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New Correlator PARSEC

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Abstract

The Institute of Applied Astronomy is developing Altera FPGA-based scalable correlator PARSEC with Mark IV specification. We have developed the prototype correlator MicroPARSEC. PCI-bus correlator board MicroPARSEC has standard office PC board format.

1. PARSEC Correlator

The Institute of Applied Astronomy is developing Altera FPGA-based scalable correlator PARSEC with Mark IV specification. The correlator unit uses PCI-bus correlator boards, standard CompactPCI hardware with single board Intel Pentium control computer and standard Linux operating system (Figure 1). We have estimated that it is possible to provide 4-station and 16-channel 1 or 2-bit data processing by using single correlator unit with Mark 5 VSI compatible playback system for VLBI and e-VLBI.

Figure 1. The prototype of Altera FPGA-based scalable correlator PARSEC with Mark IV specification.

2. MicroPARSEC Prototype Correlator

We have developed the prototype correlator MicroPARSEC. PCI-bus correlator board MicroPARSEC (Figure 2) has the following features:
– standard office PC board format,
– single board supports 2 cross-correlation 64 lags channels for one baseline,
– input data rate up to 64 Msamples/sec/channel, 1 or 2 bit sampling,
– integrated input data rate to 512 Mbit/s,
– the board can be connected directly to Canadian S2-RT or S2-PT.
The features of the IAA correlators are summarized in Table 1.

Table 1. Comparison of the correlators at the IAA

	TISS-1M	**MicroPARSEC**	**PARSEC**
Year of production	1993	2003	2004
Data input format	Mark III	S2/VSI	S2/VSI
Number of channels	30	2	16
Number of lags	8	64	64
Processing rate/ch	4 Mbps	64 Mbps	64 Mbps
Sample bit	1 bit	1 or 2 bit	1 or 2 bit
Phase resolution in fringe rotation	32 bit	32 bir	32 bit
Phase cal detect	1 Hz ÷ 1 MHz	1 Hz ÷ 4 MHz	1 Hz ÷ 4 MHz
Accumulation counter	24 it	30 bit	30 bit
Parameter period	5ms ÷ 1s	50ms ÷ 50s	50ms ÷ 50s
Pulsar gate	No	Yes	Yes
Main logic	Standard logic 1C	FPGA	FPGA
Data transfer	S2	S2/Mark 5B	S2/Mark 5B
Baselines	3	1	6

We have produced and tested four prototype correlator boards. For a first test we repeated processing data of S2 VLBI observation with 2 MHz video band at Svetloe-Zelenchukskaja baseline, which had been recorded in January 2002 at 8 GHz in S2 mode, and compared with correlator TISS-1M output data (Figure 3). The same data processing was made for 2 MHz video band at the sample rate of 32 Mbps (Figure 4).

MicroPARSEC may be used as scalable spectrum analyzer for station phase cal extraction and other different system diagnostic and/or spectral line real time observation data processing in single dish mode on our radio telescopes in Svetloe, Zelenchukskaya and Badary. The features of the IAA spectral analyzer are summarized in Table 2.

For a test of MicroPARSEC spectrum analyzer we processed spectral line observation, which have been recorded at Svetloe observatory in December 2003 at 18 cm and 1.35 cm in S2 single dish mode. The results are demonstrated at Figure 5 and 6. The spectral resolution of 1 kHz was achieved for the sample rate of 32 Mbps and 2 MHz video band.

We are going to start volume production in order of the correlator board MicroPARSEC for standard office PC with standard Windows 98/2000/XP operating system and special control and monitor program developed in IAA.

The S2/Mark III correlator and new correlator PARSEC are located at and staffed by the Institute of Applied Astronomy in Saint-Petersburg, Russia. The correlators are sponsored and

