

TABLE OF CONTENTS

Introduction	1
Chapter I. Foundations of homotopy theory and proper homotopy theory	7
§ 1 Compactifications and compact maps	8
§ 2 Homotopy	18
§ 3 Categories with a cylinder functor	22
§ 4 Cofibration categories and homotopy theory in <i>I</i> -categories	29
§ 5 Tracks and cylindrical homotopy groups	36
§ 6 Homotopy groups	44
§ 7 Cofibres	50
Appendices	53
§ 8 Appendix. Compact maps	53
§ 9 Appendix. The Freudenthal compactification	57
Chapter II. Trees and spherical objects in the category Topp of compact maps	71
§ 1 Locally finite trees and Freudenthal ends	71
Appendix. Halin's tree lemma	78
§ 2 Unions in Topp	80
Appendix. The proper Hilton–Milnor theorem	87
§ 3 Spherical objects and homotopy groups in Topp	89
§ 4 The homotopy category of <i>n</i> -dimensional spherical objects in Topp	96
Appendix. Classification of spherical objects under a tree	103
Chapter III. Tree-like spaces and spherical objects in the category End of ended spaces	107
§ 1 Tree-like spaces in End	107
§ 2 Unions in End	109
§ 3 Spherical objects and homotopy groups in End	113
§ 4 The homotopy category of <i>n</i> -dimensional spherical objects in End	117
Appendix. Classification of spherical objects under a tree-like space	122
§ 5 Z-sets and telescopes	124
§ 6 ARZ-spaces	130
Chapter IV. CW-complexes	135

§ 1 Relative CW-complexes in Top	135
§ 2 Strongly locally finite CW-complexes	140
§ 3 Relative CW-complexes in Topp	142
§ 4 Relative CW-complexes in End	148
§ 5 Normalization of CW-complexes	154
§ 6 Push outs of CW-complexes	157
§ 7 The Blakers–Massey theorem	159
§ 8 The proper Whitehead theorem	163
Chapter V. Theories and models of theories	165
§ 1 Theories of cogroups and Van Kampen theorem for proper fundamental groups	165
§ 2 Additive categories and additivization	175
§ 3 Rings associated to tree-like spaces	185
§ 4 Inverse limits of $\mathbf{gr}(T)$ -models	192
§ 5 Kernels in $\mathbf{ab}(T)$	199
Chapter VI. T-controlled homology	203
§ 1 \mathbf{R} -modules and the reduced projective class group	203
§ 2 Chain complexes in ringoids and homology	208
§ 3 Cellular T -controlled homology	211
§ 4 Coefficients for T -controlled homology and cohomology	215
§ 5 The Hurewicz theorem in End	221
§ 6 The proper homological Whitehead theorem (the 1-connected case)	224
§ 7 Proper finiteness obstructions (the 1-connected case)	225
Chapter VII. Proper groupoids	229
§ 1 Filtered discrete objects	229
§ 2 The fundamental groupoid of ended spaces	232
§ 3 The proper homotopy category of 1-dimensional reduced relative CW-complexes	236
§ 4 Free \mathcal{D} -groupoids under G	237
§ 5 The proper fundamental groupoid of a 1-dimensional reduced relative CW-complex	242
§ 6 Simplicial objects in proper homotopy theory	244
Chapter VIII. The enveloping ringoid of a proper groupoid	249
§ 1 The homotopy category of 1-dimensional spherical objects under T	249
§ 2 The ringoid $\mathbf{S}(X, T)$ associated to a pair (X, T) in End	250
§ 3 The enveloping ringoid of the proper fundamental group	253
§ 4 The enveloping ringoid of the proper fundamental groupoid	256
Chapter IX. T-controlled homology with coefficients	261
§ 1 The T -controlled twisted chain complex of a relative CW-complex (X, T)	261
§ 2 The T -controlled twisted chain complex of a CW-complex X	266

§ 3 T -controlled cohomology and homology with local coefficients	268
§ 4 Proper obstruction theory	269
§ 5 The twisted Hurewicz homomorphism and the twisted Γ -sequence in ∞ End	270
§ 6 The proper homological Whitehead theorem (the 0-connected case)	273
§ 7 Proper finiteness obstructions (the 0-connected case)	274
Chapter X. Simple homotopy types with ends	275
§ 1 The torsion group K_1	275
§ 2 Simple equivalences and proper equivalences	277
§ 3 The topological Whitehead group	279
§ 4 The algebraic Whitehead group	280
§ 5 The proper algebraic Whitehead group	282
Bibliography	285
Subject Index	291
List of symbols	295