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研发、设计、测试

频率可调带宽可选的VLBI多相数字基带转换器

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摘要 VLBI数据采集终端是VLBI台站的重要设备，近年来随着数字硬件设备例如ADC、DSP、FPGA的快速发展，数字基带转化器代替模拟基带转换器成为现实。现有采用多相滤波器实现DBBC的方法不可避免存在盲区，且频率、带宽均不可调。提出一种通用的基于多相结构的宽带数字下变频方法，将多速率信号处理和并行处理方法应用在其中，成功实现了VLBI多个通道的单边带数字基带转换，且能实现中频中心频率可调、带宽可选。硬件测试结果表明VLBI数字基带转换器频率设置正确，带宽选择正确，且数字基带转换器带通特性好于模拟基带转换器。

关键词 甚长基线干涉测量 数字基带转换器 单边带 多相滤波器组 盲带 现场可编程门阵列

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Polyphase based VLBI digital baseband converter with adjustable IF center frequency and bandwidth

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Abstract

The VLBI（Very Long Baseline Interferometry） data acquisition backend plays an important role in the VLBI station.Recently，based on advances in digital hardware like ADC（Analog-to-Digital Conversion），DSP（Digital Signal Processing），FPGA（Field Programmable Gate Arrays） and so on，it has become practical to sample and digitally process the intermediate frequency signal directly.DBBC（Digital Base-Band Converters） will replace ABBC（Analog Base Band Converters） in the VLBI data acquisition backend.A VLBI digital backend using poly-phase filter banks exits blind frequency zone inevitably.Moreover，the frequency and the band width are not adjustable in this method.This paper analyzes this limitation and presents a sequence of simple modifications to sampled data structures based on the analog prototype system to obtain the poly-phase structure in the VLBI data acquisition backend which can eliminate the blind frequency zone.The theoretical principles of digital SSB（Single Side Band） converters are discussed in detail.The approach adopts multi-rate signal processing for the designed filters in a digital SSBconverter which is carried out by virtex-4 FPGA chips.The result of hardware VLBI experiments indicate that it can receive random IF band-pass in and bandwidth can be selected.Meanwhile，a conclusion is reached from the experiment that the VLBI DBBC has a better band pass performance than the ABBC.

Key words Very Long Baseline Interferometry（VLBI） digital base-band converter Single Side Band（SSB） poly-phase filter banks blind frequency zone Field Programmable Gate Arrays（FPGA）

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