either VV or HH depending on the transmitted polarization. STC is computed by the SAR control computer at flight configuration time for the altitude, swath mode, antenna polarization, and STC law. The same law is used until a new configuration is applied.

A test was carried out to verify that the theoretical STC gain was achieved in the hardware of the system. A CW (Continuous Wave) test noise signal from the ERU built-in-test-equipment (BITE) was run through the receiver/processor system and recorded. Over 1400 lines were averaged at half resolution, to obtain a good estimate of the applied STC correction[1].

Figure 4 is a comparison of the theoretical and system response for the LAND STC for a configuration height of 20000 ft (6048 m) and antenna depression angle of 22.1°. The agreement of the modelled parameters and the actual implementation is better than 0.5 dB.

2.5 Motion Compensation System

Real-time processing of airborne SAR data obtained from straight, level and constant speed flight is, in itself, difficult. Processing with simultaneous correction for random angular, linear and turbulent aircraft motion represented a major challenge requiring unique modules for high speed calculations as well as development of large and complex software packages. Such correction is necessary to maintain good focus and correct illumination. The motion compensation system compensates the phase of the returned signals and controls antenna stablization.

Acceleration, velocity, aircraft attitude, track and heading data from a Litton 92 inertial reference unit (IRU) are used by the motion compensation computers. This unit uses laser ring gyros and has five times better angular measurement accuracy and reliability than previous mechanical gyro platforms. The motion parameters such as aircraft vertical and across-track acceleration are output on a digital bus.

Phase corrections must be related to the motion of the aircraft relative to the reference track. A real-time digital pipeline processor corrects the phase of the radar signal according to the motion calculated from the INS platform by the motion compensation module.

Digital motion compensation is more accurate than analogue phase shifting in the transceiver and delivers better performance over a wide swath because it allows the data to be delayed and modified after the corresponding motion measurements have been determined.

2.6 Real-Time SAR Processor (RTSP)

The RTSP is divided into two processing units: the Preprocessor and Control Unit (PCU) and the Azimuth Processor Unit (APU). The I and Q video signals produced by the STS Exciter-Receiver are fed, together with timing signals, to the ADC module in the PCU, where the signals are sampled into range lines of digital data. High speed buffers expand each range line in time, to allow processing to be spread over most of a pulse repetition interval (PRI). The start range of digitization and the phase of the I,Q data are compensated by the motion compensation system, described in Section 2.5, in real time for motion occurring within a synthetic aperture. The compensated data are sent to the APU, and a special interface provides for recording of the range-compressed data by a High Density Digital Recorder (HDDR). The software is designed to cope with the increase in processing load with increases in flight speed. (The same processing is performed for each PRI and the pulses are equally spaced on the ground.)

Within the APU, the azimuth bandwidth is separated into looks by a set of azimuth filters using complex frequency translators and digital filters. Time-domain azimuth compression is performed for each look in parallel by the correlator module which also outputs range lines of detected looks. A look-summation module performs summation to superimpose all data corresponding to the same pixel on the ground.

Real-time signal monitoring is also provided for outputs after detection. The output module appends annotation data to each range line of data, as well as optionally overlaying bit-mapped annotation. The radar imagery is fed to a strip recorder and video display for immediate viewing as indicated in Section 2.8.

2.7 User Accessible Modes

The CCRS C-band SAR has been designed as a flexible research instrument which allows a wide range of parameters in the three viewing geometries. The majority of the parameters are selectable from an interactive CRT display and define radar operating states. Each state defines a possible radar configuration and is automatically logged during acquisition together with a number of dynamic flight parameters to aid in image definition and later analysis. The operating states of interest to radar data users as *Standard Configurations* are defined by one selection from each row of each path in Table II.

In Table II, the entries marked with an asterisk (*) are derived from the user description of the measurement mission. Entries marked with a dagger (†) are normally set to default values chosen to produce the best results for the measurement problem as far as these are known. Careful description of the measurement problem at the flight request stage will usually result in the most suitable choice of the standard configuration used. The table is largely self explanatory; however, the following points may be of interest.

[1]The same method, using the actual ground returns, allows quantitative work to be carried out in determining the terrain reflectance model (knowing the other terms in the STC equation).