

HAPTIC PROFILING SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Application Ser. No. 60/531,416, filed Dec. 19, 2003, entitled "Haptic Profiling System" and U.S. Provisional Application Ser. No. 60/551,054 filed Mar. 9, 2004, entitled "Haptic Profiling System and Method," both of which are incorporated herein by reference in their entirety.

BACKGROUND

[0002] The invention relates generally to haptic feedback devices. More specifically, the invention relates to a system and method for profiling mechanical devices to design haptic effects for haptic feedback devices.

[0003] Before the advent of computer aided design and engineering tools, such as computer-aided drafting/computer-aided engineering (CAD/CAE) tools, the iterative design and engineering process between supplier and an equipment manufacturer, such as an original equipment manufacturer (OE or OEM), was time consuming and costly. Suppliers would present drawings or prototypes and then receive feedback based on their presentation. The supplier would make design changes based on the feedback and then go through the same process again. After many iterative cycles, the final design would be completed. Depending on how well this relationship was managed between the OE and the supplier, the results could vary widely in quality and cost.

[0004] One drawback of the iterative process is the difficulty in communicating how a device feels to a supplier. Compounding the problem of getting a mechanical device (e.g., a switch) to feel as desired, is the issue of having the decision makers (e.g., customer and/or executives) on-hand to give their approval.

[0005] Some systems represent the feel of a mechanical device with a static torque/travel curve of the force profile. The force profile is given to a supplier in the form of engineering drawings. The device manufacturer then makes a design that attempts to match the desired force profile. This is an iterative process, as the required level of customer satisfaction is only achieved after several attempts by the supplier. Typically, a drop in performance and, correspondingly, in customer satisfaction occurs when moving from soft to hard tooling.

[0006] While many design processes have become partially or fully automated, many known processes used to design certain devices, such as mechanical switches, still require multiple iterations similar to those described above. For example, many known design processes used to create mechanical and/or haptic devices in the automotive industry require an iterative process similar to the one described above.

[0007] Thus, a need exists for improvements in systems and methods for profiling and designing haptic devices.

SUMMARY OF THE INVENTION

[0008] An apparatus is disclosed that includes a characterization module configured to receive data associated with

operational characteristics of a mechanical device, the operational characteristics being associated with a perceptual experience of the mechanical device. A conversion module is coupled to the characterization module. The conversion module is configured to automatically produce, without user intervention, a parametric data set associated with the mechanical device based on the data.

[0009] In another embodiment, a method includes receiving data associated with operational characteristics of a mechanical device. The operational characteristics are associated with a perceptual experience of the mechanical device. A parametric data set associated with the mechanical device is produced automatically, without user intervention. The parametric data set is associated with the mechanical device based on the data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a schematic illustration of a haptic profiling system, according to an embodiment of the invention.

[0011] FIG. 2 is a schematic illustration of an implementation of a haptic profiling system, according to an embodiment of the invention.

[0012] FIG. 3 is an example of a graphical representation of data associated with a plurality of operational characteristics of a mechanical device.

DETAILED DESCRIPTION

[0013] An apparatus is disclosed that includes a characterization module configured to receive data associated with operational characteristics of a mechanical device, the operational characteristics being associated with a perceptual experience of the mechanical device. A conversion module is coupled to the characterization module. The conversion module is configured to automatically produce, without user intervention, a parametric data set associated with the mechanical device based on the data.

[0014] The systems and methods of the invention can be used to design outputs for haptic devices for a variety of applications and mechanical devices. For example, according to some embodiments of the invention, the systems and methods of the invention can be used to develop haptic devices (e.g., switches, knobs, etc.) for vehicles.

[0015] FIG. 1 is a schematic illustration of a haptic profiling system 10 coupled to a mechanical device 50. The haptic profiling system includes a haptic profiler 20 that receives data associated with operational characteristics of the mechanical device 50. The operational characteristics are associated with a perceptual experience of the mechanical device 50. The haptic profiler 20 converts the operational characteristics to a parametric data set and outputs a control signal to a haptic device 40 to cause the haptic device to output a haptic effect. The haptic device 40 reproduces the perceptual experience based on the measured data received from the mechanical device 50.

[0016] In some embodiments of the invention, the haptic profiling system includes a design module 30 that can be used to modify the data associated with the operational characteristics of the mechanical device 50. In other embodiments, the design module 30 is not present.