

## Rubber Bones

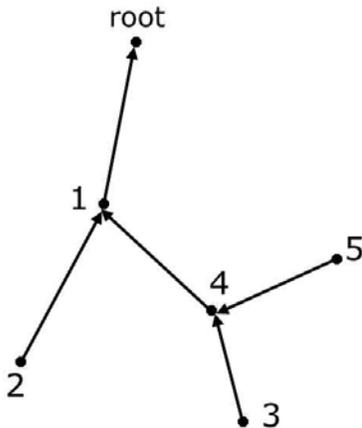
This tool facilitates an elastic type of deformation to all selected vertices using the bones of the skeleton to seed that deformation. A good analogy is the idea of the bones in the skeleton being a set of magnets pulling the model's surface with them as they move around.

The Rubber Bones tool can also be used to set up **Skinning Weights** for Skeletal/Robot actors. (See below)

The Shift, Ctrl, and Alt keys modify the behaviour of the tool.

The default action of the tool is that of *click on a node at the end of a bone and drag it*.

The Skeleton uses a parent-child hierarchy between the bones and nodes, with one of the nodes being described as the Root node. The Root node is the only node without a bone or a parent:



Here, the root node has one child (node 1) Node 1's parent is the root node and node 1 has two children, (nodes 2 and 4.) Node 1 is the parent of nodes 2 and 4. Node 2's parent is node 1. Node 3's parent is node 4. Node 5's parent is also node 4.

All the node hierarchies can be traced back to the root node. The ancestors of node 3 are, 4,1,root. Those of node 2 are 1,root.

The modifier keys change the default behaviour in the following way.

### Shift Key

Holding down the **shift key** while moving one of the bone nodes causes all descendent nodes to move by the same amount as the node being moved. For example in the diagram above if node 1 is moved then nodes 2,4,3,5 also move by the same displacement. If node 4 is moved then nodes 3 and 5 also move.

