CHAPTER 6

Conclusion and Suggested Further Research

6.1 Conclusion

This dissertation has proposes a new synthetic guiding structure of CCSs that provides a wider choice of characteristic impedance and flatter propagation characteristics than a meandered MS structure (see Fig. 3.5). It is especially appropriate for use in designing compact passive circuits using microwave TLs. The CCS TLs were used successfully in designing a 5.4-GHz CCS rat-race hybrid prototype, the area required for which is only 13% of that of the conventional MS ring-shape coupler, using a PCB process. An LC-free, fully integrated compact 5.2-GHz CMOS oscillator with an area totaling 500 × 600 μm^2 including pads is designed. Its simulated and measured oscillation frequencies are within 1% of each other. More compact and further improved microwave integrated passive circuits, including CCS TLs, will be described in the near future.

The second part of this thesis also presents a novel synthetic beam-steering leaky-wave antenna without phase shifter. The main beam can be made to point at different angles as desired, by directly manipulating the phase constant of the leaky micro-slotline using the reactive loading across the slotline. A prototype

was constructed and tested, demonstrating that a beam scanning angle of 23° is obtained by periodically loading the 0.06527-pF capacitors along the leaky line at 4 GHz. An electronic beam-steering antenna of scanning angle 13.5° was established by replacing the MIM capacitors with only four DC-blocking varactors. The periodical capacitor loading concept and design method can be applied to steer the main-beam and tune the propagation characteristics of the other leaky-wave antenna, the new antenna and technique may become good candidate for microwave and millimeter-wave integrated beam-steering, scanning antenna design.

6.2 Suggested Further Research

As the first suggestion there appears greater needs for more database covering broader guiding properties of CCS TLs applied to various processes, such as PCB hybrid, GaAs pHEMT, and CMOS foundries. Therefore RF passive circuits can be made and studied concurrently. The second is the need for a simplified or behavioural model of the CCS TLs in order to analyse or synthesize microwave circuits rapidly. A successful model of the CCS TLs can help excel the use of CCS TLs in the course of miniaturizing microwave circuit. The third can be quantitatively analyses of the beam-steering operational principle at higher precision, leading to more understanding of multi-beam phenomenon, mode conversions, and space-harmonic modulations due to the

periodically reactive-loading for the synthetic beam-steering micro-slotline. Lastly the electronic beam-steering micro-slotline can be extended to a two-dimensional, compact, electronic scannable, active array antenna.