

Multi-channel low-frequency astronomical radio observation system

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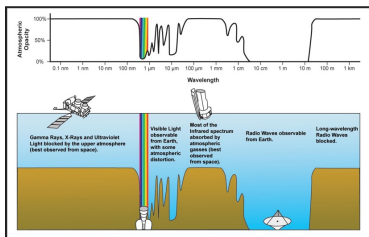
OpenHW2022



On board test by Virtex-7 FPGA

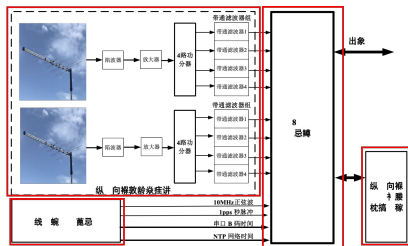
INTRODUCTION

Radio astronomy, such as single-aperture antenna type and radio interference array type, can detect a large amount of radio radiation information from the earth's space and outer space. In the radio band (10MHz-30GHz), the **low-frequency radio band (10MHz-200MHz)** is an almost new research field that has not been completely discovered. In order to meet the demand for high frequency resolution and high precision time-frequency synchronization of receivers in low-frequency radio observation scenarios, an acquisition method that achieves high resolution at a lower sampling rate and main frequency should be created.



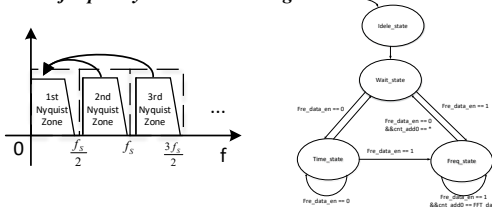
Radio astronomy and its radio observation scenarios

Architecture and structure of observation system



A low-frequency radio astronomical interferometry system that can support high-resolution observation, including an **RF front-end** and **eight-channel input** is designed with a high-precision **time-derived adaptation selection** function.

Principles of undersampling and time-frequency domain switching state machine

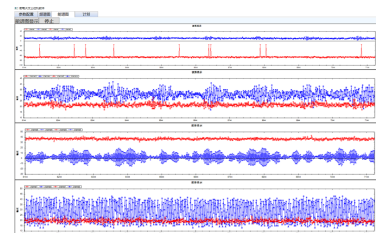


Using the **undersampling and spectral folding principles**, the acquisition band is divided into four channels according to the Nyquist zone by anti-aliasing filter. **Time-frequency domain switching state machine** to complete the mode switching. At the same time, the large-capacity buffer composed of two DDR3 is used to ensure that the data do not lost during the switching process.

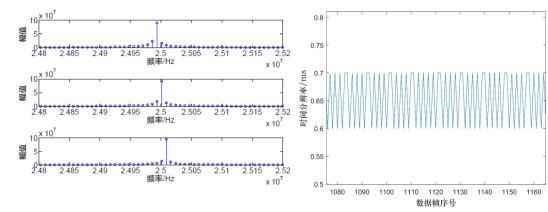
CREATIVE DESIGN

RESULT

The system is capable of acquiring two radio signals in the frequency band of 1-350 MHz and supports two acquisition modes, **time domain** and **frequency domain**, and supports flexible and adjustable time resolution, frequency resolution and time domain data bit width



Energy spectrum of the Demo



Frequency and time resolution test of observation system