

Contents

Resumen	v
Resum	vii
Abstract	ix
Contents	1
Figure list	5
Table list	15
Acronyms	17
1 Introduction	19
1.1 Motivation	19
1.2 Objectives	21
2 State of the art	23
2.1 Satellite telecommunication links and transponders	24
2.2 Transponders and waveguide technology	27
2.3 Waveguides and microwave filters	29
2.4 Tunable microwave waveguide filters	34

2.5	Full-wave electromagnetic simulators	35
2.6	Design and optimization procedures of microwave waveguide filters	36
3	Filter design using OS-ASM	39
3.1	Cavity perturbation theory	41
3.2	Experimental investigation	41
3.3	Detailed numerical investigation	48
3.4	One-Step Aggressive Space Mapping (OS-ASM)	49
3.5	CAD demonstration	50
3.5.1	Tunable rectangular four-pole filter	51
3.5.2	Tunable rectangular eight-pole filter	56
3.5.3	Classic circular dual-mode filter	60
3.6	More general examples	63
3.6.1	Tunable rectangular four-pole filter with OS-ASM	63
3.6.2	Tunable rectangular four-pole filter with ASM	66
3.6.3	Fully tunable dual-mode filter with OS-ASM	67
3.6.4	Fully tunable dual-mode filter with ASM	70
3.6.5	Folded rectangular waveguide tunable filter with OS-ASM	72
3.6.6	Folded rectangular waveguide tunable filter with ASM	76
3.7	Definition of space alignment	78
3.8	Conclusions	79
4	Tunable and reconfigurable waveguide filters	81
4.1	Circular waveguide dual-mode filter	82
4.1.1	Fixed frequency	84
4.1.2	Tunable frequency	84
4.2	Folded rectangular waveguide filter	90
4.3	Hardware manufacture	92
4.4	Measured results	96
4.4.1	Center frequency tunability	97
4.4.2	Bandwidth tuning range	98
4.5	Comparative discussion	100
4.5.1	Tuning range	100
4.5.2	Insertion losses	100
4.5.3	Out of band performance	101
4.6	Conclusions	102
5	Dielectric materials for tunability of waveguide filters	103
5.1	Phase shift of tuning elements	104

5.2	Passive Intermodulation	110
5.3	Study of one cavity in waveguide	113
5.4	Four-pole inductive filter with tuners	116
5.4.1	Experimental investigation using Teflon tuners	118
5.4.2	Experimental investigation using Sapphire tuners	120
5.5	Comparative discussion	122
5.6	Remote tunability by linear motors for 4-pole inductive filter	123
5.7	Conclusions	129
6	Automatic tuning with a robotuner	131
6.1	Mechanical implementation of the robotuner	132
6.2	Tuning algorithm of the robotuner	135
6.3	Tuning a six-pole inductive filter with metallic tuners	138
6.4	ASM-based technique using robotuner	142
6.5	Conclusions	144
7	Further advances: Quadruplet diplexer and integrated filter switch	147
7.1	Quadruplet filter	148
7.1.1	Filter specifications	148
7.1.2	Filter design	150
7.1.3	High precision design using One-Step Aggressive Space Mapping (OS-ASM)	153
7.1.4	Measured results	156
7.1.5	Conclusions	156
7.2	Quadruplet diplexer	157
7.2.1	Diplexer specifications	158
7.2.2	Out of band response	159
7.2.3	Distributed model	166
7.2.4	Low-accuracy diplexer design	171
7.2.5	High-accuracy diplexer design	175
7.2.6	Multipactor breakdown prediction	181
7.2.7	Measurements	185
7.2.8	Conclusions	187
7.3	Filter-switch	188
7.3.1	Filter & Switch	188
7.3.2	Design procedure	190
7.3.3	Experimental results	194
7.3.4	Remote control	196
7.3.5	Conclusions	197

8	Conclusions and future work	199
8.1	Conclusions	199
8.2	Future work	201
A	Robotuner flow-chart and M-code	203
A.1	Flow-chart	203
A.2	Get Connection to VNA	203
A.3	Write Robby File	205
A.4	Get Error Traces	205
A.5	Get Measurements from VNA	205
A.6	Start Program	206
B	Publications list	213
	Bibliography	215