

Contents

1	Stimuli and Procedures	1
1.1	Temporal and Spectral Characteristics of Sound	1
1.2	Presentation of Sounds by Loudspeakers and Earphones	5
1.3	Methods and Procedures	8
1.4	Stimuli, Sensations, and Data Averaging	11
2	Hearing Area	17
2.1	Threshold in Quiet	19
3	Information Processing in the Auditory System	23
3.1	Preprocessing of Sound in the Peripheral System	23
3.1.1	Head and Outer Ear	23
3.1.2	Middle Ear	24
3.1.3	Inner Ear	25
3.1.4	Otoacoustic Emissions	35
3.1.5	Model of the Nonlinear Preprocessing System	50
3.2	Information Processing in the Nervous System	58
4	Masking	61
4.1	Masking of Pure Tones by Noise	62
4.1.1	Pure Tones Masked by Broad-Band Noise	62
4.1.2	Pure Tones Masked by Narrow-Band Noise	64
4.1.3	Pure Tones Masked by Low-Pass or High-Pass Noise	66
4.2	Masking of Pure Tones by Tones	66
4.2.1	Pure Tones Masked by Pure Tones	67
4.2.2	Pure Tones Masked by Complex Tones	71
4.3	Psychoacoustical Tuning Curves	74
4.4	Temporal Effects	78
4.4.1	Simultaneous Masking	79
4.4.2	Premasking	82
4.4.3	Postmasking	83
4.4.4	Temporal Masking Patterns	84
4.4.5	Masking-Period Patterns	93
4.4.6	Pulsation Threshold	97
4.4.7	Mixed Spectral and Temporal Masking	102

4.5	“Addition” of Masking	103
4.5.1	“Addition” of Simultaneous Masking	103
4.5.2	“Addition” of Postmasking	105
4.6	Models of Masking	106
4.6.1	Psychoacoustical Model of Simultaneous Masking	107
4.6.2	Psychoacoustical Model of Non-simultaneous Masking	108
4.6.3	Masking Described in Cochlear Active Feedback Models	109
5	Pitch and Pitch Strength	111
5.1	Pitch of Pure Tones	111
5.1.1	Ratio Pitch	111
5.1.2	Pitch Shifts	113
5.2	Model of Spectral Pitch	116
5.3	Pitch of Complex Tones	119
5.4	Model of Virtual Pitch	123
5.5	Pitch of Noise	125
5.6	Acoustic After Image (Zwicker-tone)	130
5.7	Pitch Strength	135
6	Critical Bands and Excitation	149
6.1	Methods for the Determination of the Critical Bandwidth	150
6.2	Critical-Band Rate Scale	158
6.3	Critical-Band Level and Excitation Level	165
6.4	Excitation Level versus Critical-Band Rate versus Time Pattern	172
7	Just-Noticeable Sound Changes	175
7.1	Just-Noticeable Changes in Amplitude	175
7.1.1	Threshold of Amplitude Variation	175
7.1.2	Just-Noticeable Level Differences	180
7.2	Just-Noticeable Changes in Frequency	182
7.2.1	Threshold for Frequency Variation	182
7.2.2	Just-Noticeable Frequency Differences	185
7.3	Just-Noticeable Phase Differences	188
7.4	Influence of Partial Masking on Just-Noticeable Changes	192
7.5	Models of Just-Noticeable Changes	194
7.5.1	Model for Just-Noticeable Variations	194
7.5.2	Model for Just-Noticeable Differences	201
8	Loudness	203
8.1	Loudness Level	203
8.2	Loudness Function	205
8.3	Spectral Effects	208

8.4	Spectrally Partial Masked Loudness.....	214
8.5	Temporal Effects	216
8.6	Temporally Partial Masked Loudness	219
8.7	Model of Loudness.....	220
8.7.1	Specific Loudness.....	223
8.7.2	Loudness Summation (Spectral and Temporal)	226
8.7.3	Loudness Calculation and Loudness Meters	233
9	Sharpness and Sensory Pleasantness	239
9.1	Dependencies of Sharpness.....	239
9.2	Model of Sharpness	241
9.3	Dependencies of Sensory Pleasantness	243
9.4	Model of Sensory Pleasantness	245
10	Fluctuation Strength	247
10.1	Dependencies of Fluctuation Strength	247
10.2	Model of Fluctuation Strength	253
11	Roughness	257
11.1	Dependencies of Roughness	257
11.2	Model of Roughness	261
12	Subjective Duration	265
12.1	Dependencies of Subjective Duration	265
12.2	Model of Subjective Duration	268
13	Rhythm	271
13.1	Dependencies of Rhythm	271
13.2	Model of Rhythm	275
14	The Ear's Own Nonlinear Distortion.....	277
14.1	Even Order Distortions.....	279
14.2	Odd Order Distortions	282
14.3	Models of Nonlinear Distortions	286
15	Binaural Hearing	293
15.1	Just-Noticeable Interaural Delay	293
15.2	Binaural Masking-Level Differences	295
15.2.1	Dependencies of BMLDs	296
15.2.2	Model of BMLDs.....	302
15.3	Lateralization	308
15.4	Localization	309
15.5	Binaural Loudness.....	311

16 Examples of Application	315
16.1 Noise Abatement	315
16.1.1 Loudness Measurement	317
16.1.2 Evaluation of Noise Emissions	320
16.1.3 Evaluation of Noise Immissions	323
16.1.4 Evaluation of Sound Quality	327
16.1.5 Cognitive Effects: Identification of Sound Source	330
16.2 Applications in Audiology	333
16.2.1 Otoacoustic Emissions	334
16.2.2 Tuning Curves	336
16.2.3 Amplitude Resolution	340
16.2.4 Temporal Resolution	341
16.2.5 Temporal Integration	347
16.2.6 Loudness Summation and Recruitment	348
16.2.7 Speech in Background-Noise	352
16.2.8 Localisation with Hearing Instruments	356
16.3 Hearing Aids	356
16.4 Broadcasting and Communication Systems	359
16.5 Speech Recognition	361
16.6 Musical Acoustics	362
16.7 Room Acoustics	366
Literature	369
Index	429
Contents of CD: Psychoacoustic Demonstrations	447