Chapter 6

Conclusion

6.1. Background

The use of microstrip antennas has become increasingly popular. Despite the advantages promised by microstrip patch antennas, their inherent narrow impedance bandwidth often comes as a drawback limiting the antennas' usability. A number of proposals to enhance the antenna's impedance bandwidth performance by physically altering the antenna have been presented and are mentioned briefly in Chapter 2. The viability of a matching feed network to improve the bandwidth was also considered in the open literature, and the most common matching techniques were listed in Chapter 2. In Chapter 3 an alternative matching idea named the SRMT (Optimum Bandwidth Simple LC-Resonant Matching Technique) was presented. The SRMT was originally considered for probe-fed microstrip patch antennas. A number of well-known standard matching circuits were implemented in Chapter 4 to compare the SRMT with these techniques, while Chapter 5 presented examples where the matching technique was applied to various types of patch antennas both in simulation and measurement. The resulting improvement in impedance bandwidth was shown, and the different effect the SRMT has on the various types of antennas is highlighted.

In this, the final chapter, a retrospective overview of the work done in this dissertation is given. In the next section conclusions on the performance of the feed networks presented in this dissertation are drawn. Section 6.3 elaborates on the knowledge gained in this study and presents a number of ideas for future work.

6.2. Contributions

In Chapter 3 the design of a resonant circuit was explained. Theoretically predicted results were presented. It was evident in Chapter 3 that the SRMT is able to double the original antenna VSWR bandwidth. Chapter 5 presented a number of examples. The electrically thin patch antenna ("substrate-only" patch) ended up with a bandwidth improvement factor in excess of 150%, and for the electrically thick patch (10 mm air patch) an improvement of 85% was obtained. Although the improvement is less drastic, the electrically thick patch antenna presents a reasonably wide operating bandwidth in comparison to other types of microstrip patch antennas. In Chapter 4 the SRMT was compared to results obtained by the SRFT in [2, 4], and in Chapter 5 the SRMT was compared to the quarterwave coupled matching network, presented in [18]. The SRMT-matching network compared well with these matching techniques.

The SRMT-network is fairly simple to design and realise in microstrip line. The predefined circuit layout ensures that possible space occupancy is roughly known early in the antenna design process. The aim of the matching network is to reach a compact and effective solution. The SRMT-circuit succeeds in that only four components are used and the results are comparable with published results obtained for previous antenna matching techniques.

The SRMT works on the basic principle that the input impedance of a probe-fed patch antenna represents an equivalent parallel-RLC circuit with a series inductance. The impedance frequency behaviour obtained for the probe-fed patch is not limited to this type of antenna, but other patch antennas, as well as dipoles and almost any type of single element antenna can benefit from this matching technique. For other antennas without the equivalent series inductance the level of phase transforming will probably be the main variable.

In this study it was illustrated how the feed network can be integrated as part of the design process of the antenna. Once the feed network is considered an integral part of the antenna, a newly defined system (i.e. feed network and antenna integrated) can be designed with enhanced performance. The matching feed network enables one to reach a specific impedance bandwidth without necessarily altering the antenna itself.

6.3. Challenges and issues for future work

The main focus of this study was to find a relatively simple way to solve the narrow impedance bandwidth problem of microstrip patch antennas. The use of the SRMT-network was proposed and analysed. The SRMT-circuit worked very effectively for narrowband patches, with the antennas obtaining more than double the original impedance bandwidth. The wideband patch, on the other hand, has shown less drastic improvement. A topic for future work might be to investigate the possibility of two or more resonators in the circuit.

The antennas presented in the dissertation are all single element radiators. In the case of an array of radiators the SRMT-circuit will be able to enhance the impedance bandwidth of each of the individual elements in the array. Another possible option for further investigation would be to look at how a single LC-resonator would be able to improve the impedance bandwidth of an array of antennas.