Docket #: S12-176

Multiple Tap Feed Forward Cancellation

Wireless spectrum is increasingly fragmented due to the growing proliferation of unlicensed wireless devices and piecemeal licensed spectrum allocations. Current radios are ill-equipped to exploit such fragmented spectrum since they expect large contiguous chunks of spectrum to operate on. In this patent, we present a novel system architecture which provides radios with a general full duplex signal shaping capability, allowing them to exploit fragmented spectrum. By full duplex signal shaping we mean that the radio can be configured to transmit on an arbitrary set of spectrum fragments and receive on a different arbitrary set of spectrum fragments, simultaneously.

Applications

- There are numerous applications which would benefit from this adaptive cancellation technique.
- In the analog domain, such an approach could be used to reduce out-of-band leakage enabling different wireless chipsets to coexist peacefully or eliminating the use of SAW and BAW based filters which are currently used to eliminate out-of-band leakage at the cost of insertion loss. Such a cancellation technique could also be used in analog to linearize non-linear effects - such as low grade amplifiers. This wideband cancellation technique could be used as a wideband linearization technique for amplifiers and other devices which experience non-linear effects at high powers and frequencies.
- In the digital domain, such an approach could be used as a part of an adaptive equalization algorithm, either to linearize or cancel the signal. It could be used in conjunction with higher order digital filters to further mitigate out-of-band interference and leakage.

Advantages

- We first compare our cancellation technique against prior cancellation work. Prior cancellation work has primarily focused on the cancellation aspect from the point of matching attenuation and delays. Thus many of the works have used a single feed-forward cancellation path. Such approaches are fundamentally limited by the precision of the subcomponents, and precision errors are magnified as the bandwidths of the desired signals to cancel increase. There have been approaches using multiple feedforward lines, up to 2, as well. These approaches typically follow an approach where the delay line components are tunable and as a result, they typically try to tune the 2 different delays such that they get precise cancellation at 2 specific frequencies can be cancelled. This can be useful if there are only 2 narrowband frequencies which need cancellation, e.g. narrowband duplexer, but for wideband signal cancellation - 2 paths will not suffice.
- Our cancellation technique can also be used to replace many off-chip components such as duplexers and inter-stage SAW filters which are currently necessary to compensate by the exacting out of band requirements imposed by cell phone manufacturers. The cancellation technique could either be used to replace these filters, or reduce their requirements such that the filtering can be implemented on-chip. In addition to having a wider bandwidth of operation compared with these duplexers and filters, our cancellation system would enable adaptive operation. For instance, with a filter or duplexer, the transmit and receive channels are statically configured. If the goal is to reverse the operation, that is to transmit in the channel currently being used for receive and vice versa, the filters cannot be re-purposed for this use. On the other hand, our cancellation circuit would be able to perform this easily. Lastly, duplexers and filters typically have high insertion losses due to their use of high impedance passive components. As a result, power efficiencies of these devices are typically low. Our cancellation system could potentially improve significantly on the power consumption, an attractive proposition for implementations in mobile handsets which are battery limited.

Patents

- Published Application: 20130301488
- Published Application: WO2013185106
- Issued: 9,331,737 (USA)

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