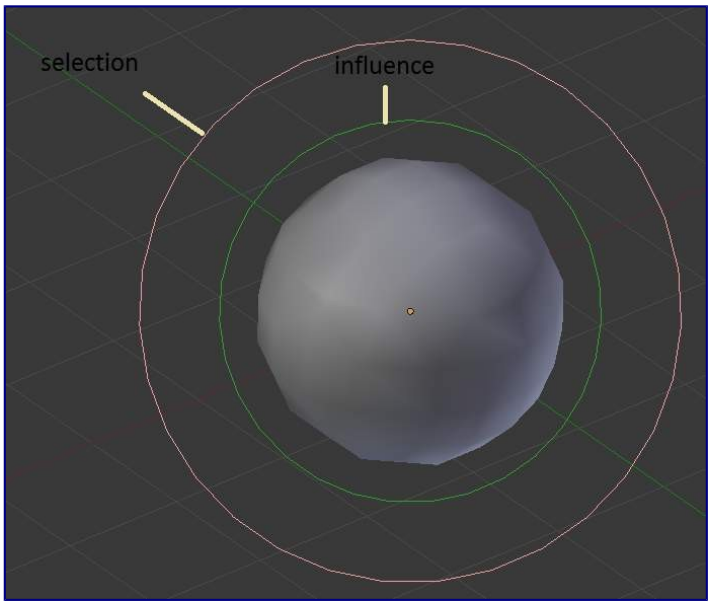
Meta Plane
: adds a meta with a planar underlying structure.

Meta Ellipsoid
: adds a meta with an ellipsoidal underlying structure.

Meta Cube
: adds a meta with a volumetric cubic underlying structure.

Visualization

In Object mode, the calculated mesh is shown, along with a black “selection ring” (becoming pink when selected).

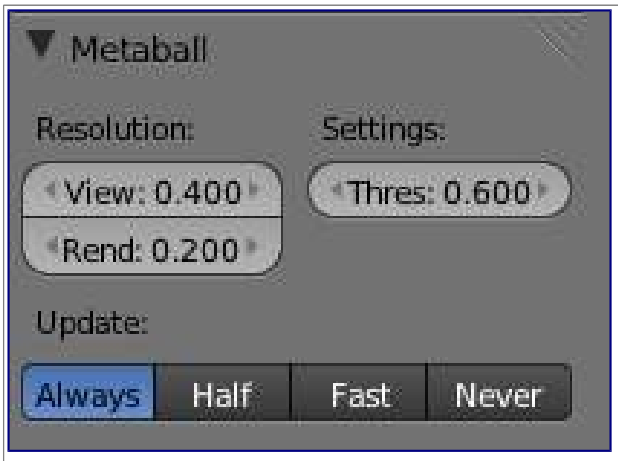


Meta Ball example.

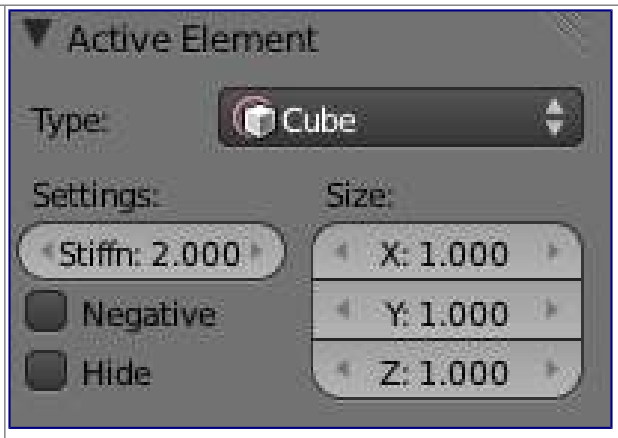
In *Edit* mode (*Meta Ball example*), a meta is drawn as a mesh (either shaded or as black wireframe, but without any vertex of course), with two colored circles: a red one for selection (pink when selected), and a green one for a direct control of the meta's stiffness (light green when active). Note that except for the *Scale* (S) transformation, having the green circle highlighted is equivalent to having the red one.

