PREFACE

The eagerness to seal the millimetre-wave technology gap in the high-power regime, where there are numerous civilian and military applications, has resulted in extensive research and development activities in fast-wave gyro-sources and amplifiers. Although different gyro-source, namely, the gyro klystron and gyro – TWT are available for radar applications such as asteroid tracking, weather monitoring, space debris detection, the gyro-amplifiers like the gyro-twystron is required that unite the merits of gyro-klystron and gyro-TWT, i.e., high power with wider band width.

The gyro-twystron, employs a resonant cavity in conjunction with a waveguide to support propagating waves, combines the high power merits of the gyro-klystron with the wider bandwidth advantage of the gyro-TWT. Despite this aspect, the gyro-twystron is the most unexplored device in gyrotron family. These advantages and applications have aroused considerable research interest in widening the bandwidth of a gyro-twystron for applications such as in high-resolution radar and high information density communication systems in the millimetre-wave frequency band.

The author, in the present thesis, has explored the different mechanism i.e., stagger tuning (chapter 2 and chapter 3) and cluster cavity (chapter 5), for the bandwidth widening of the gyro-twystron for the various radar application. The periodic dielectric loading (PDL) technique is used to detect and suppress oscillations while increasing output power (chapter 4). A simple field matching technique is used for the analysis of a dielectric loading, for dispersion control and hence wideband coalescence between the beam-mode and waveguide-mode dispersion characteristics of a gyro-twystron. The complete gyro-twystron is designed and simulated in commercially available CST environment and the beam wave interaction behaviour of

the gyro-twystron based on Particle In Cell (PIC) is also investigayed.

The ability of the gyro-twystron to deliver the desired outputs is constrained by the design and performance of the various sub-assemblies, such as the electron beam source, spent beam collector, and RF output window. The author has designed, simulation and optimized the magnetron injection gun (MIG), undepressed and single stage depressed collector, single and double disc RF window to improve the amplifier's performance.

The author, from time to time, has reported the present work part-wise at national and international conferences as well as in professional journals, namely, IEEE Transaction on Electron Devices.

The author will consider his small effort a success if this work helps the vacuum electron device community to develop the wideband gyro-twystron, which has a lot of potential but hasn't been looked into much.