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一种新的时间交叉采样ADC时钟偏斜误差自适应补偿算法

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摘要：

针对时间交叉采样模数变换器(time-interleaved analog-to-digital converter, TIADC)中存在的时钟偏斜误差,提出了一种新的自适应误差估计和补偿方法,该方法根据误差信号和原始输入信号频率之间关系和分布特征,设计了基于最小均方(least-mean-square, LMS)算法的估计模型。与已有算法相比,新方法实现简单,收敛速度快。同时根据时钟偏斜误差产生的原理,设计了基于数字分数延时滤波器的时钟偏斜补偿算法,该方法概念清楚,易于通道扩展,资源利用率高。通过应用Farrow结构,将误差参数独立出来,和误差估计算法组成了自适应系统。仿真结果表明,该自适应系统仅需要5 000个采样点就可以收敛,通过补偿算法,使输出的信噪失真比(signal-to-noise-and-distortion ratio, SINAD)提高了30 dB以上。

关键词： 自适应补偿 时间交叉采样模数变换器 数字分数延时器 时钟偏斜

Novel adaptive method for compensation of timing-skew in time-interleaved ADC

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Abstract:

A novel method for identification and compensation of the timing-skew in time-interleaved analog-to-digital converter (TIADC) in digital domain is presented. In this method, the relationship between the spectrums of original input and error signals is used to establish an estimation-model based on least-mean-square (LMS). Compared with the existing methods, the new method has major advantages from an implementation point of view, and can converge rapidly. According to the principle of timing-skew, the compensation method based on digital fractional delay element is designed with the advantages of simple conception and resource economy. By using Farrow structure, the error parameters are extracted, and it is very convenient to build an adaptive system with the estimation-model. The simulation results show that the proposed method can converge after about 5 000 samples and the compensated output can get an improvement of at least 30 dB in signal-to-noise-and-distortion ratio (SINAD).

Keywords: adaptive compensation time-interleaved analog-to-digital converter (TIADC) digital fractional delay element timing-skew

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