INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION

Edited by

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Chapter 8

OVERSAMPLING ANALOG-TO-DIGITAL CONVERTER

MA LI YA, SHEROZ KHAN, ANIS NURASHIKIN

Except Nyquist-rate ADCs, the other kind of analog-to-digital converter (ADC) is oversampling ADCs. With the development of very large scale integration (VLSI), the oversampling ADCs become very popular interface circuits, especially in CMOS technology. In this chapter, an overview of oversampling ADCs is introduced, as well as its most important techniques, that is, oversampling and noise shaping are also discussed.

8.1. SYSTEM ARCHITECTURE

Oversampling conversion is a technique that improves the resolution obtained from straightforward Nyquist-rate conversion (Aziz, 1996). This improvement is achieved through oversampling the input analog signal, which means that the sampling frequency is at a rate significantly faster than the Nyquist rate; normally it is 20 to 500 times faster. Fig. 8.1 is a block diagram for oversampling ADC.

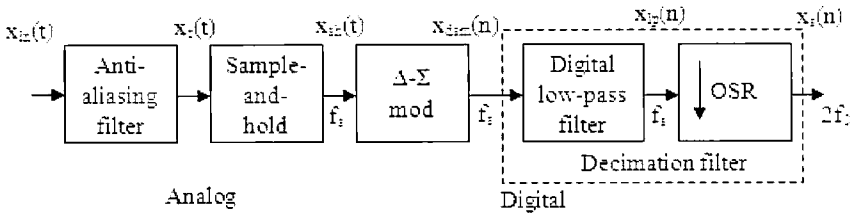

Fig. 8.1: Oversampling conversion system architecture (Aziz, 1996)

This kind of converters modulates the analog signal into a simple code, normally single-bit signal, at a frequency much higher than the Nyquist rate (Norsworthy et al., 1996). In this oversampling conversion system, the most important part (or the key technique) is sigma-delta (Σ-Δ) modulator. The use of high-frequency modulation eliminates the need for abrupt cutoffs in the analog anti-aliasing filter at the input to the ADC. The decimation filter used here is for smoothing the output of the modulator, attenuating noise, interference, and high-frequency components of the signal before they can alias into the signal band when the code is re-sampled at the Nyquist rate (Norsworthy et al., 1996).