CONCLUSION AND FUTURE PERSPECTIVE

5.1 Thesis highlights and contributions

This chapter highlights the accomplishments and achievements of the research work. A sum up of the results and the directions for future study are also discussed.

5.1 Thesis highlights and contributions

This chapter stands as a brief conclusion of the thesis. It also highlights the objectives of the study and the achievements attained.

The aim of the thesis was to design highly compact uniplanar antennas which can be easily fabricated. The conventionally used coplanar wave guide fed antennas cannot easily cater to the growing requirements of ultra compact antennas.

On a broader sense an antenna can be considered as composed of a feed and a radiator, even though they cannot be segregated in practice. The feed acts as an interface between the radiator and the coaxial connector and is essential for the proper functioning of the antenna. The radiating element primarily
determines the reflection and radiation characteristics of the antenna. But in compact antennas such a division is untrue since the feed as well as the radiator together determines the reflection and radiation characteristics.

In this thesis emphasis is given both to the design of the feed as well as the radiator. The Asymmetric coplanar strip (ACS) – a compact uniplanar feed is chosen in place of the conventional coplanar wave guide. Various designs are studied using this feed to design different compact and ultra compact antennas highly useful for practical applications.

5.1.1 The Asymmetric coplanar strip fed antennas

The choice of the Asymmetric coplanar strip (ACS) as a feed in place of the conventional coplanar wave guide (CPW) feed is one of the important highlight of the Thesis. From comparative studies it is proved that the ACS fed antennas exhibit nearly the same characteristic as compared to antennas fed by conventional feeding techniques like the CPW barring a tilt in the radiation pattern. For the efficient use of this feed in place of the conventional ones, exhaustive simulation and experimental studies are performed.

From the studies the following conclusions are reached upon in the case of ACS fed strip monopoles. These inferences are used to design compact Single band, Dual band and triple band antennas as discussed in chapter 3.

The following inferences are obtained from the study of the ACS fed strip monopole.

1) The resonance is due to the combined length of the signal strip and the ground plane.

2) Better performance is noted when the length of the ground plane is kept nearly equal to the signal strip length.
Thus the ground plane contributes to the radiation and acts as part of the feed. The designs with baluns are also studied. Much difference in the performance is not seen. It remains upto the designer to choose the antenna with or without the balun according to his constraints of area since the usage of balun requires larger area.

The strip monopole is then bent in the form of an inverted L to achieve further compactness (Fig. 5.2.b). The dimensions of the inverted L antenna are optimized for better performance. It is interesting to note that the tilt in the pattern as in the previous case is removed in this design.

![Asymmetric Coplanar Strip fed compact antennas]

Fig. 5.1. Asymmetric Coplanar Strip fed compact antennas

a. ACS fed Single band antenna  
b. ACS fed inverted L antenna  
c. F shaped dual band antenna  
d. ACS fed Triple band antenna

This single band inverted L is further modified to a dual band antenna by adding an additional strip at the position of minimum current intensity. This gives an F shaped dual band antenna (Fig. 5.1.c).
The width of the signal strip of the inverted L shaped antenna is further modified and along with the insertion of a slot to produce the multi band antenna in (Fig.5.1.d).

All the above compact designs have an overall size of $\lambda_d/4 \times \lambda_d/4$. These studies are elaborately presented in chapter 3. The rapid development of wireless communication demand further ultra compact designs. This is also discussed elaborately in the thesis in chapter 4.

5.1.2 Asymmetric coplanar strip fed Ultra compact antennas

The ACS feed can be used for the design of ultra compact antennas. The signal strip is bent in the form of a loop. The resulting reactance is balanced by the insertion of a proper slot at the appropriate position. This results in a ultra compact antenna with overall dimension in the order of $\lambda_d/5 \times \lambda_d/18$ (Fig.5.2.a).

The above dual band antenna is properly modified to design a triple band antenna by adding an additional strip at the current minimum position as in the earlier case. The resulting antenna covers GSM 900/1800 and 2.4 GHz WLAN bands with dimensions of the order of $\lambda_d/5 \times \lambda_d/10$ (Fig.5.2.b.).

**Fig 5.2.** Asymmetric Coplanar Strip fed Ultra compact antennas  
(a) Dual Band  
(b) Triple band

5.1.3 ACS fed Ultra compact antennas for DVB-H applications

The recent introduction of DVB-H services has fostered a great need for compact antennas for designing compact devices. The above designs are
suitably modified to design ultra compact antennas for DVBH applications. A highly compact antenna having dimensions of the order of $\lambda_d/7 \times \lambda_d/22$ is presented (Fig.5.3.a). The antenna exhibits good reflection and radiation characteristics and is highly suitable for DVB-H applications.

The above design is further modified into a dual layer with a eye on practical applications (Fig.5.3.b). This facilitates further compact design so that only $\lambda_d/8 \times \lambda_d/23$ of the PCB space is needed for the DVB-H antenna. The top layer is more compact of the order of $\lambda_d/9 \times \lambda_d/66$.

![Fig 5.3. Asymmetric Coplanar Strip fed Ultra compact antennas (a) DVBH antenna 1  b) Top view of the modified DVBH antenna](image)

### 5.2 Slot line fed antennas

In addition to the Asymmetric Coplanar Strip feeding technique another uniplanar feed which has received recent attraction is the Slotline feed.

The Slot line may be considered as a complementary of the coplanar wave guide. The main advantage of this transmission line is the ease for mounting active and passive circuits into these lines.

Two different slot line fed designs (slot line fed dipole (Fig.5.4.a) and slot line fed dual band antenna (Fig.5.4.b)) are also studied in the thesis and is given as appendix.
5.3 Scope of future work……

The Asymmetric coplanar strip is an effective candidate for the design of compact antennas and it has been proved by the studies presented in the thesis. The practical use of the device into mobile phones and other compact devices require further optimizations. Also the introduction of the antenna into a practical circuitry with ICs, resistors, capacitors, cameras, speakers etc are expected to create variations in the performance. This has to be practically tested and the antenna has to be fine tuned for best performance.

Also the need for an “Universal Antenna” which can support the existing mobile communication bands along with the DVB-H bands is in a rise. As a future challenge the design of an ACS ultra compact “Universal Antenna” can be seriously looked upon.

The reduction of radiation towards users head while using the antenna in practical mobile phones may also be conducted by suitably loading with metamaterials. Other different compact designs using metamaterials can also be worked upon
In short the Asymmetric coplanar strip feed antennas opens up new and interesting arenas for the design of simple miniaturized antennas for an antenna designer which are cost effective and can be easily fabricated.