

GPRI-II-2 Operational Description

The GPRI-II-2 (Gamma Portable Radar Interferometer) developed by Gamma Remote Sensing is an FM-CW radar operating in the frequency range 17.1 – 17.3 GHz (17.4 mm) with an operational range from 20 meters to 16 km as shown in Figure 1. The system is fully coherent and can be used to perform highly sensitive interferometric measurement of target motion along the line of sight (LOS). Motion of 8.71 mm along the line of sight (LOS) between observations results in a 2- π interferometric phase signal. Shifts as small as 0.1mm can be measured at 1 km distance.

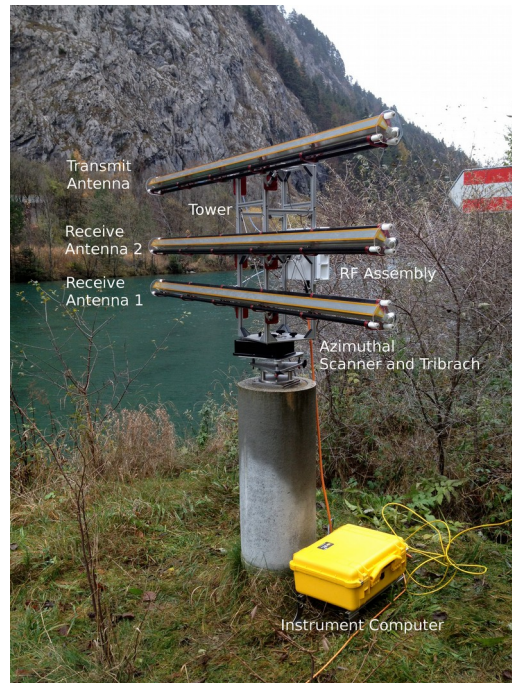


Figure 1: GPRI Instrument Located at the Simme-fluh, Canton Bern, Switzerland

The radar consists of an antennas, antenna tower with azimuthal scanner, RF electronics assembly mounted on the tower, and an instrument computer enclosure. The antenna tower supports the transmitting antenna and two receiving antennas. Power and control is provided by the instrument computer and power supply contained in a Pelican case located near the tower base. Baseband receiver signals are digitized by a software-defined radio (SDR) system located in the instrument computer enclosure. A GPS receiver provides frequency and time reference for the GPRI-II-2.

The GPRI-II-2 is a real-aperture radar using a 206 cm long slotted-waveguide antenna to generate an antenna fan-beam that is 0.5 x 35 degrees. During data acquisition, the radar performs a rotary scan of the scene at a programmable rate between 5 and 10 degrees/second. The time required to obtain a single image is approximately 20 seconds for a 180 degree azimuthal sweep. The transmitter is switched on at the start of the scan and switched off at the end of the scan.

Azimuth resolution is range dependent due to the fixed azimuth beamwidth of 0.5 degrees. Azimuth resolution is approximately 7 meters at a distance of 1 km. Range resolution is determined by the bandwidth of the radar signal and subsequent filtering. The nominal range resolution (3 dB) is 90 cm along the LOS.

The radar uses FM-CW modulation generated by a direct digital synthesizer programmed to generate a chirp between 100 and 300 MHz. The duration of the chirp is fully programmable. Suggested values of the chirp duration are 500 μ s, 2 ms, 4 ms, and 8 ms. The 500 μ s chirp is used for targets out to 1 km, 2 ms out to 4 km, 4 ms out to 8 km and 8 ms out to a distance of 16 km. The rotational velocity is nominally 10 deg/sec for 500 μ s and 2 ms chirps, 5 deg/sec for the 4 ms chirp, and 2.5 deg/sec for the 8 ms chirp.

The FM-CW waveform is generated by a direct-digital synthesizer (DDS) at baseband (100-300 MHz). The Pulse Repetition Frequency (PRF) is 1/chirp duration. Therefore the PRF is 2 kHz for a 500 μ s chirp. The transmit chirp is translated 17.1 to 17.3 GHz using an intermediate frequency of 900-1100 MHz. The received signal at 17.1 to 17.3 GHz is heterodyned to 900-1100 MHz and then deramped using the transmitted chirp to generate a baseband signal that is digitized. The range echo signal is obtained by applying an FFT to the digitized signal.