signal to the host computer **14**. A scroll wheel can also be include to provide additional input to the host computer.

[**0043**] Device **12** includes an actuator assembly **54**, and the actuator assembly includes an actuator **66** and a flexure mechanism ("flexure") **68** coupled to the actuator **66** by the flexure **68**. In the described embodiment, the actuator **66** acts as an inertial mass, so that a separate inertial mass is not required; this is described in greater detail with respect to **FIG. 3**. The actuator acting as inertial mass is oscillated in a linear direction by the actuator **66**, such as approximately along the z-axis **51** which is approximately perpendicular to the planar workspace of the mouse in the x- and y-axes. The actuator is coupled to the housing **50** of the mouse such that inertial forces caused by the motion of the inertial mass are applied to the housing of the mouse, thereby conveying haptic feedback such as tactile sensations to the user of the mouse who is contacting the housing. These type of tactile sensations are different from kinesthetic haptic sensations, which are caused by the user directly contacting a moved (forced) object without a compliant flexure between the user and object. The mouse device can apply inertial forces substantially along the z axis, orthogonal to the planar x and y axes of the mouse controller.

[**0044**] Many types of actuators can be used, such as DC motors, a moving magnet actuator, a stepper motor, a pneumatic/hydraulic actuator, a torquer (motor with limited angular range), shape memory alloy material (wire, plate, etc.), a piezo-electric actuator, etc. In other embodiments, a linear force can be output using a linearly moving element, as in a voice coil actuator or a linear moving-magnet actuator, which are suitable for high bandwidth actuation. These embodiments are described in greater detail in U.S. Pat. No. 6,211,861, which is incorporated herein by reference. A variety of tactile sensations can be output to the user, many of which are described in greater detail in copending application Ser. No. 09/585,741, incorporated herein by reference.

[**0045**] A flexible or semi-flexible surface can be provided between the mouse and the ground surface, such as a standard mouse pad, a layer of rubber provided on the underside of the mouse or between portions of the mouse housing, etc. This type of flexible surface increases the transmissibility of the inertial forces from the actuator to the housing. In handheld device embodiments such as gamepads, no such flexible surface or layer is required.

[**0046**] **FIG. 3** is a perspective view of one embodiment **100** of the actuator assembly **50** for use in the remote control **12**. Actuator assembly **100** includes a grounded flexure **120** and an actuator **110** coupled to the flexure **120**. The flexure **120** can be a single, unitary piece made of a material such as polypropylene plastic ("living hinge" material) or other flexible material. Flexure **120** can be grounded to the housing of the device**12**, for example, at portion **121**.

[**0047**] Actuator **110** is shown coupled to the flexure **120**. The housing of the actuator is coupled to a receptacle portion **122** of the flexure **120** which houses the actuator **110** as shown. A rotating shaft **124** of the actuator is coupled to the flexure **120** in a bore **125** of the flexure **120** and is rigidly coupled to a central rotating member **130**. The rotating shaft **124** of the actuator is rotated about an axis B which also rotates member **130** about axis B. Rotating member **130** is coupled to a first portion **132***a* of an angled member **131** by a flex joint **134**. The flex joint **134** preferably is made very thin in the dimension it is to flex so that the flex joint **134** will bend when the rotating portion **130** moves the first portion **132***a* approximately linearly. The first portion **132***a* is coupled to the grounded portion **140** of the flexure by a flex joint **138** and the first portion **132***a* is coupled to a second portion **132***b* of the angled member by flex joint **142**. The second portion **132***b*, in turn, is coupled at its other end to the receptacle portion **122** of the flexure by a flex joint **144**.

[**0048**] The angled member **131** that includes first portion **132***a* and second portion **132***b* moves linearly along the x-axis as shown by arrow **136**. In actuality, the portions **132***a* and **132***b* move only approximately linearly. When the flexure is in its origin position (rest position), the portions **132***a* and **132***b* are preferably angled as shown with respect to their lengthwise axes. This allows the rotating member **130** to push or pull the angled member **131** along either direction as shown by arrow **136**.

[**0049**] The actuator **110** is operated in only a fraction of its rotational range when driving the rotating member **130** in two directions, allowing high bandwidth operation and high frequencies of pulses or vibrations to be output. To channel the compression or stretching of the flexure into the desired z-axis motion, a flex joint **152** is provided in the flexure portion between the receptacle portion **122** and the grounded portion **140**. The flex joint **152** allows the receptacle portion **122** (as well as the actuator **110**, rotating member **130**, and second portion **132***b*) to move (approximately) linearly in the z-axis in response to motion of the portions **132***a* and **132***b*. A flex joint **150** is provided in the first portion **132***a* of the angled member **131** to allow the flexing about flex joint **152** in the z-direction to more easily occur.

[**0050**] By quickly changing the rotation direction of the actuator shaft **124**, the actuator/receptacle can be made to oscillate along the z-axis and create a vibration on the housing with the actuator **110** acting as an inertial mass. In addition, the flex joints included in flexure **120**, such as flex joint **152**, act as spring members to provide a restoring force toward the origin position (rest position) of the actuator **110** and receptacle portion **132**. In some embodiments, the stops can be included in the flexure **120** to limit the motion of the receptacle portion **122** and actuator **110** along the z-axis.

[**0051**] Other embodiments can provide other types of actuator assemblies, such as an eccentric mass coupled to a rotating shaft of an actuator to provide rotational inertial tactile sensations to the housing. The eccentric mass can be unidirectionally driven or bidirectionally driven. Other types of actuator assemblies may also be used, as disclosed in U.S. Pat. No. 6,184,868, such as a linear voice coil actuator, solenoid, moving magnet actuator, etc.

[**0052**] **FIG. 4** is a block diagram illustrating one embodiment of a haptic feedback system suitable for use with the present invention including a local microprocessor and a host computer system.

[**0053**] Host computer system **14** may include a host microprocessor **160**, a clock **162**, a display screen **26**, and an audio output device **164**. The host computer also includes other well known components, such as random access memory (RAM), read-only memory (ROM), and input/output (I/O) electronics (not shown). Display screen **26**