can be simultaneously applied to the various sensing zones of region **101**, thereby potentially reducing the switching complexity of sensor **100**.

[**0023**] Spread spectrum techniques applied within sensor **100** may provide additional benefits, such as improved resistance to noise. Because each signal channel **113** results from the application of an appropriate digital code, for example, principles of code gain can be readily exploited to improve the performance of sensor **100**. The gain of each modulation signal **110** applied to one or more transmit electrodes **112** increases with the length of the code. Through the use of conventional code generation techniques, combinatorial variations of the digital codes with well-known spectral and correlation properties are relatively easy to generate. Further, these combinatorial variations provide a relatively large pool of potential distinct digital codes from which to create modulation signals **110** with desirable time or frequency domain characteristics, as described below. Additional detail about particular code generation and signal processing techniques are described more fully below.

[**0024**] Again with reference to FIGS. **1**A-B, sensing region **101** is any capacitive, resistive, inductive or other type of sensor that is capable of detecting the position, proximity and/or other position-based attribute of a finger, stylus or other object **121**. Exemplary sensing regions **101** include the various sensors produced by Synaptics Inc. of Santa Clara, Calif., which appropriately detect a one dimensional, two dimensional or multi-dimensional position of an object **121** using capacitive or inductive coupling, although many other sensing regions **101** could be used in a wide array of alternate embodiments. Other types of sensing regions **101** capable of detecting position or proximity include sensors based upon acoustic, optical, or electromagnetic properties (e.g. radio frequency, infrared, ultraviolet or the like), and/or any other effects.

[**0025**] Controller **102** is any processor, microcontroller, neural network, analog computer, programmed circuitry, or other module capable of processing input data **118** to extract output indicia **120** and/or the like. The particular control circuitry **102** used varies widely from embodiment to embodiment, but in exemplary embodiments controller **102** is a model T1004, T1005, T10XX or other microcontroller produced by Synaptics Inc. of Santa Clara, Calif. In many embodiments, controller **102** includes and/or communicates with a digital memory **103** that suitably stores digital instructions in any software or firmware form that are executable by controller **102** to implement the various sensing, control and other functions described herein. Alternatively, the functions of memory **103** may be incorporated into controller **102** such that a physically distinct memory device **103** may not be present in all embodiments. The physical controller may also incorporate more elements including the drive circuitry **109** and receive circuitry **115**, as well as, others described.

[**0026**] Code generation module **104** is any discrete or integrated circuit, device, module, programming logic and/or the like capable of producing digital codes **106** that can be used in generating modulation signals **110**A-D. The number, size and types of digital codes produced vary significantly, but in various embodiments the codes are substantially orthogonal to each other, and are of sufficient length to provide for enough distinct digital codes to be associated with each sensing zone of region **101**. The discrete codes may be binary, ternary, or generically multilevel, and may indicate both driven and un-driven states (tri-state). Various circuits, modules and techniques for generating digital codes suitable for use with CDM include shift register sequences such as Walsh-Hadamard codes, m-sequences, Gold codes, Kasami codes, Barker codes, delay line multiple tap sequences, and/or the like. Alternatively, digital codes may be pre-determined and stored in a lookup table or other data structure within controller **102** and/or memory **103**, and/or may be generated by controller **102** using any suitable algorithm. In such embodiments, code generation module **104** may not be present as a separate physical element from controller **102**, but rather should be considered to be a logical module representing the code generation and/or retrieval function carried out by controller **102** or other digital processing devices as appropriate.

[**0027**] The term "substantially orthogonal" in the context of the distinct digital codes is intended to convey that the distinct codes need not be perfectly orthogonal from each other in the mathematical sense, so long as the distinct codes are able to produce meaningful independent results. Strict orthogonality may thus be traded off for various other properties such as correlation, spectra, or compressibility. Similarly, the term "sensing zone" is intended to convey that a single code could be applied to multiple electrodes **112** to create a single zone of sensitivity that encompasses a larger portion of sensing region **101** than any of the individual electrodes **112**. Also, more than one code could be applied to an electrode creating overlapping or spatially filtered "sensing zones". For example phase delayed or "shifted" versions of the same code sequence can be distinct and substantially orthogonal such that they are readily distinguishable. In various cases, interpolation between phase shifts may even be possible.

[**0028**] Modulator **107** is any circuit, logic or other module capable of producing modulation signals **110**A-D using the distinct digital codes produced by module **104**. Typically, modulator **107** modulates a carrier signal **111** with the digital codes **106** using any type of amplitude modulation (AM), frequency modulation (FM), phase modulation (PM) or another suitable technique to create modulation signals **10**A-D. Accordingly, modulator **107** may be implemented using any conventional digital and/or analog circuitry, or may be partially or entirely implemented with software logic executing within controller **102** or the like. Carrier signal **111** may be produced by any oscillator or other signal generator **105** as appropriate. In one embodiment suitable for use in a capacitively-sensing touchpad, signal **111** can be produced at frequencies that range from about 10 kHz-100 MHz, although these signals may be produced at any frequency or range in a wide array of equivalent embodiments. Additional detail about an exemplary modulation function is described below with respect to FIG. **3**. In still other embodiments, carrier signal **111** is eliminated and spectral components of the applied modulation signals **110**A-D are determined from the clock rate, repeat lengths and/or other aspects of the digital codes. The carrier signal **111** may therefore be eliminated and/or conceptualized as a direct current (DC) signal in various alternate embodiments.

[**0029**] Modulation signals **110**A-D are applied to electrodes **112**A-D of sensing region **101** in any manner. In