Meta Ball Options

All Meta objects in a scene interact with each other. The settings in the *MetaBall* section apply to all meta objects. In *Edit* mode, the *Active Element* panel appears for editing individual meta elements.



global meta properties.



individual meta properties.

Resolution

The *Resolution* controls the resolution of the resultant mesh as generated by the

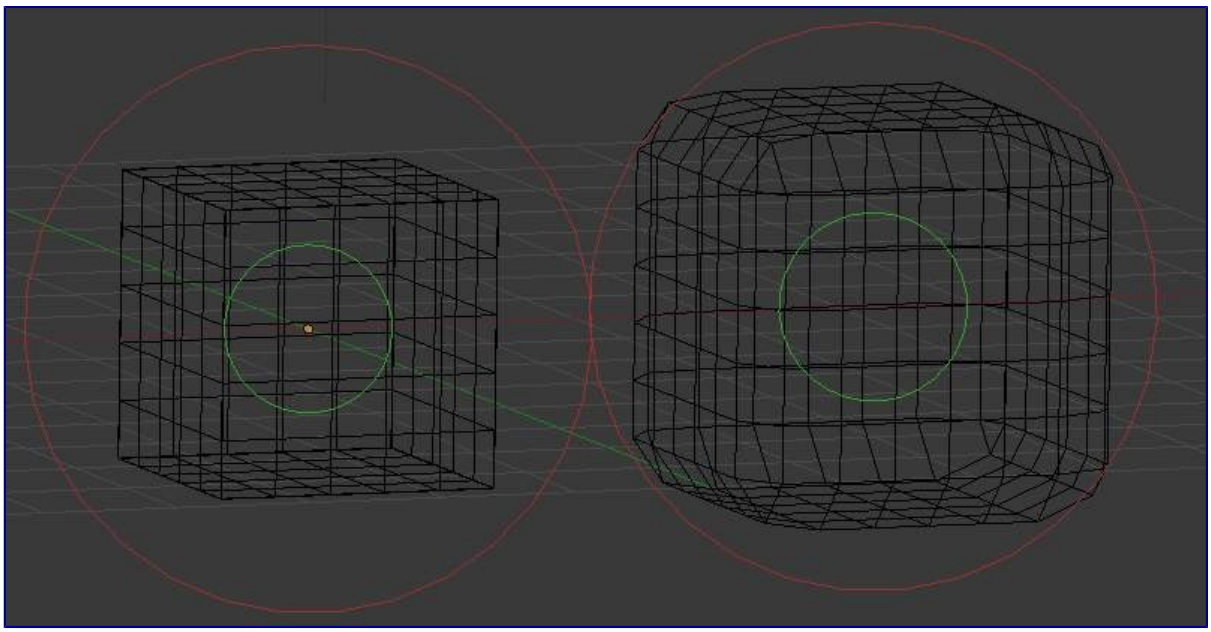
Meta
: object.

View
: The 3D View resolution of the generated mesh. The range is from **0.05** (finest) to **1.0** (coarsest).

Render

The rendered resolution of the generated mesh. The range is from **0.05** (finest) to **1.0** (coarsest).

One way to see the underlying mathematical structure is to lower the *Resolution*, increase the *Threshold* and set the *Stiffness* (see below) a fraction above the *Threshold*. (*Underlying structure*) is a (*Meta cube*) with the above mentioned configuration applied as follows: *Resolution* of **0.410**, *Threshold* of **5.0** and *Stiffness* a fraction above at **5.01**.



Left: Underlying structure, Right: the shape.

