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Development of a calibration device for absolute reception power of HRO meteor echoes.

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1.Background and purpose

HRO(Ham-band Radio Observation) is known as an easy meteor observation method using forward-scattering echoes of beacon waves (Maegawa, 1999). In Kochi University of Technology, a 6-channels HRO (North, South, East, West and zenith with 2 polarizations) began in July 2003. A 3-channels radio interferometer was produced and started its observation with direction-findings of meteor echoes in January 2005. (Horiuchi et al., 2005). In January 2009, a 5-channels radio interferometer was developed, resulting more precise calculations of meteor appearance position than the 3-channels radio interferometer as well as quasi-realtime web casting of meteor plasma coordinates in 90 km plane (Noguchi, 2009). However, accurate absolute values of reception power of meteor echoes can not be obtained by these observation tools. Observational data are insufficient for deriving statistical studies of energy estimation of each meteor, mass distribution, and flux. Purpose of the present research is development of absolute reception power by developing a calibration device for HRO echoes.

2.Absolute power calibration device

Reception power of each meteor echo is usually indicated in an intensity graph of the ”HROFFT” (a dedicated software for HRO) corresponding to relative power (dB value) on a noise floor. Intensity of Doppler distribution is indicated on a FFT spectrogram using relative color scale of 13 levels (0 to 12). In HRO, expectation of absolute power of each meteor echo is in a range between -80 dBm and -120 dBm (Usui, 2004). In this study, we develop a signal generator that can output simulated meteor echo signal, creating a descending step-function with 10 dB intervals in 5 seconds per 10 minutes. The developed device will be applied to receiver block of the 5-channels radio interferometer. We can analyze absolute power of each meteor echo by indicating the simulated signal by HRO_IF_View software that can display waveform of each echo.

3.Development

In this study, we produced a circuit using PLL (Phase Lock Loop) technique based on an experiment at Nobeyama observatory (NAOJ) as a reference (Usui et al., 2004). In the PLL circuit, phases are compared between a reference signal of 16 MHz from a crystal oscillator and an output signal from VCO (Voltage Controlled Oscillator). When phases of the both signals are locked by auto-tuning feedback process, the PLL circuit can output a carefully-adjusted 860 MHz signal. Then, the frequency of output signal is down-converted to 1/16 by two frequency dividers. A final output is 53.75 MHz, the observational frequency of HRO. Typical output power of the PLL circuit is about -50 dBm. Therefore, absolute power range of our purpose can be obtained by attenuation and precise calibration process of the output signal by a signal generator (Aglient, 33250A) . In this presentation, we will introduce a preliminary result and detail of the study.

References:

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