CHAPTER 8

CONCLUSION

8.1 INTRODUCTION

The most important part of the MRI system which pedals the cost and quality of MR imaging is RF coil. The usage of microstrip transmission lines for high frequency RF circuit and antenna design has been greatly evolved over the years. The ability of microstrip based structures for low frequency (63.87 MHz) operation will lead to physically a large sized RF coil. In most of the MRI RF coil structures the design part of input matching is often ignored. By considering all the above shortfalls in this work many variants of microstrip based RF coil structures are proposed for 1.5 Tesla MRI system and their performance results are discussed.

8.2 SUMMARY OF THE RESULTS

The research focuses on the design and analysis of surface Type and volume type RF coils for 1.5 Tesla MRI system. There are four different types of surface coil geometries are proposed for low field (1.5 Tesla) MRI requirements. The three structures were extended to construct phased array RF coil with optimized impedance matching (modified Type1 matching) network.
The optimized matching network consists of two capacitors (C1 & C2) in shunt and series configuration to the RF coil. The quality factor is analytically expressed for all the phased array coils.

Short circuited stepped impedance structured (SIS) 8 channel phased array RF coil achieves a quality factor value of 236 and a return loss of greater than 20 dB in all the 8 channels. The total area (FOV) occupied by the 8 channel SIS RF coil is 387 mm x 300 mm.

The 8 mm width octagon shaped 12 channel phased array structure with diagonal spacing of 11.3137 mm is implemented within a field of view of 382 mm x 284 mm. It achieves a quality factor of 169 and a return loss of greater than 19 dB in all the 12 channels.

The 8 mm width hexagon shaped 24 channel phased array structure with parallel spacing of 12 mm is implemented within a field of view of 427 mm x 281 mm. It achieves a quality factor of 330 and a return loss of greater than 20 dB in all the 24 channels.

Table 8.1 shows the performance comparison of quality factor and return loss for all the phased array RF coil structures.

A 12 element volume type microstrip birdcage coil is proposed for 1.5 Tesla MRI system. An FDTD simulation is performed to analyze the behaviour of RF coil at 63.87 MHz. The coil achieves a return loss of more than 25 dB. The SAR value obtained for the proposed design is less than the SAR limitation specified by IEC (IEC 2002) standard.
Table 8.1 Quality factor and Return loss comparison of proposed phased array surface coils

<table>
<thead>
<tr>
<th>Phased array structure</th>
<th>Number of channels</th>
<th>Field of View (mm$^2$)</th>
<th>Quality factor</th>
<th>Return loss (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short circuited Stepped impedance</td>
<td>8</td>
<td>386 x 300</td>
<td>236</td>
<td>Minimum : 20.8 Maximum : 26.5</td>
</tr>
<tr>
<td>structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octagon shaped structure</td>
<td>12</td>
<td>382 x 284</td>
<td>169</td>
<td>Minimum : 19.3 Maximum : 25</td>
</tr>
<tr>
<td>Hexagon shaped structure</td>
<td>24</td>
<td>427 x 281</td>
<td>330</td>
<td>Minimum : 20.3 Maximum : 26.4</td>
</tr>
</tbody>
</table>

8.3 SCOPE FOR FUTURE WORK

The proposed research works are analyzed and their performances are verified at the simulation level by Advanced Design System 2011 & Electromagnetic Professional 2011 softwares. The future extension of the proposed RF coil research works are the hardware realization and testing.

The phased array works could be implemented in Printed Circuit Board (PCB) fabrication. Lumped matching capacitors will be soldered at the input side of PCB to perform the return loss performance testing of the RF coil using vector network analyzer. Even though the volume type birdcage coil is giving better results, the difficulty arises to fabricate it. The fabrication of microstrip structures in cylindrical format is a major hurdle. It is good to concentrate planar type SIS for volume type RF coil construction. Instead of placing the SIS elements horizontally, insertion of the individual SIS elements inside a cylindrical frame will give volume type RF coil structure.

This leads to the indigenous development of proposed RF coils for 1.5 Tesla MRI system.