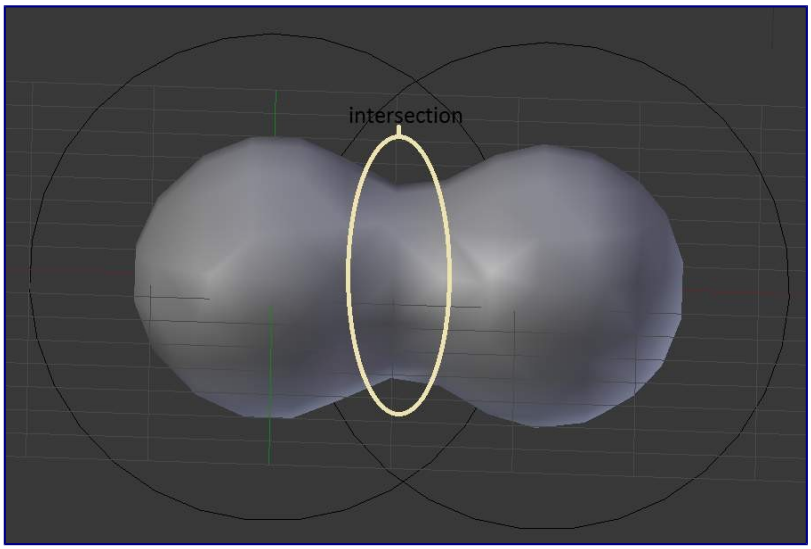
You can clearly see the underlying cubic structure that gives the meta cube its shape.

Threshold (Influence)

Reference
Mode: *Object* or *Edit* modes Panel: *MetaBall* (*Editing* context)

Threshold defines how much a meta's surface "influences" other metas. It controls the *field level* at which the surface is computed. The setting is global to a group of *Meta* objects. As the threshold increases, the influence that each meta has on each other increases.

There are two types of influence: **positive** or **negative**. The type can be toggled on the *Active Element* panel while in *Edit* mode, using the *Negative* button. You could think of **positive** as attraction and **negative** as repulsion of meshes. A negative meta will push away or repel the meshes of positive *Meta* objects.



Positive.

A *positive* influence is defined as an attraction, meaning the meshes will stretch towards each other as the *rings of influence* intersect. (*Positive*) shows two meta balls' *rings of influence* intersecting with a *positive* influence.

Notice how the meshes have pulled towards one another. The area circled in white shows the green *influence* rings intersecting.

Update

While transforming metas (grab/move, scale, etc.), you have four "modes" of visualization, located in the *Update* buttons group of the *MetaBall* panel:

Always
: fully draw the meta during transformations.

Half Res
: During transformations, draw the meta at half its *Wiresize* resolution.

Fast
: Do not show meta mesh during transformations.

Never
: Never show meta mesh (not a very recommended option, as the meta is only visible at render time!).

This should help you if you experience difficulties (metas are quite compute-intensive...), but with modern computers, this shouldn't happen, unless you use many metas, or very high resolutions...

Meta Structure

Technical Details

A more formal definition of a meta object can be given as a *directing structure* which can be seen as the source of a static field. The field can be either positive or negative and hence the field generated by neighboring directing structures can attract or repel.

The implicit surface is defined as the surface where the 3D field generated by all the directing structures assume a given value. For example a meta ball, whose directing structure is a point, generates an isotropic (i.e. identical in all directions) field around it and the surfaces at constant field value are spheres centered at the directing

point.

Meta objects are nothing more than mathematical formulae that perform logical operations on one another (AND, OR), and that can be added and subtracted from each other. This method is also called **Constructive Solid Geometry** (CSG). Because of its mathematical nature, CSG uses little memory, but requires lots of processing power to compute.

Underlying Structure

Reference
Mode: *Edit* mode Panel: *MetaBall tools* (*Editing* context), *Transform Properties*

Blender has five types of metas, each determined by its underlying (or directing) structure. In *Edit* mode, you can change this structure, either using the relevant buttons in the *MetaBall tools* panel, or the drop-down list in the *Transform Properties* panel (`N`). Depending on the structure, you might have additional parameters, located in both *Transform Properties* and *MetaBall tools* panels.

Ball (point, zero-dimensional structure)
: This is the simplest meta, without any additional setting. As it is just a point, it generates an isotropic field, yielding a spherical surface (this is why it is called *Meta Ball* or *Ball* in Blender).

Tube (straight line, uni-dimensional structure)

This is a meta which surface is generated by the field produced by a straight line of a given length. This gives a cylindrical surface, with rounded closed ends. It has one additional parameter:

dx
: The length of the line (and hence of the tube - defaults to **1.0**).

Plane (rectangular plane, bi-dimensional structure)

This is a meta which surface is generated by the field produced by a rectangular plane. This gives a parallelepipedal surface, with a fixed thickness, and rounded borders. It has two additional parameters:

dx, dy
: The length, width of the rectangle (defaults to **1.0**).

