Doppler Shift Correction for 2SB Receivers of the 45m Telescope at the Nobeyama Radio Observatory

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Introduction

Two sideband-separating (2SB) receivers (T100H&T100V) have been installed for public use. These new receivers can simultaneously observe in both sidebands (LSB&USB). For Doppler shift correction, the local frequency (Lof) correction method used in NRO is not suitable for these receivers, because the correction can be applied for only one sideband, and the correction of the other sideband is not accurate. In order to solve this problem, we have developed a new Doppler shift correction method for the 2SB receivers. In this poster, we present this software Doppler shift correction method for the 2SB receivers, showing a comparison with the conventional Lof correction method.

Data Flow

T100 H&V

Observation

Receiver Local Mixing

Spectrometer A/D

Logging Data Storage

Data Logging

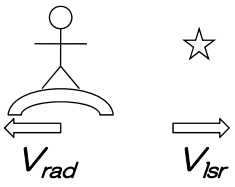
Raw Data Storage

Data Merge (add headers)

User Data Processing

Doppler Effect

Since relative velocity between an object and an observer has time dependency due to the earth rotation and revolution, Doppler correction should be done for each scan.

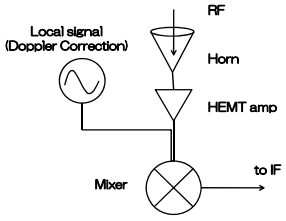


$$V = V_{rad}(t) + V_{lsr}$$

$$f_{obs} = f_{rest} \times \frac{1}{1+\frac{V}{c}}$$ (Optical definition)

Doppler Correction for non-2SB Receivers

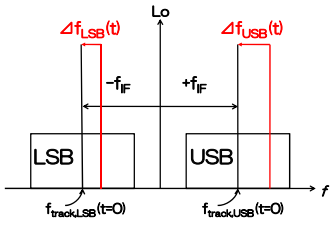
When observations are performed using a position switching method, receivers (HEMT22, SIS80/100, BEARS etc.) of the 45m telescope at the Nobeyama Radio Observatory adopt a local frequency (Lof) correction method; namely, the correction is done by slightly changing the Lof (synthesizer frequency) every integration.



Ex.) Doppler correction for HEMT receivers

Doppler Correction for 2SB Receivers

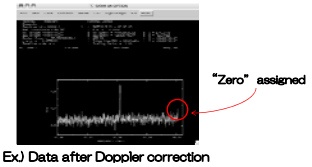
We have developed a new Doppler shift correction method for the 2SB receivers . The new method is that Lof is set as the value of the first integration and fixed throughout an observation, and all the Doppler corrections are done at the merge process.



The correction values in the case of the LSB reference are described as follows.

$$\Delta f_{LSB}(t) = f_{LSB}(t) - f_{track\,LSB}(0)$$

$$\Delta f_{USB}(t) = f_{USB}(t) - f_{LSB}(0) - 2\times IF$$



Ex.) Data after Doppler correction

Summary

- For non-2SB receivers, Doppler corrections are done by changing the Lo frequency (hardware corrections).
- For 2SB receivers, Doppler corrections are done at the merge process (software corrections).