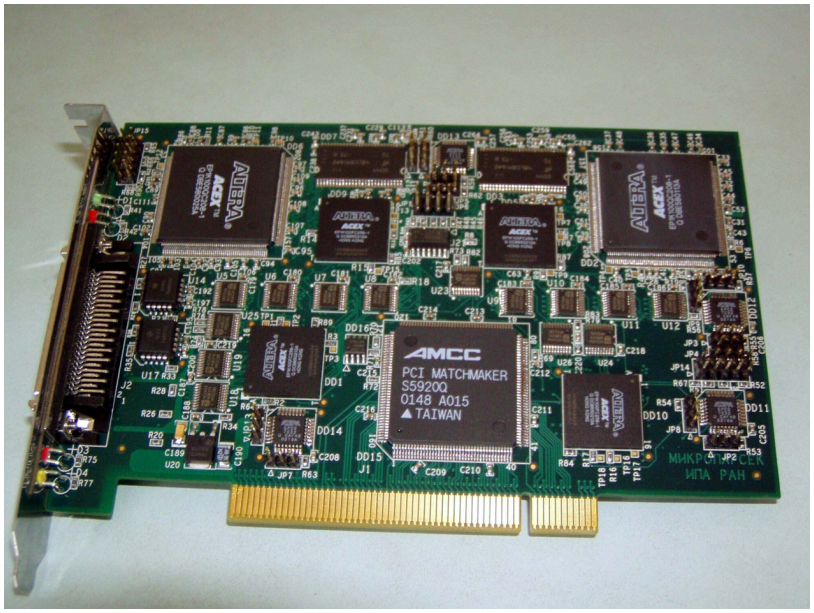

Figure 2. PCI-bus correlator board MicroPARSEC.

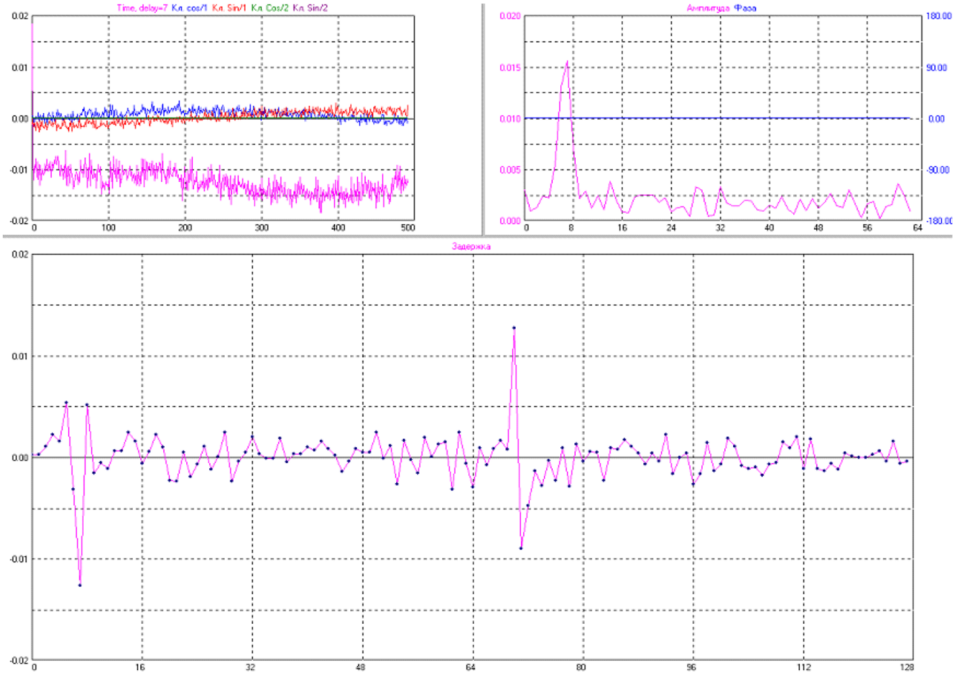

Figure 3. Output data of the MicroPARSEC at the 4 Mbit/s.

funded by the Russian Academy of Sciences, by the Russians Foundations of Basic Reserch and by the Russian Ministry of Sciences and Technologies. Dedicated to processing geodetic, astrometric

