brake shoe **598**. The disk can be coupled to a variety of objects, such as a joystick handle or mouse, a rotating finger wheel or knob, or a rotating axle in a vehicle.

[0114] A stylus-shaped interface device can also be provided with an EAP actuator to produce haptic feedback to the user of the stylus. A stylus can be used to point to or select objects on a screen, or draw or write lines by contacting the stylus with a tablet or with a display screen surface, e.g. on Personal Digital Assistants (PDA's), touch screens, graphics tablets, laptop computers, etc. For example, FIG. **14***a* shows a stylus **610** having a moveable tip **612**, where the tip is moved by an EAP actuator **614** that is coupled to the tip and positioned inside the stylus housing. The EAP actuator moves linearly and causes the tip member **616** to move linearly through an aperture in the stylus housing. The EAP actuator can be controlled to produce vibrations, pulses, or other force sensations on the tip and thus to the user holding the stylus.

[0115] FIG. **14***b* shows a different embodiment **620** that causes a front end portion **622** of the stylus to linearly move with respect to the back portion **624** of the stylus. A rubber bellows **626** can be positioned between the moving front portion and the back portion, and an EAP actuator (not shown) can be positioned inside the stylus housing. The EAP actuator can be a linearly-moving element that is coupled to the front end portion **622** to move that portion similarly to moving the tip member as shown in FIG. **14***a*. Haptic sensations can be output to the user similarly as described with respect to FIG. **14***a*.

[0116] Other features of a stylus can also be actuated using EAP actuators. In FIG. **14***c*, a stylus **640** is shown having a button **642** which can be controlled (by a host computer or other controller) to linearly move back and forth by coupling a linearly moving EAP actuator **644** to the button as shown. The button can be actuated to correspond to interactions between a controlled cursor and other displayed objects, for example.

[0117] In FIG. **14***d*, a stylus **650** includes an expanding grip **652** which can be implemented using EAP actuators. The cylindrical grip provides an expanding circumference that is haptically discernible to the user gripping the cylindrical grip. The grip can be expanded and contracted to provide various haptic sensations, such as pulses, vibrations, 3-D surface simulations, etc. The grip can be implemented using a plurality of EAP actuators **654** (four are shown) that are disc-shaped and which expand in circumference with the activation signal is applied, as indicated in FIG. **14***e* which shows a single EAP actuator **654**. These actuators can be similar to the EAP structure described above with respect to FIG. **2***e*.

[0118] Other devices can also be used with EAP actuators. For example, as shown in FIG. **15***a*, a steering wheel **660** of a steering wheel controller device can be provided with an EAP inertial shaker **662** coupled in or on the wheel to provide inertial forces to the user contacting the steering wheel and which are coordinated with displayed events or interactions. The inertial shaker can be similar to the shaker described above with reference to FIG. **4***a*. Brakes can also be provided to exert frictional forces in the degree of freedom of the steering wheel, similar to the knob of FIG. **12***b*. FIG. **15***b* shows a joystick handle **666** of a joystick controller, where the handle is similarly outfitted with an inertial EAP actuator **668** provided within the joystick handle to output inertial forces on the joystick handle.

[0119] FIG. **15***c* is a perspective view of a joystick embodiment **680** that provides passive force feedback to the joystick. Joystick handle **682** is placed in apertures of two rotating members **684***a* and **684***b*. When the handle **682** is rotated in a direction, the corresponding member **684** rotates as well. Frictional brake disks **686***a* and **686***b* are coupled to their associated rotating members **684***a* and **684***b*. EAP brakes **688***a* and **688***b* provide frictional forces on the disks **686** which causes resistance in the two degrees of freedom of the joystick handle (sensors, not shown, sense the rotational motion of the joystick handle). For example, the EAP brakes can include linearly-moving elements, similar to other brake embodiments described herein. FIG. **15***d* illustrates one example of an EAP brake caliper that can be used as an EAP brake **688**, where a linearly-moving EAP actuator **690** coupled to a caliper support **691** can be coupled to a brake shoe **692** that frictionally contacts the disk **686**.

[0120] EAP actuators as disclosed herein can also be used on other types of controllers. For example, FIG. **16** is a perspective view of a cylindrical pointer controller **700**, which includes a cylinder **702** that can be rotated about its lengthwise axis as indicated by arrow **704** to provide input in one degree of freedom (e.g. move a cursor along one axis) and can be translated parallel to its axis of rotation as indicated by arrow **706** on a carriage **708** to provide input in another degree of freedom (e.g. move a cursor along the other axis). Sensors (not shown) detect the rotation and translation. Such a controller is described in greater detail in U.S. Pat. No. 4,896,554. In one embodiment, an EAP brake **710** can move a brake shoe against an axle **712** coupled to the cylinder to provide frictional braking forces in the rotational degree of freedom. That EAP brake and the cylinder can be translated linearly on carriage **708**, and another EAP brake **714** can apply braking frictional forces on the carriage in the translatory degree of freedom. Other types of EAP actuators can also be used in a cylindrical controller, e.g. inertial shakers.

[0121] FIG. **17***a* illustrates an embodiment **720** providing skin tactors using an EAP actuator. Skin tactors are similar to the pin grid arrays described above, in which one or more moving elements contacts a user's skin to provide a tactile sensation. One or more skin tactors can be provided in a haptic glove to engage the user's fingers and palm, in arrays on a vest to engage the user's chest or other body parts, or in other areas that can contact a user's skin. In FIG. **17***a*, an EAP linearly-moving actuator **722** is coupled to a tactor element **724**, where the tactor element is moved linearly into the user's skin through an opening in a support **726**. The tactor element is preferably moved and/or oscillated with a waveform similarly to the pin grid arrays described above.

[0122] FIG. **17***b* illustrates another embodiment **730** having tactor elements. A linearly-moving EAP actuator **732** is coupled to a support **734**. A tactor element **736** is coupled to a member **738** that is coupled to the end of the actuator **732**. When the actuator **732** is moved linearly, the tactor element is moved laterally as indicated by arrow **740**. This motion stretches the user's skin instead of moving an element into the skin. The grounded surface surrounding the tactor element, as well as the tactor element itself, can include ridges **742** or bumps to engage the user's skin. The stationary ridges on the grounded surface hold an engaged portion of the user's skin in place, while the moving ridges on the tactor element **736** stretch the middle area of the engaged portion of user's skin, creating a highly effective tactile sensation.

[0123] Other types of interface devices can employ EAP actuators, such as touchpads on laptop computers, PDA and game device screens used with styluses or fingers, etc., where