UWB Analog FIR-Filter in MIC Technology as Adaptive Analog Filter and as Pulse Shaper Saeed Arafat^{* (1)}, and Klaus Solbach ⁽¹⁾ (1) University of Duisburg-Essen, Duisburg, Germany, <u>https://www.unidue.de/hft/index_en.php</u>

Digital FIR filters are widely used in digital signal processing for the realization of filter responses with prescribed frequency behavior. In a companion paper, we present the design, manufacturing, and measurement result of a single UWB analog FIR-Filter tap in MIC technology which could replace digital technology in cost- and power sensitive applications. The aim of this paper is to demonstrate some applications for the proposed analog UWB FIR filter tap, in particular an adaptive filter and a pulse shaper.

Conventional filter design is for specific frequency bands and it is hard to modify it to use for different frequency bands. In particular, the type of filter cannot be modified, e.g., one cannot easily modify a PBF to be a BSF. The big advantage of a tunable FIR filter is that we can adjust the filter type and cut off frequency by only changing the filter coefficients digitally by using a computer, Figure 1. Several design examples will be presented for different filter types and for different cutoff frequencies covering the whole UWB frequency band.



Figure 1 Universal tunable analog FIR filter concept.

Figure 2 Concept and implementation setup of UWB FIR filter as pulse shaper.

In many UWB applications, the signal's equivalent isotropically radiated power (EIRP) must conform to the regulation defined by the Federal Communication Commission (FCC). As a result, the closer the signal power spectrum density (PSD) conforms to the area under the FCC's PSD mask the more power the signal is able to transmit. This can be realized using pulse shaping. Most research contributions on pulse shaper optimization and pulse design propose new theories or methods from the mathematical viewpoint only, without practical circuit implementation such as, creating an optimal pulse through DSP implementation of a digital FIR filter which requires an immense computational effort. In This paper we will present the concept of an adaptive arbitrary pulse shaper using our analog FIR filter design, Figure 2, by just optimizing the filter coefficients. Several examples will be presented for the optimized pulse under FCC and European Commission (EC) regulation.