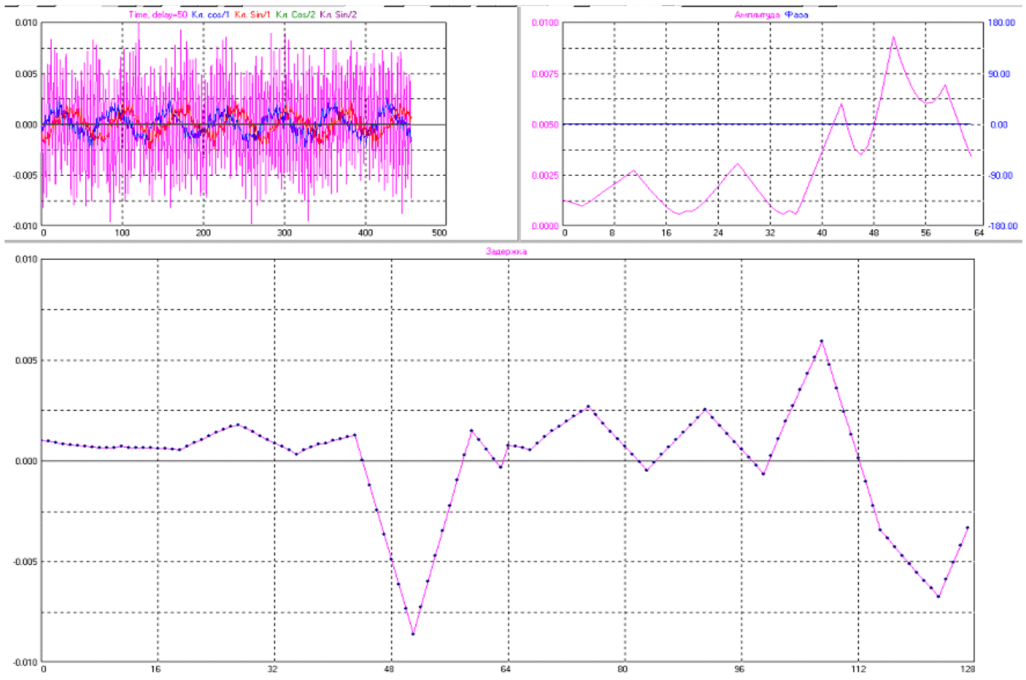

Figure 4. Output data of the MicroPARSEC at the 32 Mbit/s.

and astrophisic VLBI observations, the general role of the correlators are an operational processor for VLBI observation in Russia.

Table 2. The IAA spectrum analyzer specification

Parameter	MicroPARSEC spectrum analyser
Number of input ECL 1 bit/2bit signals	1-16/1-8
Processing rate	64 Mbps
Number of real lags	256
Number of multiplexing lags:	
for 16 MHz video band	512
for 8 MHz	1024
for 2 MHz	4096
for 125 kHz	65536
Spectral real time resolution:	
for 32 MHz video band (minimum)	250 kHz
for 125 kHz video band (maximum)	3.81 Hz
Sample bit	1 bit or 2 bit
Accumulation time	from 50 ms up to 10 s
Accumulation counter	30 bit

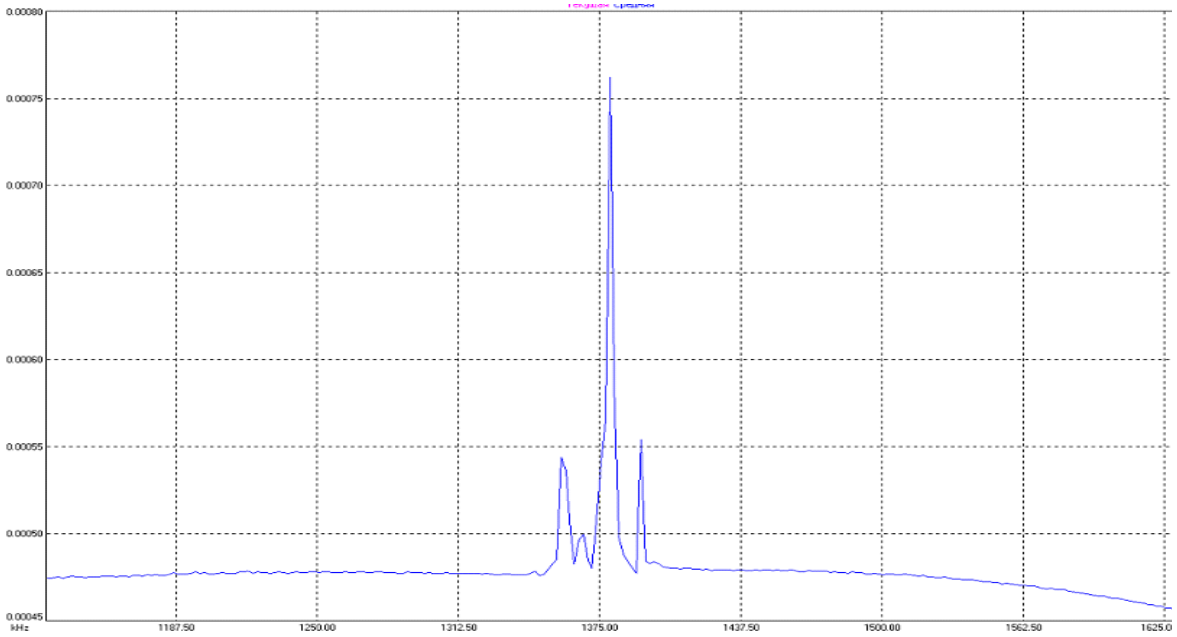

Figure 5. Spectrum of W3OH radio source at the wavelength of 18 cm.

Figure 6. Spectrum of W49 radio source at the wavelength of 1.35cm.