accomplished by dropping the magnitude of the forces, or by reducing the types or number of graphical objects in the GUI that have haptic effects associated with them. This can also be accomplished by shortening the duration of haptic effects, e.g. effects that are normally 56 ms can be reduced to 40 ms, etc. Also, a combination of such methods can be used. Finally, some laptop computers have different settings, such as high power, medium power, and low power, which a user can select according to his or her needs, e.g. lower power setting allows the batteries to last longer. The haptic feedback control can link into the setting and be governed by this setting as well. For example, if the user selects low power mode, the haptic feedback controller can adapt as described above to reduce power requirements of the haptic effects.

FIG. **18** is a top elevational view of a touchpad **450** of the present invention. Touchpad **450** can in some embodiments be used simply as a positioning device, where the entire area of the touchpad provides cursor control. In other embodiments, different regions of the pad can be designated for different functions. In some of these region embodiments, each region can be provided with an actuator located under the region or otherwise physically associated with the region, while other region embodiments may use a single actuator that imparts forces on the entire touchpad **450**. In the embodiment shown, a central cursor control region **452** can be used to position a cursor or viewpoint displayed by the laptop computer or other device.

The cursor control region of a touchpad can cause forces to be output on the touchpad based on interactions of the controlled cursor with the graphical environment and/or events in that environment. The user moves a finger or other object within region **452**, for example, to correspondingly move the cursor **20**. Forces are preferably associated with the interactions of the cursor with displayed graphical objects. For example, a jolt or "pulse" sensation can be output, which is a single impulse of force that quickly rises to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude. The touchpad **450** can be jolted in one direction or as an oscillation in the z-axis or other axis inertially in the inertial haptic feedback embodiments, or the touchpad can be translated in one direction or oscillated one or more times to provide the pulse. A vibration sensation can also be output, which is a time-varying force that is typically periodic. The vibration can cause the touchpad **450** or portions thereof to oscillate back and forth multiple times, and can be output by a host or local microprocessor to simulate a particular effect that is occurring in a host application.

Another type of force sensation that can be output on the touchpad is a texture force. This type of force is similar to a pulse force, but depends on the position of the user's finger on the area of the touchpad and/or on the location of the cursor in a graphical environment. Thus, texture bumps can be output depending on whether the cursor has moved over a location of a bump in a graphical object. This type of force is spatially-dependent, ice a force is output depending on the location of the cursor as it moves over a designated textured area; when the cursor is positioned between "bumps" of the texture, no force is output, and when the cursor moves over a bump, a force is output. This can be achieved by host control (e.g., the host sends the pulse signals as the cursor is dragged over the grating). In some embodiments, a separate touchpad microprocessor can be dedicated for haptic feedback with the touchpad, and the texture effect and be achieved using local control (e.g., the host sends a high level command with texture parameters and the sensation is directly controlled by the touchpad processor). In other cases a texture can be performed by presenting a vibration to a user, the vibration being dependent upon the current velocity of the user's finger (or other object) on the touchpad. When the finger is stationary, the vibration is deactivated; as the finger is moved faster, the frequency and magnitude of the vibration is increased. This sensation can be controlled locally by the touchpad processor (if present), or be controlled by the host. Such texture sensations are described in copending application Ser. No. 09/504,201, which is incorporated herein by reference. Other spatial force sensations can also be output. In addition, any of the described force sensations herein can be output simultaneously or otherwise combined as desired.

Different types of graphical objects can be associated with haptic sensations. Haptic sensations can output on the touchpad based on interaction between a cursor and a window, menu, icon, web page link, etc. For example, a "bump" or pulse can be output on the touchpad to signal the user of the location of the cursor when the cursor is moved over a border of a window. In other related interactions, when a rate control or scrolling function is performed with the touchpad (through use of the cursor), sensations can be output related to the rate control functions. Furthermore, the magnitude of output forces on the touchpad can depend on the event or interaction in the graphical environment, including user-independent events. These force sensations can also be used in games or simulations. These and other haptic sensations are described in U.S. Pat. No. 6,211,861 and copending patent application Ser. No. 09/585,741, both incorporated herein by reference. Other control devices or grips that can include a touchpad of the present invention in its housing include a gamepad, mouse or trackball device for manipulating a cursor or other graphical objects in a computer-generated environment; or a pressure sphere or the like.

Some forms of touchpads and touchscreens allow the amount of pressure the user is exerting on the touchpad to be sensed. This allows a variety of haptic sensations to be determined based at least in part on the sensed pressure. For example, a periodic vibration can be output having a frequency that depends on the sensed pressure. Or, the gain (magnitude) of output haptic sensations can be adjusted based on the sensed pressure. Those users that always tend to use the touchpad with more pressure can be allowed to select an automatic magnitude increase that would be in effect constantly.

Other embodiments of touchpads and touchscreens allow the user to enter "gestures" or shortcuts by tracing a symbol on the cursor control region or other region, which is recognized as a command or data by a processor. Haptic sensations can be associated with or dependent on particular gestures. For example, a confirmation of modes can be conveyed haptically with a particular haptic sensation when a mode confirmation gesture is recognized. Characters recognized from gestures also may each have a particular haptic sensation associated with them. In most touchpad embodiments, a user can select a graphical object or menu item by "tapping" the touchpad. Some touchpads may recognize a "tap-and-a-half" or double tap, which is the user doing a tap and then again touching the pad and maintaining the finger or object on the pad while moving the finger. For example, such a gesture can provide a "drag" mode in which objects may be moved with the cursor. When the user is in such a drag mode, a vibration or other haptic sensation can be output to indicate to the user that this mode is active.

As stated above, the touchpad **450** can also be provided with different control regions that provide separate input from the main cursor control region **452** in some embodiments, the different regions can be physically marked with lines, borders, or textures on the surface of the touchpad **450** (and/or