

Table of Contents

List of Abbreviations	XIII
1 Introduction.....	1
2 State of Research.....	5
2.1 Interior Sound Components of Vehicles with Electrified Drives	5
2.2 Sound Separation and Classification Algorithm.....	12
2.3 Pleasantness and Magnitude of Tonal Content.....	16
2.4 Active Sound Design.....	18
3 Audibility of Sound Components.....	21
3.1 Listeners	21
3.2 Apparatus	21
3.3 Stimuli.....	21
3.4 Experimental Procedure.....	23
3.5 Estimation of Masked Threshold	24
3.5.1 Auditory Masking Model	24
3.5.2 Critical Masking Ratio	25
3.6 Results.....	26
4 Experiments with Synthetic Sounds	29
4.1 Setup and Methodology	29
4.2 Synthetic Electric Vehicle Interior Sounds.....	31
4.2.1 Stimuli.....	31
4.2.2 Results	34
4.3 Generalized Synthetic Electric Vehicle Interior Sounds.....	41
4.3.1 Stimuli.....	41
4.3.2 Results	45
4.4 Acoustic Optimization with Synthetic Sounds.....	54
4.4.1 Stimuli.....	54
4.4.2 Results	58
4.5 Discussion	65

Table of Contents

5 Experiments with Recorded Vehicle Interior Sounds.....	73
5.1 Pure-Electric Driving Condition	73
5.1.1 Stimuli.....	73
5.1.2 Results	74
5.2 Hybrid Driving Condition	78
5.2.1 Stimuli.....	78
5.2.2 Results	79
5.3 Discussion	82
6 Experiments with Augmented Sounds	85
6.1 Variation of Electric Motor Order Levels.....	85
6.1.1 Stimuli.....	85
6.1.2 Results	86
6.2 Variation of Inverter Component Levels	88
6.2.1 Stimuli.....	88
6.2.2 Results	89
6.3 Application of Subharmonics to Recorded Sounds	91
6.3.1 Stimuli.....	91
6.3.2 Results	94
6.4 Variation of Tire-Road and Wind Noise Levels.....	96
6.4.1 Stimuli.....	96
6.4.2 Results	97
6.5 Discussion	99
7 Development of a Pleasantness Assessment Model	103
7.1 Calculation of Potential Predictors	103
7.2 Data Preprocessing	106
7.3 Choice of Model Architecture	107
7.4 Model Estimation and Validation	113
7.5 Temporal Analysis of Parameter Influences	116
8 Summary and Conclusions	119
References.....	121

Table of Contents

A Complete Results for the Electric Motor Order Variation Experiment	135
B Complete Results for the Inverter Component Variation Experiment	145