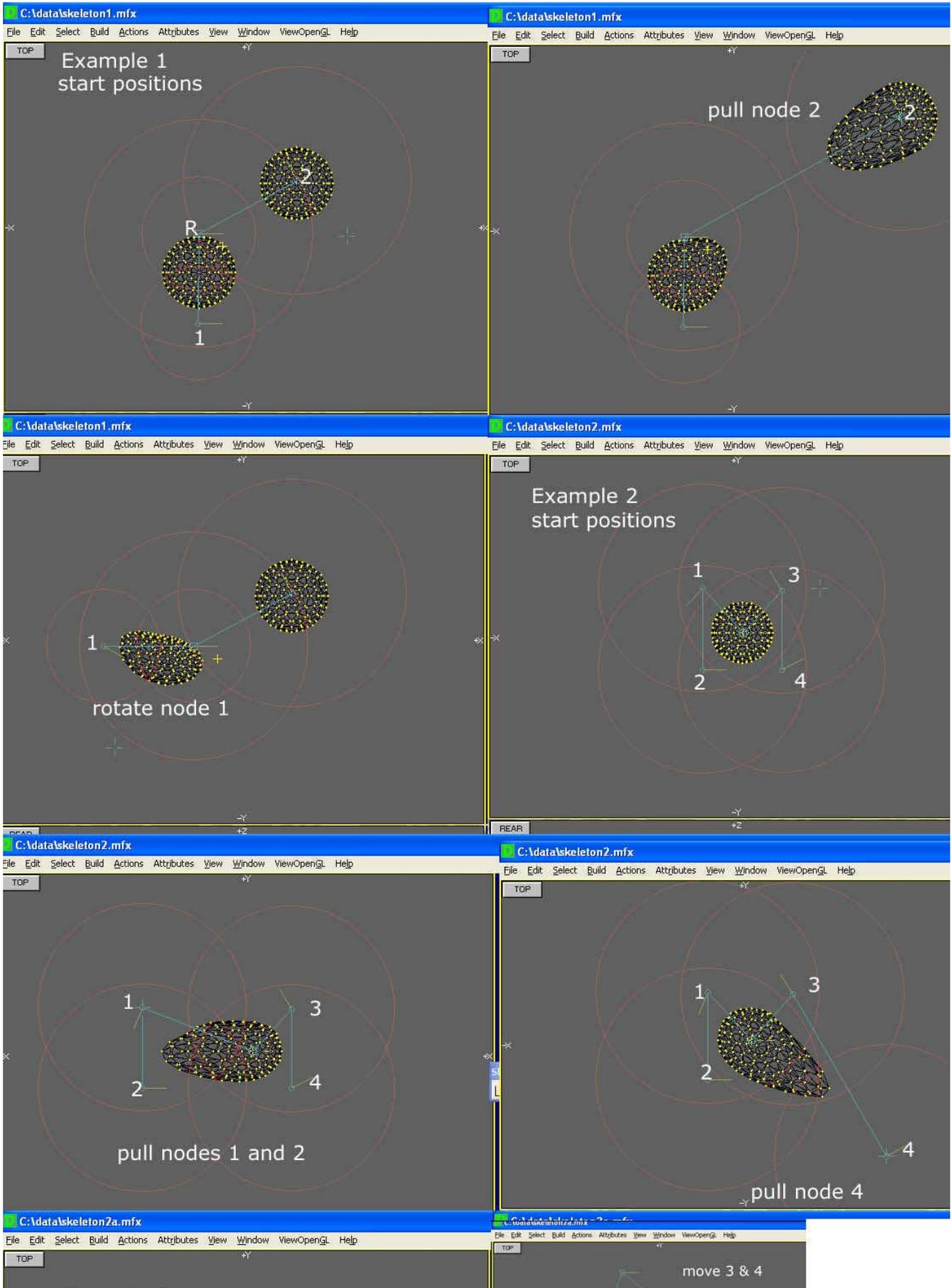
### Ctrl Key

Holding down the **Ctrl key** while moving one of the bones also causes the parent of that bone to move by the same amount. For example, if node 2 is moved then node 1 also moves. If node 4 is moved then node 1 also moves.

### Alt Key

Holding down the **Alt key** while moving the mouse causes the bone (and all its descendants) to rotate around the parent location. The rotation takes place around the normal to the plane of the view. Thus, clicking and dragging in the Top window causes rotation around the vertical Z axis. For example if node 4 is moved then nodes 4,3, and 5 rotate around node 1. All the bones maintain their original length.

The effect that the use of this tool has on the vertices will depend on how they are positioned relative to the bones.



This diagram shows three examples.

1. Two spheres and two bones. The extent of the range is shown for each bone, this is drawn as a radius around each end of the bone. The range of bone 1 extends over the whole of sphere 1 but does not influence sphere 2. The range of bone 2 is larger and does extend to cover the sphere around bone 1. When bone 2 is elongated (by moving node 2) there is a small distortion of the top part of the sphere around bone 1. When we rotate bone 1, the sphere around it is distorted but the influence does not affect the sphere at the end of bone 2 as it is too far away.
2. In this example we see the effect of distorting a sphere when all vertices lies within the range of all the bones.
3. Example 2a is a variation of example 2, where the bone joining nodes 3 and 4 lies too far away from the vertices in the sphere to influence it. The result of moving vertices 1&2 and 3&4 together is illustrated. (Moving 3&4 has no effect) Moving 1&2 causes an 'on-block' move of the the vertices because all those bones influencing the vertices move by the same amount at the same time.

### Mesh Skinning:

The rubber bone settings can also be used for mesh skinning. Thus its use depends on wether it is to be used for local deformation in the Designer or used in Robot (Skeleton) skinning by the renderer.

#### Meaning 1) For use only within the Modeller.

Here: Each bone has a degree of 'Pull' towards it - this is the **Weight** (0 -> 1). The bone's pull extends over a Range of influence - this is the **Range**. The bone's pull decreases linearly to zero over the **Zone** distance beyond the 'Range' until it fades to zero influence.

In the modeller the units given in the Range and Zone are in current Units.

#### Meaning 2) For use with a Robot actor with automatic skinning.

Here: The **Weight** defines how much influence the bone (to which a vertex is assigned) exerts at its end. Thus if a bone has a weight of 1 then vertices attached to that vertex are NOT influenced at all by any parent or child bones. A weight of 0.5 means that any vertex at either end of the bone is influenced equally by the adjacent bones. A weight of 0.0 means that any vertex at the ends of the bone are moved as if they were part of a parent or child bone. (Note that for skinning purposes onlp parent and child bones will influence a bone (even if there are nearer bones in a different part of the skeleton.)

The **Range** parameter sets how much of bone is influenced by its adjacent parent.) A value of 0.24 means that any vertex in the last 1/4 of the bone will be influenced by the parent bone.

The **Zone** parameter sets how much of the bone is influenced by its adacent child bones. (Note there can be more than one child bones - the average of their influence is taken - but there can be only one parent.

When Skinning in the renderer the Range and Zone parameters are specified as a % of the length of the bone.