
CONTENTS

i	INTRODUCTION TO AUDIO FEATURES AND CORPUS ANALYSIS	16
1	INTRODUCTION	17
1.1	Research Goals	17
1.1.1	Audio Corpus Analysis	17
1.1.2	The COGITCH project	18
1.1.3	Research Goals	20
1.2	Disciplinary Context	21
1.2.1	Musicology in the Twentieth Century.	22
1.2.2	Music Information Retrieval	24
1.2.3	Empirical Musicology and Music Cognition	26
1.2.4	Why Audio?	30
1.2.5	Conclusion	32
1.3	Outline	33
1.3.1	Structure	33
1.3.2	How to Read This Thesis	35
2	AUDIO DESCRIPTION	37
2.1	Audio Features	37
2.1.1	Basis Features	39
2.1.2	Timbre Description	42
2.1.3	Harmony Description	46
2.1.4	Melody Extraction and Transcription	50
2.1.5	Psycho-acoustic Features	54
2.1.6	Learned Features	58
2.2	Applications of Audio Features	59
2.2.1	Audio Descriptors and Classification	60
2.2.2	Structure Analysis	65
2.2.3	Audio Fingerprinting and Cover Song Detection	71
2.3	Summary	77

CONTENTS

3	AUDIO CORPUS ANALYSIS	79
3.1	Audio Corpus Analysis	79
3.1.1	Corpus Analysis	79
3.1.2	Audio Corpus Analysis	80
3.2	Review: Corpus Analysis in Music Research	81
3.2.1	Corpus Analysis Based on Manual Annotations	81
3.2.2	Corpus Analysis Based on Symbolic Data	83
3.2.3	Corpus Analysis Based on Audio Data	86
3.3	Methodological Reflections	89
3.3.1	Research Questions and Hypotheses	90
3.3.2	Choice of Data in Corpus Analysis	92
3.3.3	Reflections on Audio Features	93
3.3.4	Reflections on Analysis Methods	96
3.4	Case Study: the Evolution of Popular Music	99
3.4.1	Serrà, 2012	100
3.4.2	Mauch, 2015	103
3.4.3	Discussion	104
3.4.4	Conclusion	107
3.5	Summary and Desiderata	110
3.5.1	Research Questions and Hypotheses	110
3.5.2	Data	110
3.5.3	Audio Features	111
3.5.4	Analysis methods	112
3.6	To Conclude	113
ii	CHORUS ANALYSIS & PITCH DESCRIPTION	114
4	CHORUS ANALYSIS	115
4.1	Introduction	115
4.1.1	Motivation	115
4.1.2	Chorus Detection	116
4.1.3	Chorus Analysis	118
4.2	Methodology	119
4.2.1	Datasets	119
4.2.2	Audio Features	121
4.3	Choruses in Early Popular Music	126

CONTENTS

4.4	Choruses in the Billboard dataset	129
4.4.1	Graphical Models	130
4.4.2	Chorusness	132
4.4.3	Implementation	133
4.4.4	Analysis Results	134
4.4.5	Discussion	135
4.4.6	Regression	137
4.4.7	Validation	138
4.5	Conclusions	138
5	COGNITION-INFORMED PITCH DESCRIPTION	140
5.1	Introduction	140
5.1.1	Improving Pitch Description	141
5.1.2	Audio Description and Cover Song Detection	142
5.2	Cognition-inspired Pitch Description	144
5.2.1	Pitch-based Audio Bigrams	145
5.2.2	Pitch Interval-based Audio Bigrams	147
5.2.3	Summary	149
5.3	Experiments	150
5.3.1	Data	150
5.3.2	Methods	151
5.3.3	Results & Discussion	157
5.4	Conclusions	161
6	AUDIO BIGRAMS	163
6.1	Introduction	163
6.2	Soft Audio Fingerprinting	164
6.3	Unifying Model	166
6.3.1	Fingerprints as Audio Bigrams	166
6.3.2	Efficient Computation	168
6.3.3	Audio Bigrams and 2DFTM	173
6.4	Implementation	176
6.4.1	PYTCH	176
6.4.2	Code Example	177
6.4.3	Example Experiment	178
6.5	Conclusions and Future Work	179

CONTENTS

iii	CORPUS ANALYSIS OF HOOKS	181
7	HOOKED	182
7.1	Catchiness, Earworms and Hooks	182
7.2	Hooks in Musicology and Music Cognition	184
7.2.1	Hooks in Musicology	184
7.2.2	Hooks and Music Cognition	186
7.2.3	Summary: Hook Types	190
7.3	Experiment Design	191
7.3.1	Measuring Recognisability	191
7.3.2	Games and Music Research	192
7.3.3	Gameplay	193
7.3.4	Experiment Parameters	195
7.4	Implementations	198
7.4.1	<i>Hooked!</i>	198
7.4.2	<i>Hooked on Music</i>	201
7.5	Conclusion	202
8	HOOK ANALYSIS	204
8.1	Second-Order Audio Features	204
8.1.1	Second-Order Features	205
8.1.2	Second-Order Symbolic Features	205
8.1.3	Second-Order Audio Features	206
8.1.4	Song- vs. Corpus-based Second-order Features	211
8.2	Discovery-driven Hook Analysis	212
8.2.1	Data	213
8.2.2	Audio Features	216
8.2.3	Symbolic Features	218
8.2.4	Statistical Analysis	218
8.3	Results and Discussion	222
8.3.1	Audio Components	222
8.3.2	Recognisability Predictors	223
8.4	Conclusions and Future Work	226
9	CONCLUSIONS	228
9.1	Contributions	228
9.1.1	Audio Description	228
9.1.2	Audio Corpus Analysis	229

CONTENTS

9.1.3	Music Similarity and Hooks	230
9.2	Looking Back	232
9.2.1	Research Goals	232
9.2.2	Methodology	234
9.3	Looking Ahead	236
9.3.1	Ongoing Work	236
9.3.2	Future work	237
9.4	The Future of Audio Corpus Analysis	241
A	<i>hooked!</i> AUDIO PCA LOADINGS	242
	Nederlandse samenvatting	244
	Curriculum Vitae	252