even further by selecting digital codes to produce frequency-domain signals that avoid known sources of noise. Spread spectrum techniques can therefore apply increased power to the sensing region while reducing the effects of noise, thereby resulting in a significantly improved SNR for the sensor in comparison to conventional time-domain multiplexing techniques of a comparable sample period. Spread spectrum techniques applied within the sensor may enable other beneficial sensor designs and features as well. These concepts are explored more fully below.

[0017] As used herein, the term "position sensor" is intended to encompass not only conventional touchpad devices, but also a broad range of equivalent devices that are capable of detecting the position or proximity of one or more fingers, pointers, styli or other objects. Such devices may include, without limitation, touch screens, touch pads, touch tablets, biometric authentication devices (e.g. fingerprint sensors), handwriting or character recognition devices, and the like. Similarly, the terms "position", "object position" and "position-based attribute" as used herein are intended to broadly encompass various types of absolute or relative positional or proximity information, and also other types of spatial-domain information such as speed, velocity, acceleration, and the like, including measurement of motion in one or more directions. Various position-based attributes may also include time history components, as in the case of gesture recognition and the like. Accordingly, many different types of "position sensors" may be capable of detecting widely varying "position-based attributes" beyond the mere presence or absence of an object in a wide array of alternate but equivalent embodiments determined by their applications.

[0018] Turning now to the drawing figures and with initial reference to FIG. **1**A, an exemplary sensor **100** suitably includes a sensing region **101**, a controller **102**, a modulator **107**, with associated drive circuitry **109**, and a demodulator **117** with associated receiver circuitry **115** as appropriate. A position-based attribute of a finger, stylus or other object **121** is detected by applying various modulation signals **110**A-D to electrodes **112**A-D that, along with sensing electrode **114**, define sensing region **101**. The modulation signals **110**A-D are capacitively or otherwise electrically coupled to one or more receiving electrodes **114**, thereby forming any number of data transmission channels **113**A-D. Electrical effects produced by object **121** upon channels **113**A-D can be subsequently identified in signals **116** received by the receive electrode, and these received signals can be subsequently processed to isolate the location of object **121** with respect to electrodes **112**A-D within sensing region **101**. An example of a conventional technique for capacitively sensing and processing object position in a touchpad is set forth in U.S. Pat. No. 5,880,411, referenced above, although any other sensing techniques could be used in a wide array of alternate embodiments.

[0019] Although various types of sensors **100** are capable of detecting different electrical effects produced by object **121**, the exemplary embodiments of FIGS. **1**A-B show configurations for monitoring changes in capacitance across sensing region **101** caused by the presence or absence of object **121**. More particularly, as modulation signals **110**A-D are applied to electrodes **112**A-D, a "virtual capacitor" is formed between each electrode **112**A-D transmitting the modulated signal and a receiving electrode **114**. If an object is present within the fields created by this capacitor, the capacitance between the transmitting electrode **112** and the receiving electrode **114** is affected. Typically, the effective capacitance between electrodes **112** and **114** is reduced if a grounded (or virtually grounded) object such as a finger is present, and the effective capacitance is increased if an ungrounded conductor (e.g. a stylus) or higher dielectric object is present. In either case, the change in capacitance caused by the presence of object **121** is reflected in the output signal **116** such as voltage, current, or charge measured from receive electrode **114**.

[0020] By monitoring signals **116** produced by each modulation signal **110**A-D, then, the presence of object **121** with respect to each electrode **112**A-D (respectively) can be determined. In the exemplary embodiment shown in FIG. **1**A, four sensing channels **113**A-D are shown arranged in a one-dimensional sensing array **101**. In the exemplary embodiment of FIG. **1**B, seven channels **113**A-G are implied with several channels **113**A-C arranged in a first direction between **112**A-C and **114**, and the remaining channels **113**D-G arranged in a substantially orthogonal direction between **112**D-G and **114** to allow for detection of image "silhouettes" in two dimensions, as described more fully below with reference to FIG. **4**. In practice, as few as one channel (e.g. a button) or as many as dozens, hundreds or even more sensing channels could be arranged in any single or multi-dimensional pattern in a wide array of alternate embodiments. Properly arranged, the position of an object **121** with respect to sensing region **101** can be determined from the electrical effects produced by object **121** upon the transmission of modulation signals **110**A-D applied to the various electrodes. These effects, in turn, are reflected in the received signals **116** that are demodulated and subsequently processed as appropriate to arrive at output signal **120**.

[0021] Further, sensor **100** may be readily configured or re-configured to create any type or number of sensing zones within region **101** by simply assigning or re-assigning digital codes used to create modulation signals **110**. As shown in FIGS. **1**A-B, each receiving electrode **114** may receive signals coupled by any number of signal channels **113**, thereby resulting in multiple result signals **116** being provided on a single path. Because signals **116** are provided on a common path, sensing channels **113** of any number of electrodes may be created on a permanent or temporary basis by simply applying a common modulation signal **110** (e.g. a modulation signal **110** formed from a common digital code) to each of the transmit electrodes **112** making up the sensing zone. Sensing zones within region **101** may overlap and/or vary with time, and are readily re-configurable through simple application of different digital codes to one or more electrodes **112**. More than one electrode may be part of a channel, and more than one channel modulation may be applied to an electrode.

[0022] In a traditional sensor, modulation signals **110**A-D are typically simple sinusoidal or other periodic alternating current (AC) signals applied sequentially to the various channels using any form of time domain multiplexing (TDM). By applying spread spectrum concepts commonly associated with radio communications to sensor **100**, however, numerous benefits can be realized. In particular, digital coding techniques similar to those used in code division multiple access (CDMA) radio communications can be employed to create distinct modulation signals **110**A-D that