interferometry sensor **102** is configured to emit an outgoing beam of light **106** directed toward a location on a user's head **110**. The outgoing beam of light **106** may pass through an optional collimating or other lens **104** for focusing and/or filtering prior to impinging on a location of the user's head **110**. Reflections or backscatter **108** of the outgoing beam of light **106** from the user's head **110** may reflect back into the light source within the self-mixing interferometry sensor **102** and alter a property of the outgoing emitted beam of light **106**.

[0054] In some embodiments, the light source within the self-mixing interferometry sensor **102** may be a laser diode in which the received reflections **108** of the beam of light **106** induce self-mixing interference within the laser diode's lasing cavity. The self-mixing interference produces an altered steady state of operation of the laser diode from a state of operation that would occur in the absence of received reflections **108**. For example, the emitted optical power of the beam of light or emitted wavelength may be altered. Such an alteration may be detectable as a change in an operational parameter (or "interferometric parameter") of the source of the beam of light **106**, or of an associated electrical component of the electronic device. A particular type of laser diode that may be used in a self-mixing interferometry sensor is a vertical cavity, surface emitting laser (VCSEL) diode. Structural and operational details regarding VCSELs are described below. One skilled in the art will recognize that other types of laser diodes or light sources may be used in the self-mixing interferometry sensors described herein.

[0055] Motion of the location on the user's head **110** may be caused by the user's speech, such as a voiced command, or by a silent gesture of the user. Examples of locations on the user's head **110** include the skin or scalp proximate to temporomandibular joints, the temporal bones, the parietal bone, or another location. As an example, speech by the user may cause vibrations in the temporal bones, which in turn may cause vibrations in the skin proximate to the temporal bones. The skin vibrations may be detected by the self-mixing interferometry sensor **102** of the device.

[0056] FIGS. **2**A-C show various block diagrams of configurations for wearable electronic devices. The configurations shown in the block diagrams are representational only, and do not imply any information regarding dimensions or shape of the features shown.

[0057] FIG. **2**A is a block diagram of a configuration **200** by which a wearable electronic device **202** may have an attachment **204** to a part of a user's head **206** in order to receive inputs from the user by detecting skin deformations. The skin deformations may be caused by the user audibly or inaudibly making a voiced command or a silent gesture, or by another cause related to a user input to the wearable electronic device.

[0058] The device **202** may include a self-mixing interferometry (SMI) sensor **210** that emits an outgoing beam of light **208***a* toward a location on the user's head **206**, and receives reflections **208***b* of the outgoing beam of light **208***a*. The reflections **208***b* may cause self-mixing interference in a light source, such as a laser diode, of the SMI sensor **210**. The self-mixing interference may be observed in a self-mixing interferometry signal, and may be associated or correlated with motion of the user's head **206**.

[0059] The device **202** may include a command interpreter **212**, that may analyze the self-mixing interferometry signal, such as by the methods described below in relation to FIGS. **7**A-**10**. The command interpreter **212** may include processors and/or other processing circuits to detect skin deformation information, such as distance, displacement, motion or velocity of the skin at the location on the user's head **206**. From the skin deformation information, the command interpreter **212** may be able to recognize a command of the user, whether it be voiced or a silent gesture.

[0060] The command interpreter **212** may send instructions or other signals to affect the state of the device **202**, or of an associated device. For example, in the case that the device **202** is an earbud speaker/microphone combination, the instructions may cause the device **202** to reduce a volume produced by the speaker, or may instruct a cellphone linked with the earbud to dial a person.

[0061] FIG. **2**B shows a block diagram of an additional and/or alternative configuration **220** that may extend the configuration **200** of FIG. **2**A. The configuration **220** includes a wearable device **222** that can attach to a user's head **226** by means of a connection component **224**. Particular devices making use of the configuration **200** will be described below, with two exemplary devices shown in FIGS. **3**A-B. As in the configuration **200** of FIG. **2**A, the device **222** includes a self-mixing interferometry (SMI) sensor **240**, as described above, configured to emit a beam of light **228***a* toward a location on the user's head **226**, and receive reflections **228***b* from the location that may cause a light source in the SMI sensor **240** to undergo self-mixing interference. The self-mixing interference may be detected in a self-mixing interferometry signal of the self-mixing interferometry sensor **240**.

[0062] The device **222** further includes a microphone **232** configured to receive sound input **230**. The sound input **230** may be a voiced command of the user, or originate from another sound source, such as another person, a music source, or from background noise. The microphone **232** may perform an initial filtering or signal conditioning on the received sound input **230**, and may produce a corresponding output signal having an alternate format, such as a digital encoded format. The microphone **232** allows the device **222** to use sensor fusion, in which both the output signal of the microphone **232** and the self-mixing interferometry signal from the SMI sensor **240** are both used to detect a user input.

[0063] The device **222** includes a command interpreter **234** configured to receive a signal output from the microphone **232** and associated with the sound input **230**. The command interpreter **234** may optionally receive a self-mixing interferometry signal from the SMI sensor **240**. The command interpreter **234** may analyze the microphone's sound signal and apply a voice recognition algorithm to decide if the sound input **230** originated from a person's voice, such as the user's voice. The command interpreter **234** may also make a decision about the content in the sound input **230**, and determine if they represent a voiced command.

[0064] The command interpreter **234** may optionally be configured to analyze the self-mixing interferometry signal from the SMI sensor **240** to determine if the user was speaking during the time interval in which the sound input **230** was received. The command interpreter **234** may also make a decision, based on skin deformation information in the self-mixing interferometry signal, about whether the user