SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (3)

Author: Mr. Khwaja Bilal Jillani
Pakistan Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan

Mr. Muhammad Salman Yousaf
Pakistan
Mr. Muhammad Ahmad
Pakistan Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan

APPLICATION OF FREQUENCY DEMODULATION TECHNIQUE FOR DOPPLER COMPENSATION IN RECEIVER

Abstract

For a communication scenario, where relative position of transmitter and receiver changes, consequent Doppler frequency shift in the received signal is unavoidable.This deviation can cause critical impairments, such as carrier synchronization loss and higher bit error rates in the receivers. This paper presents implementation and test results of the Doppler shift mitigation technique utilizing intrinsic property of frequency demodulation. In a typical super-hetero dyne receiver architecture, the Doppler shift in received carriers signal is linearly translated on both intermediate frequency (IF) stages. Frequency demodulator is located at the output of 2nd IF stage and tracks frequency deviation in the down converted carrier. The response of the frequency demodulator is in the form of voltage versus carrier frequency deviation, the well-known S-Curve. The instantaneous output voltage of a frequency demodulator is congruent to net instantaneous frequency deviation present at its input and hence carries information for both the desired deviation caused by modulating message signal and the deviation caused by undesired Doppler shift. At the output of the frequency demodulator, the voltage variation component peculiar to Doppler shift is alienated, conditioned and then applied to reference frequency source of the receiver, to change its frequency commensurate for the Doppler shift, and thus alleviating Doppler shift. This approach eases the design as it avoids a fixed frequency reference which is otherwise required for comparison with down-converted version of received signal and to emanate stable DC voltage for frequency control. This work present mathematical modeling of Doppler frequency shift and implementation of Doppler compensation with frequency demodulation technique, supported with hardware performance results for Doppler Compensation in receivers. Frequency Demodulator is developed and tested by implementing different modules including limiter, amplifier, discriminator and envelope detector. The circuit is then developed and deployed in prototype receiver to verify its tracking capability.