

Controller Algorithms for Single Feed Switched Parasitic Antennas

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An ideal smart antenna should provide a continuous high quality RF signal to the transmitter/receiver circuit independent of multipath fading and interference. A switched parasitic antenna with a central feed element encircled by a number of parasitic elements with DC activated switches can serve this purpose. In receive mode, a power splitter provides RF output to both the receiver and the controller circuits so they can operate independently. The main beam direction must be updated should the signal level fall below a predefined threshold. In this implementation, a simple, battery powered microcontroller provides the intelligence to determine the RF signal condition and to generate the bit sequence for beam steering. Experimental results of one smart antenna configuration will be presented.

Threshold crossing algorithm: The RF level is monitored and converted to analog signal $V_{a_RF}(t)$. This is compared electronically with a preset fading threshold level $V_{fad_th}(t)$. If $V_{a_RF}(t)$ is less than $V_{fad_th}(t)$, and an update sequence is run. This involves checking the RF level in all possible beam switch positions (5 parasitic elements require 5 switch positions) and setting the parasitic configuration for maximum signal. The output of the comparator is “1” or “0”. If logic-1 is detected the controller generates the bit sequences for the parasitic element switches of 01111, 10111, 11011, 11101, and 11110 every 64.5 μ Sec (Delay 1). Note that a logic 0 opens the switch and de-activates the parasitic element. This algorithm provides the smart antenna with the best beam direction to achieve the maximum power. However, while $V_{a_RF}(t)$ is greater than $V_{fad_th}(t)$ the logic-0 of comparator output will appear meaning that the received RF-signal is sufficient for communications. At this time, the parasitic elements are set in one of the five possible combination of bit sequence for a longer time (Delay 2) unless the RF signal level drops below the threshold. When the antenna is in transmit mode, the antenna beam is directed to maximum reception. With appropriate component selection, the system functions adequately for $V_{fad_th}(t)$ less than -60 dBm with a dynamic range of 80 dB.

BER algorithm: A controller computation algorithm suitable for wireless TDMA application can include a check of BER rather than simple RF signal level. The antenna must be more closely integrated into the receiver output to obtain this information.