The simulations of stability comparisons between on-board atomic clocks and PLL methods from the ground to the satellite

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Recently, it is essential to measure precisely and accurately in pinpointing and a land surveying measurement of a scale of the earth as progressing science and technology. In these measurements, high precise and accurate time and frequency sending source in space segment is indispensable. The GPS satellites in the United States are equipped with atomic clocks, and are used widely. GLONASS in Russia and Galileo planning in Europe are enumerated as an example of being equipped with atomic clocks in the satellite.

On the other hand, the example of being synchronized atomic clock on the ground and sending source of space segment is the HALCA which was used VSOP project. In this case, the experiment result of VLBI was realized equivalent to case of being equipped with atomic clock, by controlling and comparing the signal that multiply the atomic clock signal on the ground with carrier frequency made by VCXO on the satellite.

At present, in quasi-zenith satellite, the project that sends baseband clock synchronized atomic clock on the ground and realizes clock synchronization of VCXO on the satellite is examined.

We examine theoretical formulae of each synchronous accuracy and simulations to compare on-board atomic clock with signal carrier from the ground or clock synchronous method of baseband.

Frequency instability is measured by the index for frequency domain or time domain. The index for frequency domain represents frequency fluctuations in the form of a power spectrum density indicating the intensity of slow or rapid frequency fluctuation. The index for time domain represents temporal frequency fluctuations averaged over t seconds. The index for time domain is appropriate to express frequency and phase stability over relatively long time periods. In index for time domain, the number of measurement points N should be sufficiently large, however, there is a matter that the diverging noise exists when N is infinite. Therefore, an established solution to this problem is to calculate variances for a definite N and to then average them over infinite time, to avoid divergence. This method, in which N=2, is referred to as two-sample variance (or Allan variance) and serves as the basis of stability of the time domain index.

We report evaluation result of using Allan variance to examine stability comparisons between on-board atomic clocks and PLL methods from the ground to the satellite.