Note that by default, the plane is a square.

Elipsoid (ellipsoidal volume, tri-dimensional structure)

This is a meta which surface is generated by the field produced by an ellipsoidal volume. This gives an ellipsoidal surface. It has three additional parameters:

dx, dy, dz
: The length, width, height of the ellipsoid (defaults to **1.0**).

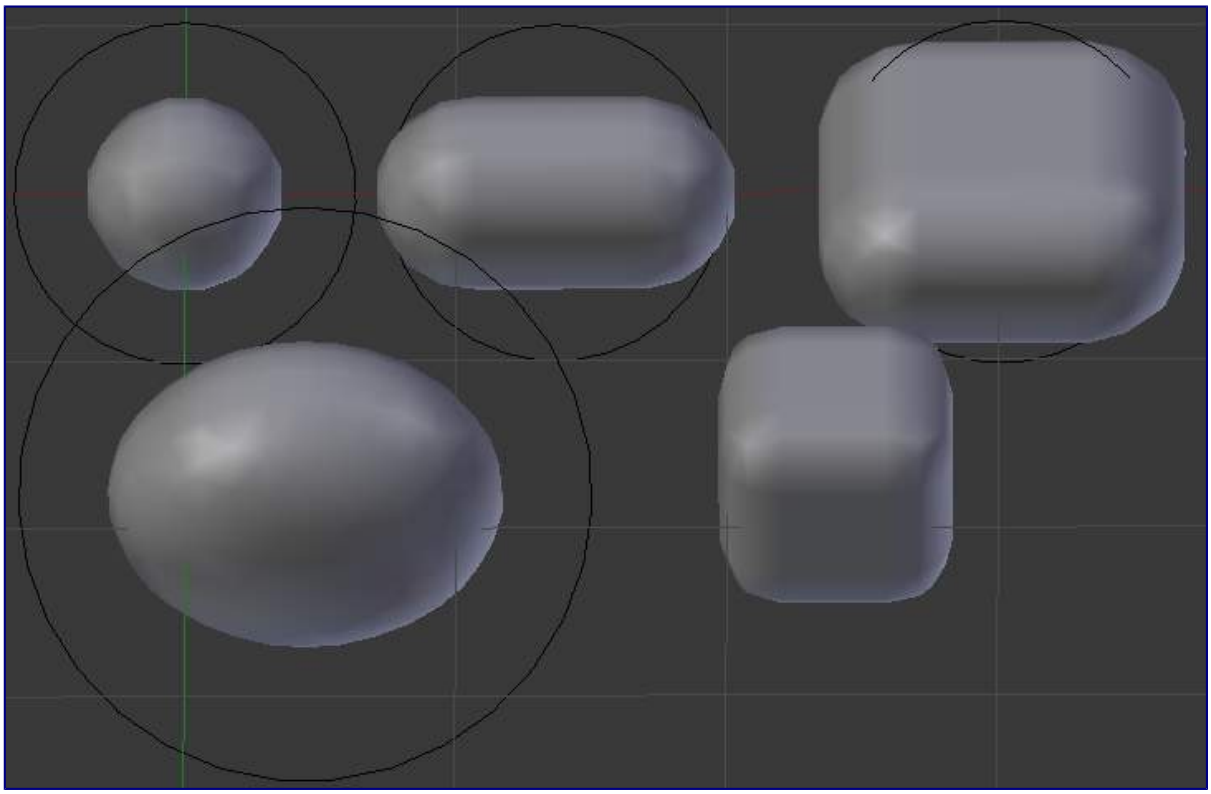
Note that by default, the volume is a sphere, producing a spherical meta, as the *Ball* option...

Cube (parallelepipedal volume, tri-dimensional structure)

This is a meta which surface is generated by the field produced by a parallelepipedal volume. This gives a parallelepipedal surface, with rounded edges. As you might have guessed, it has three additional parameters:

dx, dy, dz
The length, width, height of the parallelepiped (defaults to **1.0**).

Note that by default, the volume is a cube.



the 5 meta primitives.