Utilization of Bitset Technologies for XF Correlation Processing in Software VLBI

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The K5 software correlator is a software correlation processing system that the NICT develops. Yokohama National University is trying the improvement of the algorithm that aims at the speed-up of processing and simplification of the code about this XF method correlation processing program as part of software VLBI research now.

The correlation is calculated by integrating while correcting the data of fringe stopping and the delay tracking to the observed data in the XF software correlator.

Refinement done to 'cor' (the original XF correlation software correlator) by present are the following three matters.

(1)Correlation processing that uses dynamic_bitset of Boost C++ Libraries

(2)Two level approximation of fringe stopping

(3)Correspondence to parallel processing by MPI

When the correlation is processed in 'cor', the integration value is calculated from cutting out data in every one byte and the table reference in the bit pattern. In this part, it was tried to do the correlation processing by using dynamic_bitset of Boost C++ Libraries. The two data of several hundred thousand bits can be operated directly by using it.

At fringe stopping in original 'cor', phases of sin and cos approximates by three levels (-1,0,1). This time it was tried to approximate by two levels (-1,1). In the algorithm by the table reference of 'cor', the amount computational complexity of fringe stopping can be reduced because the part of 0 doesn't be calculated. However, when bitset is used, work of not calculating the correlation of the part of fringe phase 0 is fundamentally difficult, so an extra operation is required for the correction. Therefore, we made it to handle the two level approximation of the fringe phase in the algorithm using bitset. As a result, the speed-up of processing has been achieved compared with approximating three levels. However, reducing the phase from three level approximation to two level approximation will accompany a few loss of coherent.

Moreover, we are challenging the distributed correlation processing that uses the PC cluster. The method of distributed processing is timesharing of data. Data is divided into 1PP, and of each is allocated in separate PC. Each PC processes the allocated data, and returns the result. We used MPI (mpich) that was the library most generally used with Linux for the parallel calculation library.

The software correlator that we made this time can process several times as fast as 'cor'. In addition, it was confirmed to be able to achieve the speed-up for the number of PC by distributed processing. We will examine algorithm for improvement of further correlative transaction speed in future and are going to examine correspondence to correlative processing at real time.