SCOPE OF FUTURE WORK

Since AMPA is a viable technique, different quasi-optical power combining can be done by synchronising the individual AMPA array. Once this is done progressive phase shift needed for beam scanning can be written according to the rule of injection locking is

\[ \phi = \sin^{-1} \left( \frac{\omega_s - \omega_f}{\Delta\omega} \right) \]

where \( \omega_s \) is the frequency of synchronising signal and \( \Delta\omega \) is the locking bandwidth. Several active patch antennas (having different bias voltages) oscillating at different frequencies lie within the locking bandwidth for a given locking gain. They can be locked mutually or through a reference source resulting in coherent combination of power. The combined beam can be steered in the broad side direction. It is seen that the steering angle \( \phi \) is directly proportional to the phase difference between self-oscillating frequencies. Beam steering is thus possible without conventional phase shifters. It has been observed theoretically that with the introduction of a hybrid array (described in 4.9) comprising two active patches separated by a passive patch at the middle can successfully steer a beam in any direction. Experimental verifications will be studied in future. This type of hybrid array can be suitably used to design an active phased array antenna.

As the external signal couples to the array through substrate increased locked power, lock range has been realised with the proposed hybrid array. This type of arrangement should be useful for reception purpose. Diminished locking range was one of the disadvantages of the proposed receiving scheme (chapter 5). With a hybrid array (section 4.9.1) consisting of a number of active elements, larger demodulation bandwidth can be realised which can successfully accommodate a large number of voice or data channels. Effect of co-channel interference and unwanted disturbances will be studied in future.

Future generation space-based communication systems are required to generate a large number of shaped re-configurable and re-positionable antenna beams for earth stations and mobile receivers. To meet this challenge large aperture active phased array antenna systems are needed, because in the approach RF circuit functions are transferred to the antenna platform. High-density integration of these circuits is made possible with the help of GaAs microwave monolithic integrated circuit technology. The antenna system will have a transmitting module and a receiving module with each of the elements or a group of radiating elements. These circuits will require a frequency reference to local oscillators in the sub-arrays to have them frequency and phase synchronised. In recent years extensive research works have been done on the use of lightwave technology to microwave systems, particularly for space based systems where size, weight etc are of prime consideration. Optical fibres posses several advantages due to its light weight, flexibility, large bandwidth, immunity to electromagnetic interference etc. An OPLL can be designed with a view to build up opto-electronic microwave signal generator with the help of commercially available wide linewidth DFB lasers. This technique obviously reduces the cost of the system. The outputs of the transmitter laser and VCO laser (both are DFB lasers) generate a beat signal corresponding to the frequency offset between the two sources. This can be gainfully used as a reference signal. This OPLL seems a realistic approach for generating reference signal for future advanced communication systems with active phased array antennas. Detailed theoretical work supported by numerical experiments will be taken up in future.